

Studies in Systems, Decision and Control 449

Pedro M. Arezes · J. Santos Baptista ·  
Rui B. Melo · Jacqueline Castelo Branco ·  
Paula Carneiro · Ana Colim ·  
Nélson Costa · Susana Costa · J. Duarte ·  
J. C. Guedes · Gonçalo Perestrelo *Editors*

# Occupational and Environmental Safety and Health IV

 Springer

# **Studies in Systems, Decision and Control**

Volume 449

## **Series Editor**

Janusz Kacprzyk, Systems Research Institute, Polish Academy of Sciences,  
Warsaw, Poland

The series “Studies in Systems, Decision and Control” (SSDC) covers both new developments and advances, as well as the state of the art, in the various areas of broadly perceived systems, decision making and control—quickly, up to date and with a high quality. The intent is to cover the theory, applications, and perspectives on the state of the art and future developments relevant to systems, decision making, control, complex processes and related areas, as embedded in the fields of engineering, computer science, physics, economics, social and life sciences, as well as the paradigms and methodologies behind them. The series contains monographs, textbooks, lecture notes and edited volumes in systems, decision making and control spanning the areas of Cyber-Physical Systems, Autonomous Systems, Sensor Networks, Control Systems, Energy Systems, Automotive Systems, Biological Systems, Vehicular Networking and Connected Vehicles, Aerospace Systems, Automation, Manufacturing, Smart Grids, Nonlinear Systems, Power Systems, Robotics, Social Systems, Economic Systems and other. Of particular value to both the contributors and the readership are the short publication timeframe and the worldwide distribution and exposure which enable both a wide and rapid dissemination of research output.

Indexed by SCOPUS, DBLP, WTI Frankfurt eG, zbMATH, SCImago.

All books published in the series are submitted for consideration in Web of Science.

Pedro M. Arezes · J. Santos Baptista · Rui B. Melo ·  
Jacqueline Castelo Branco · Paula Carneiro ·  
Ana Colim · Nélon Costa · Susana Costa ·  
J. Duarte · J. C. Guedes · Gonçalo Perestrelo  
Editors

# Occupational and Environmental Safety and Health IV

 Springer

## *Editors*

See next page

ISSN 2198-4182

ISSN 2198-4190 (electronic)

Studies in Systems, Decision and Control

ISBN 978-3-031-12546-1

ISBN 978-3-031-12547-8 (eBook)

<https://doi.org/10.1007/978-3-031-12547-8>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2023

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

*Editors*

Pedro M. Arezes  
Department of Production and Systems  
School of Engineering  
University of Minho  
Guimarães, Portugal

Rui B. Melo  
Faculty of Human Kinetics  
University of Lisbon  
Lisbon, Portugal

Paula Carneiro  
Department of Production and Systems  
School of Engineering  
University of Minho  
Guimarães, Portugal

Nélson Costa  
Department of Production and Systems  
School of Engineering  
University of Minho  
Guimarães, Portugal

J. Duarte  
Department of Mining Engineering  
Faculty of Engineering  
University of Porto  
Porto, Portugal

Gonçalo Perestrelo  
Department of Mining Engineering  
Faculty of Engineering  
University of Porto  
Porto, Portugal

J. Santos Baptista  
Department of Mining Engineering  
Faculty of Engineering  
University of Porto  
Porto, Portugal

Jacqueline Castelo Branco  
Department of Mining Engineering  
Faculty of Engineering  
University of Porto  
Porto, Portugal

Ana Colim  
School of Engineering  
University of Minho  
Guimarães, Portugal

Susana Costa  
School of Engineering  
University of Minho  
Guimarães, Portugal

J. C. Guedes  
Department of Mining Engineering  
Faculty of Engineering  
University of Porto  
Porto, Portugal

# Adaptation to Stress in Psychology Graduate Students



Clara Simões , Alexandra Costa , Catarina Morais ,  
and A. Rui Gomes 

**Abstract** This study analyzed stress adaptation in university students, considering the role of cognitive appraisal in the relationship between stress and burnout during the testing season. A total of 187 students from a university in the northern region of Portugal participated in the study. In the total sample, 154 were female (82.4%) and 32 males (17.1%), aged between 17 and 41 years old ( $M = 20.72$ ;  $SD = 3.28$ ). The evaluation protocol included a Sociodemographic Questionnaire, the Stress Questionnaire for Students, the Primary and Secondary Cognitive Appraisal Scale, and the Shirom-Melamed Burnout Measure. The results showed that 55.6% of the students perceived high-stress levels, mainly derived from academic evaluation and work overload. Cognitive appraisal mediated the relationship between the overall level of students' academic stress and the experience of burnout, mostly regarding physical fatigue and cognitive weariness. These findings reinforce the importance of considering the role of cognitive appraisal processes in understanding the dynamics of stress adaptation among university students. To promote healthy educational environments, we must attend to these effects regarding occupational safety and hygiene interventions within the academic context.

**Keywords** Cognitive appraisal · Burnout · University students · Academic stress

C. Simões (✉)

School of Nursing, University of Minho, Braga, Portugal

e-mail: [csimaes@ese.uminho.pt](mailto:csimaes@ese.uminho.pt)

Health Sciences Research Unit: Nursing (UICISA: E), Nursing School of Coimbra (ESENFC),  
Coimbra, Portugal

A. R. Gomes

Psychology Research Centre, School of Psychology, University of Minho, Braga, Portugal

e-mail: [rgomes@psi.uminho.pt](mailto:rgomes@psi.uminho.pt)

C. Morais

Research Centre for Human Development, Faculty of Education and Psychology, Universidade  
Católica Portuguesa, Porto, Portugal

e-mail: [ctmorais@ucp.pt](mailto:ctmorais@ucp.pt)

A. Costa

Adaptation, Performance, and Human Development Research Group, School of Psychology,  
University of Minho, Braga, Portugal

## 1 Introduction

Stress arises when students perceive their personal and social resources as insufficient to deal effectively with new challenges imposed by the environment (Lazarus 1991). Stress is an integral and inevitable part of the academic journey (Labrague et al. 2017) since it is necessary to deal with new responsibilities potentially stressful during this period (Buchanan 2012). When stress occurs at a moderate level, it may be considered healthy and motivate goals achievement (Ramaprabou and Dash 2018). However, high-stress levels can lead to severe symptoms of anxiety, depression, or other psychological problems in students (Acharya et al. 2018; Leppink et al. 2016). These can result in adverse effects, such as low grades, failure (Frazier et al. 2018; Leppink et al. 2016), school dropout (Britt et al. 2017), alcohol and drugs abuse (Böke et al. 2019), violent behaviors (Alrawwad and Alrfooh 2014), and low self-esteem (Hudd et al. 2000).

Thus, it is essential to gather knowledge about these phenomena in students, going beyond understanding stress sources and consequences and comprehending how students evaluate, react, and adapt to these situations. This study aims to understand the stress adaptation process in Psychology graduate students during the academic year. Specifically, it analyzes the relationships between stress, cognitive appraisal, and burnout during one academic year, adopting the theoretical framework of the Interactive Model of Human Adaptation to Stress (Gomes 2014) and the cognitive-motivational-related model of stress and emotions proposed by Lazarus (1991, 1999). Both models reinforce the need to understand the stress adaptation process from an integrated and conceptual perspective, considering the adverse events, the cognitive appraisal processes (primary and secondary), and the individual responses (Gibbons 2010; Gomes 2014). The primary cognitive appraisal refers to evaluating the significance of a situation in terms of its importance, challenge, or threat perceptions, pointing out the personal relevance of the stressful event to someone's values, goals, beliefs, and intentions. The secondary cognitive appraisal involves the personal evaluation of the ability to cope with stressors, comprising the perceptions of coping and control over the stressful event (Gomes 2014).

There are several studies about stress among graduate students (e.g., Reddy et al. 2018; Weber et al. 2019); however, the majority do not consider simultaneously the transactional relationship between the adaptation to stress, cognitive appraisal, and stress consequences, which would be fundamental to test the transactional and interactive models of stress adaptation (Gomes 2014; Lazarus 1991). Moreover, there is a lack of evidence about how the adaptation to stress occurs over time, which is very important due to the dynamic nature of the stress adaptation process (Enns et al. 2018). This study intends to capture the entire dynamic process involved in the stress experience of students by using a longitudinal perspective and the conceptual framework of the transactional models of adaptation to stress. The adaptation to stress is an antecedent variable, the cognitive appraisal is the mediating variable, and burnout is the consequent variable. Burnout constitutes the consequent variable because of its high prevalence among students (Farrell et al. 2019; Gomes et al.



2022; Muzafar et al. 2015) and its consequences on their academic performance (Vizoso et al. 2019). This construct represents a psychological syndrome related to the experience of chronic job stress, which has not been successfully managed (Maslach and Leiter 2016; World Health Organization 2019). Burnout has extended from the professional to the educational environment (Eaves and Payne 2019; Jordan et al. 2020) and is characterized by physical fatigue, emotional exhaustion, and cognitive weariness (Shirom and Melamed 2006).

In sum, the present study aimed to capture the students' adaptation process during a school year that occurred before the pandemic lockdown. We used a critical incident methodology (Allen 2017; Flanagan 1954) related to the academic evaluation period and the repeated measures methodology (Singer and Willett 1996) in two phases. In order to study the negative effect of the chronic experience of stress on students' burnout, as proposed by the transactional models of adaptation to stress, we used specific measures in phases one and two of data collection. The first phase occurred during the academic evaluation period of the first semester of the school year (November 2019) and included the antecedent and mediation variables (i.e., stress and cognitive appraisal measures). In contrast, the second phase occurred after the academic evaluation period (February 2020) and involved the burnout measure—the outcome variable related to the experience of chronic academic stress. This data collection plan followed theoretical (Gomes 2014; Lazarus 1991, 1999) and empirical (Gibbons 2010; Gomes et al. 2022; Gomes and Teixeira 2016) guidelines of adaptation to stress, proposing that exposing to stress represents the first factor of the adaptation process (antecedent variable), followed by the cognitive evaluation of stressors (mediating variable) that, in turn, produce distinct effects on human functioning, represented in our case by the burnout experience (outcome variable). Burnout only occurs after people being repeatedly exposed to stress and this is why it was evaluated in the second phase of data collection. Thus, the following objectives were established:

1. analyze graduate students' psychological experience during a week of academic evaluation (critical incident);
2. test the mediating role of cognitive appraisal in the relationship between students' academic stress (i.e., overall level of stress) and burnout.

## 2 Materials and Methods

### 2.1 Design

We developed a quantitative and longitudinal study design with an exploratory and descriptive nature, which used the critical incident and the repeated measures methodology.

## 2.2 Participants

This study used a non-probabilistic sample for convenience, including 187 Psychology graduate students from Portugal North. The majority was female ( $n = 154$ , 82.4%), with a mean age of 20.72 years ( $SD = 3.28$ ; min = 17, max = 41). Participants were preponderantly in the 4th year of the Psychology course ( $n = 62$ , 33.2%), followed by those in the 3rd year ( $n = 50$ , 26.7%), 1st year ( $n = 39$ , 20.9%), and, lastly, 2nd year ( $n = 36$ , 19.3%) of the course. The 5th-grade students were not included in the sample, as they had not taken exams anymore. Psychology was the first option of graduation course for 157 of the students (84%). Participants' average score on the course was 14.52 ( $SD = 1.51$ ; min = 11, max = 19.4). Students reported an average of 12.28 h of studying per week ( $SD = 10.50$ ; min = 0, max = 60 h).

## 2.3 Instruments

### 2.3.1 Sociodemographic Questionnaire

This instrument collected information on personal (e.g., sex, age) and academic (e.g., course year, number of study hours per week) characteristics.

### 2.3.2 Stress Questionnaire for Students (SQS)

This instrument was used to evaluate the students' perception about the sources of stress faced in their academic activities (Gomes et al. 2022). The questionnaire comprised two distinct parts. In the first part, students were asked to evaluate the level of stress that they usually feel in their academic life through a single item (0 = No stress; 2 = Moderate stress; 4 = High stress). In the second part, 28 items were presented regarding the potential sources of stress associated with academic activities, being the stress intensity evaluated on a 5-point Likert scale (0 = No stress at all; 2 = Some stress; 4 = Very high stress). Stress was measured through seven dimensions: (a) academic performance: stress resulting from the possibility of a school performance below that expected by the student (4 items;  $\alpha = 0.89$  for this study); (b) academic evaluation: stress resulting from the evaluation moments of the teaching–learning process (4 items;  $\alpha = 0.78$  for this study); (c) motivation: stress resulting from a low motivation to perform study activities (4 items;  $\alpha = 0.83$  for this study); (d) learning: stress resulting from the student's possible difficulty in following the teaching–learning process (4 items;  $\alpha = 0.89$  for this study); (e) work overload: stress resulting from excessive activities and school tasks (4 items;  $\alpha = 0.92$  for this study); (f) future expectations: stress resulting from the student's lack of confidence about the usefulness and interest of studies for their future (4 items;  $\alpha = 0.84$  for this study); and (g) financial problems: stress resulting from

the impossibility of continuing the studies due to financial difficulties (4 items;  $\alpha = 0.89$  for this study). Confirmatory Factor Analysis confirmed good psychometric properties for the five-factor structure of the instrument ( $\chi^2 (79 df) = 116.048, p = 0.004; \chi^2/df = 1.469; RMSEA = 0.050, 90\% \text{ C.I. } [0.029; 0.069]; SRMR = 0.0717; IFI = 0.967; CFI = 0.967$ ), and for a second order factor structure, ( $\chi^2 (11 df) = 15.362, p = 0.167; \chi^2/df = 1.397; RMSEA = 0.046, 90\% \text{ C.I. } [< 0.001; 0.096]; SRMR = 0.0258; IFI = 0.995; CFI = 0.994$ ), which was used to test the hypotheses.

### 2.3.3 Primary and Secondary Cognitive Appraisal Scale (PSCAS)

This instrument, validated by Gomes and Teixeira (2016), was used to assess students' primary and secondary cognitive appraisal processes regarding their academic activities. The scale measures students' primary cognitive appraisal through the following dimensions: (a) importance perception: which indicates the extent to which the student evaluated the academic activity as significant and important for their personal wellbeing (3 items;  $\alpha = 0.81$  for this study); (b) threat perception: which indicates the extent to which the student evaluated the academic activity as disturbing and negative for their personal wellbeing (3 items;  $\alpha = 0.85$  for this study); and (c) challenge perception: which indicates the extent to which the student evaluated the academic activity as stimulating and exciting for their personal wellbeing (3 items;  $\alpha = 0.68$  for this study).

The scale measures students' secondary cognitive appraisal through the following dimensions: (d) coping perception: which indicates the extent the student felt to have personal resources to cope with the demands of the academic activity (3 items;  $\alpha = 0.85$  for this study); and, (e) control perception: which indicates the extent to which the student felt to have control over the processes of decision making of the academic activity (3 items;  $\alpha = 0.73$  for this study). The instrument presented 15 items, each measured on a 7-point Likert scale (0 = *Is not at all important to me*; 6 = *Is very important to me*, for academic activities importance). Thus, high scores on each subscale indicated higher perceptions of the corresponding dimension. Confirmatory Factor Analysis confirmed the five-factor structure of the instrument for this study ( $\chi^2 (79 df) = 116.048, p = 0.004; \chi^2/df = 1.469; RMSEA = 0.050, 90\% \text{ C.I. } [0.029; 0.069]; SRMR = 0.0717; IFI = 0.967; CFI = 0.967$ ).

### 2.3.4 Shirom-Melamed Burnout Measure (SMBM)

This instrument evaluated the burnout levels regarding academic activities (Shirom and Melamed 2006). In the current study, we used the Portuguese version (Gomes et al. 2022), which consisted of 14 items divided into three dimensions: (a) physical fatigue: feelings of physical tiredness regarding academic activities, resulting in physical energy decrease (6 items;  $\alpha = 0.95$  for this study); (b) cognitive weariness: cognitive wear regarding academic activities, resulting in the decrease of the ability to think and concentrate (5 items;  $\alpha = 0.96$  for this study); and (c) emotional

exhaustion: feelings of emotional exhaustion in the relationships to others, resulting in the decrease of the cordiality and sensitivity to other people's needs (3 items;  $\alpha = 0.89$  for this study). The instrument measured the items on a 7-point Likert scale (1 = *Never*; 7 = *Always*). Higher scores indicated higher levels of physical fatigue, cognitive weariness, and emotional exhaustion, thus, pointing to higher levels of burnout. Confirmatory Factor Analysis confirmed the three-factor structure of the instrument for this study ( $\chi^2 (72 df) = 157.118, p < 0.001$ ;  $\chi^2/df = 2.182$ ; RMSEA = 0.080, 90% C.I. [0.063; 0.097]; SRMR = 0.0442; IFI = 0.969; CFI = 0.969).

### 2.3.5 Procedures

The Ethical Committee of one of the authors' institutions of the paper approved the study (CEICSH 034/2019), which was authorized by the directors of a Psychology course from a university in the North of Portugal. We performed data collection in two phases: moment 1 (Mt 1) of data collection occurred four to six weeks after the beginning of the academic semester for university students and before the academic exams period (critical incident methodology), where we collected the measures of stress and cognitive appraisal; and moment 2 (Mt 2) of data collection occurred after the period of exams, approximately at the middle of the semester, where we collected the measure of burnout. All participants filled out the informed consent term before answering the questions through an electronic platform (Qualtrics). To pair the data between the two phases of collection and guarantee their use in future studies, students were asked for an identification code so that the researchers could not interpret their identity. In total, 320 students attended the course. Two hundred sixteen responses were received, representing a response rate of 67.5%.

### 2.3.6 Data Analysis Procedure

Data analysis was performed through quantitative research methodologies using the Statistical Package for Social Science (SPSS, v. 28, Inc. Chicago, IL). Initially, 23 participants were excluded from the total sample of 216 students since they did not participate in both phases of the data collection. Then, we also excluded six participants as they attributed reduced or no importance to their academic activity (subscale of "importance perception"  $\leq 2$  in the PSCAS) (Gomes and Teixeira 2016). We used descriptive statistics proceedings to analyze graduate students' psychological experiences during a week of academic evaluation. Then, we performed structural equation modeling analyses through AMOS 28.0 software to test the mediating role of cognitive appraisal in the relationship between academic stress and burnout dimensions. For each of the three models tested (i.e., direct, total, and partial), we performed adjustment analyses using the literature's mentioned indicators (Marôco 2014). Therefore, the indicators used were the following: the chi-square test ( $\chi^2$ ); the Root Mean Square Error of Approximation (RMSEA, Steiger 1990); the Standardized Root Mean Square Residual (SRMR) (Hair et al. 2009); the Comparative

Fit Index (CFI, Bentler 1990) and the Normed Fit Index (NFI, Bentler and Bonett 1980). To better understand the mediation process and the causal relationships in the model with the best-fit indices, we also analyzed the model's standardized direct, indirect, and total effects.

### 3 Results

#### 3.1 Descriptive Statistics of the Study Variables

Table 1 shows the descriptive statistics of all variables under study (e.g., the sources of stress, the dimensions of the Primary and Secondary Cognitive Appraisal Scale, and the burnout levels).

**Table 1** Descriptive statistics of the study variables ( $N = 187$ )

<b>SQS: stress questionnaire for students</b>	<b>n (%)</b>	<b>Min–Max</b>
No stress	4 (2.1)	–
Low stress	12 (6.4)	–
Moderate stress	67 (35.8)	–
Considerable stress	77 (41.2)	–
High stress	27 (14.4)	–
<b>SQS: stress factors</b>	<b>M (SD)</b>	<b>Min–Max</b>
Academic performance	2.90 (0.81)	0–4
Academic evaluation	3.05 (0.81)	0–4
Motivation	2.49 (0.85)	0–4
Learning	2.85 (0.89)	0–4
Work overload	3.02 (0.88)	0–4
Future expectations	2.46 (1.02)	0–4
Financial problems	1.95 (1.13)	0–4
<b>PSCAS: cognitive appraisal</b>	<b>M (SD)</b>	<b>Min–Max</b>
Importance perception	5.07 (0.94)	3–6
Threat perception	3.84 (1.28)	0–6
Challenge perception	3.64 (1.07)	0–6
Coping perception	3.30 (1.00)	0–6
Control perception	4.30 (0.96)	0–6
<b>SMBM: levels of burnout</b>	<b>M (SD)</b>	<b>Min–Max</b>
Physical fatigue	4.68 (1.37)	1–7
Cognitive weariness	4.16 (1.46)	1–7
Emotional exhaustion	2.40 (1.38)	1–7

Concerning the general stress levels in students, 55.6% reported feeling considerable to high stress in their academic activity, 35.8% reported moderate stress, and 8.5% reported feeling low to no stress. Regarding the seven stress factors of the SQS instrument, the academic evaluation and work overload dimensions were rated by students as the most stress-inducing, while the dimension of the financial problems appeared as the least stress-inducing. About the PSCAS instrument, the highest scores concerned the dimensions of importance perception, control perception, and threat perception. Concerning the SMBM dimensions, students expressed more physical fatigue and cognitive weariness, and less emotional exhaustion. Specifically, 128 students (68.4%) revealed physical fatigue problems, 66 (35.3%) cognitive weariness, and 12 (6.4%) emotional exhaustion. Considering the three dimensions of burnout, 31 students (16.6%) were in this burnout situation.

### ***3.2 The Mediation Effect of Cognitive Appraisal in the Relationship of Stress and Burnout***

This phase tested the mediating role of cognitive appraisal between students' overall level of stress and burnout. This analysis considered three possibilities: the direct model, the total mediation model, and the partial mediation model.

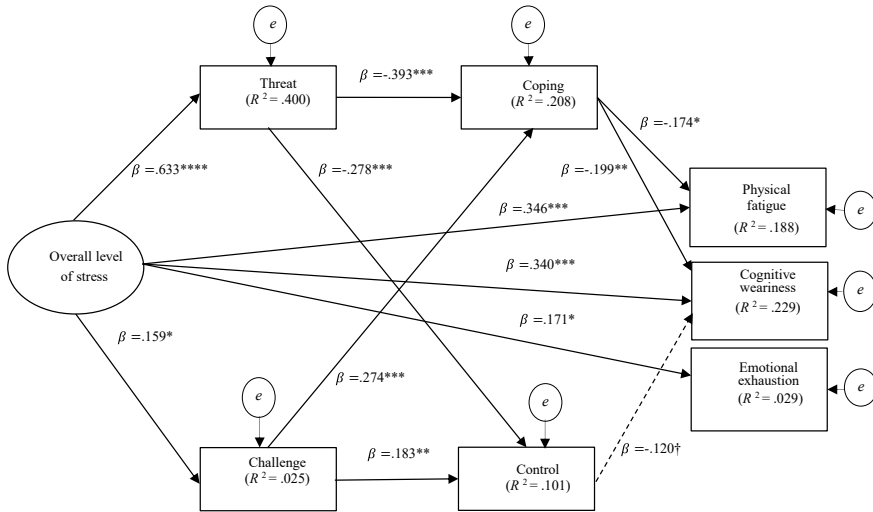
#### **3.2.1 Students' Overall Level of Stress and Burnout**

To test the relationship between the overall levels of stress, cognitive appraisal, and burnout, we performed three models: (a) the direct model, which established relationships between the overall level of stress and cognitive appraisal to burnout; (b) the total mediation model, which established relationships between the overall level of stress, through cognitive appraisal to burnout; removing the direct pathways from stress to burnout; and (c) the partial mediation model, which established relationships from the overall level of stress, through cognitive appraisal to burnout and from the overall level of stress directly to burnout. The results indicated that the partial mediation model obtained the best adjustment rates ( $\chi^2(62) = 89.652, p = 0.012, \chi^2/df = 1.446, RMSEA = 0.049$  (90% C.I. [0.024; 0.070],  $p$  (RMSEA  $\leq 0.05$ ) = 0.509); SRMR = 0.046; CFI = 0.978; IFI = 0.978; GFI = 0.935 (see Table 2).

The differences between the chi-squared values of the direct effect model and the partial mediation model were statistically significant ( $\Delta\chi_2(1) = 159.700; p < 0.001$ ), the differences between the direct effect model and the total mediation model were substantial ( $\Delta\chi_2(2) = 133.283; p < 0.001$ ), and finally, the differences between the partial mediation model and the full mediation model were also significant ( $\Delta\chi_2(3) = 26.417; p < 0.001$ ). These results indicated a better adjustment of the partial mediation model (Fig. 1).

**Table 2** Mediation effect: structural model fit indices ( $N = 187$ )

Structural models	$\chi^2$	df	$\chi^2/df$	$p$	RMSEA	$p$ -value (RMSEA $\leq$ 0.05)	RMSEA [LO90- HI90]	SRMR	CFI	IFI
Direct	249.352	63	3.958	<0.001	0.126	<0.001	[0.110; 0.143]	0.166	0.849	0.852
Total mediation	116.069	65	1.786	<0.001	0.065	0.099	[0.045; 0.084]	0.117	0.959	0.959
Partial mediation	89.652	62	1.446	0.012	0.049	0.509	[0.024; 0.070]	0.046	0.978	0.978



**Fig. 1** Path analysis results for the partial mediation model ( $N = 187$ ). Rectangles represent observed variables, the oval is the latent variable, arrows the significant direct paths, the dashed arrow refers to marginally significant direct paths ( $p = 0.09$ ), and  $e$  represents the measurement error. Note.  $* p < 0.05$ ,  $** p < 0.01$ ,  $*** p < 0.001$ ,  $^\dagger p < 0.1$

As shown in Fig. 1, the model allowed to explain 23% of the variance associated with cognitive weariness and 19% of the variance related to physical fatigue. Additionally, the model explained 40% of the variance related to threat perception, 2.5% of challenge perception, 21% associated with coping perception, and 10% related to control perception.

### 3.2.2 Partial Mediation Model: Direct, Indirect, and Total Effects

Based on the best fit of the partial mediation model, it is now essential to analyze the direct, indirect, and total effects of the variables under study. Regarding significant direct effects, we found that higher levels of students’ overall experience of academic stress increased the perception of challenge, but mainly students’ perception of threat. Additionally, an increase in threat perception predicts a decrease in control and coping perceptions, but an increase in challenge perception indicates greater control and coping perceptions. Finally, a reduction in coping perception led to higher physical and cognitive fatigue. Students’ overall experience of academic stress significantly increased all burnout dimensions (see Fig. 1).

As for the significant indirect effects, there was a relationship between students’ overall experience of stress and physical fatigue and cognitive weariness, mediated by cognitive appraisal processes. Specifically, higher levels of academic stress were related to higher threat perception, which led to lower coping perception, ultimately decreasing physical fatigue and cognitive weariness. So, the negative impact



**Table 3** Standardize Indirect and Total effects for the partial mediation model ( $N = 187$ )

	Secondary cognitive appraisal		Burnout dimensions		
	Control perception	Coping potential	Physical fatigue	Cognitive weariness	Emotional exhaustion
<i>Standardize indirect effect</i>					
Overall level of stress	-0.147* (-0.229, 0.046)	-0.205** (-0.307, -0.114)	0.042** (0.014, 0.088)	0.058** (0.023, 0.104)	-0.002 <sup>ns</sup> (-0.023, 0.023)
<i>Primary cognitive appraisal</i>					
Threat perception	-	-	0.081** (0.032, 0.156)	0.111** (0.051, 0.183)	-0.004 <sup>ns</sup> (-0.051, 0.044)
Challenge perception	-	-	-0.056* (-0.109, -0.017)	-0.077** (-0.131, -0.037)	0.003 <sup>ns</sup> (-0.033, 0.038)
<i>Standardize total effect</i>					
Overall level of stress	-	-	0.388* (0.224, 0.477)	0.398* (0.24, 0.491)	0.169* (0.044, 0.281)

Note \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .  $ns = p$  value statistically non-significant

of students’ academic stress exacerbates the perception of threat; this threat decreases the coping perception, but in the end, coping may even reduce the physical fatigue and cognitive weariness of the students. Additionally, there was a significant indirect effect of challenge perception on burnout dimensions. Higher perceived challenges lead to higher coping perception, decreasing students’ physical fatigue and cognitive weariness. Table 3 shows the indirect and total effects.

## 4 Discussion

The study of stress in the academic context has received increasing attention since it represents a problem that affects students’ mental and physical health (Leppink et al. 2016). In this study, we chose to understand the phenomenon of human adaptation to stress in higher education students in the psychology course in the light of the transactional and interactive approach.

Regarding the first objective of this study, to analyze graduate students’ psychological experience during a week of academic evaluation (critical incident), 55.6% of the students reported feeling high stress in their activity. These data are consistent with the literature, with several studies indicating that university students find their academic experience stressful (Wahed and Hassan 2017). That experience of stress seems to relate more intensely to the academic evaluations students undertake

throughout their educational journey and the excess of activities and tasks to do. The literature also reports similar results (Pitt et al. 2017; Shdaifat et al. 2018).

Regarding the second objective of this study, it was tested the mediating role of cognitive appraisal in the relationship between students' academic stress and burnout. The results indicated that we could understand this relationship better by assigning a partial mediating effect to cognitive appraisal. Expressly, the partial mediation model assumes relationships between stress and burnout, which is in line with the literature (see Karaman et al. 2019), but mainly reinforces the mediating role of cognitive appraisal in this relationship, which confirms the theoretical models in this domain (see Gomes 2014; Lazarus 1999). In addition to considering the mediation pathways via cognitive appraisal, we should not disregard the direct paths between stress and burnout, which present significant relationships. Thus, the analysis of the mediation effect reinforces two essential points. First, the relations of stress to primary cognitive appraisal follow distinct paths. That is, the overall level of stress resulting from all sources of academic stress experienced by students exacerbated the perception of threat, which, in turn, negatively conditioned the secondary cognitive appraisal (decreasing control and coping perceptions); but, in the end, the perception of coping decreased the physical fatigue and the cognitive weariness of burnout.

The second point to retain from the partial mediation model is even more complex. From the start, results showed that the overall level of stress related to the potential sources of stress associated with students' academic activity could stimulate positive patterns of adaptation to stress. Specifically, higher levels of academic stress produced a greater perception of challenge in students, which, in turn, was related to a higher ability to manage stress at the secondary level (more coping and control perceptions) which, in the end, resulted in a decrease of physical fatigue and cognitive weariness (mainly via coping potential). Thus, we confirm the expected result in the process of adaptation to stress; that is, a higher perception of the challenge is associated with an improved ability to cope with stress and, consequently, lower the burnout experience, as proposed in the theoretical models that are the basis of this study (Gomes 2014; Lazarus 1999). Consequently, stress can be evaluated as positive and stimulating for the individual, as suggested in other studies (Ramaprabou and Dash 2018).

This study has an innovative character due to the inclusion of cognitive appraisal processes as a mediating variable between stress and burnout in university students. The results confirm and strengthen the transactional perspective (Lazarus 1991, 1999) and highlight the importance of cognitive appraisal processes in adapting to stress in the academic context.

Despite its innovative character, we must recognize some limitations of the study. As we focused on psychology university students, future research must diversify the target population, including students from different university courses, academic degrees, and those with particular academic statuses (e.g., worker students; student-athletes). Additionally, considering the pandemic lockdown, the effect of students' isolation regarding COVID19 infection, and the blended learning methodologies implemented as a remediation strategy constitute variables we must attend to in future research designs. Allied to that, expanding the data collection moments between the

two academic semesters of the school year with the same protocol of measures, including a baseline measure of burnout, constitutes an option to implement.

## 5 Conclusion

We must highlight the main assumptions from this study. First, a significant percentage of psychology university students reported high stress in their academic activity due to the evaluations they face throughout their educational journey and the high number of academic tasks. Second, the relationship between the overall level of academic stress and students' experience of burnout is better understood through the partial mediation effect of cognitive appraisal. Aside from the direct effect of academic stress on burnout, the overall stress level could strongly exacerbate the students' perception of threat, decreasing control and coping perceptions, or, in a weaker relationship, produce a greater perception of challenge, increasing control and coping perceptions. Third, greater control and coping perceptions were related to a higher ability to manage stress, decreasing students' physical fatigue and the cognitive weariness of burnout.

Occupational safety and hygiene interventions guidelines must focus on the reduction of chronic stress by implementing life skills training programs (Gomes et al. 2019) that can help students to cope with academic sources of stress and to evaluate their education as more challenging, reducing physical fatigue and cognitive weariness of burnout (Gomes et al. 2022). And thus, increasing students' mental health promotes safety and healthy occupational environments. Intervention must consider the organizational level to develop favorable policies that promote occupational health and safety in the academic context. Specifically, academic leaders (course directors, professors) should coordinate efforts to propose realistic working plans to students that balance the amount of work required by each curricular unit along the semester and course, avoiding feelings of work overload in students and lack of time for rest and leisure activities. In sum, intervention strategies directed towards students and towards the design of curricular programs may increase students' ability to learn and progress along their formative process and prevent undesirable consequences of occupational stress.

## References

- Acharya, L., Jin, L., Collins, W.: College life is stressful today—emerging stressors and depressive symptoms in college students. *J. Am. Coll. Health* **66**(7), 655–664 (2018). <https://doi.org/10.1080/07448481.2018.1451869>
- Allen, M.: *The Sage Encyclopedia of Communication Research Methods*, vols. 1–4. Sage (2017). <https://doi.org/10.4135/9781483381411.n111>
- Alrawwad, T.M., Alrfooh, A.E.: Causes of students' violence at AL-hussein bin talal university. *Int. Educ. Stud.* **7**(3), 30–39 (2014). <https://doi.org/10.5539/ies.v7n3p30>

- Bentler, P.M.: Comparative fit indexes in structural models. *Psychol. Bull.* **107**(2), 238–246 (1990). <https://doi.org/10.1037/0033-2909.107.2.238>
- Bentler, P.M., Bonett, D.G.: Significance tests and goodness of fit in the analysis of covariance structures. *Psychol. Bull.* **88**(3), 588–606 (1980). <https://doi.org/10.1037/0033-2909.88.3.588>
- Böke, B.N., Mills, D.J., Mettler, J., Heath, N.L.: Stress and coping patterns of university students. *J. Coll. Stud. Dev.* **60**(1), 85–103 (2019). <https://doi.org/10.1353/csd.2019.0005>
- Britt, S.L., Ammerman, D.A., Barrett, S.F., Jones, S.: Student loans, financial stress, and college student retention. *J. Stud. Financ. Aid.* **47**(1), 25–37 (2017). <http://publications.nasfaa.org/jsfa/vol47/iss1/3>
- Buchanan, J.L.: Prevention of depression in the college student population: a review of the literature. *Arch. Psychiatr. Nurs.* **26**(1), 21–42 (2012). <https://doi.org/10.1016/j.apnu.2011.03.003>
- Eaves, J.L., Payne, N.: Resilience, stress, and burnout in student midwives. *Nurse Educ. Today* **79**, 188–193 (2019). <https://doi.org/10.1016/j.nedt.2019.05.012>
- Enns, A., Eldridge, G.D., Montgomery, C., Gonzalez, V.M.: Perceived stress, coping strategies, and emotional intelligence: a cross-sectional study of university students in helping disciplines. *Nurse Educ. Today* **68**, 226–231 (2018). <https://doi.org/10.1016/j.nedt.2018.06.012>
- Farrell, S.M., Moir, F., Molodynski, A., Bhugra, D.: Psychological wellbeing, burnout and substance use amongst medical students in New Zealand. *Int. Rev. Psychiatry* **31**, 630–636 (2019). <https://doi.org/10.1080/09540261.2019.1681204>
- Flanagan, J.C.: The critical incident technique. *Psychol. Bull.* **51**(4), 327–358 (1954). <https://doi.org/10.1037/h0061470>
- Frazier, P., Gabriel, A., Merians, A., Lust, K.: Understanding stress as an impediment to academic performance. *J. Am. Coll. Health* **67**(6), 562–570 (2018). <https://doi.org/10.1080/07448481.2018.1499649>
- Gibbons, C.: Stress, coping and burnout in nursing students. *Int. J. Nurs. Stud.* **47**(10), 1299–1309 (2010). <https://doi.org/10.1016/j.ijnurstu.2010.02.015>
- Gomes, A.R.: Positive human functioning in stress situations: an interactive proposal. In: Gomes, A.R., Resende, R., Albuquerque, A. (eds.), *Positive Human Functioning from a Multidimensional Perspective: Promoting Stress Adaptation*, vol. 1, pp. 165–194. Nova Science (2014)
- Gomes, A.R., Fontes, L., Maciel, T., Simões, C., Resende, R.: Treino de competências de vida: Uma proposta teórica e desafios futuros [Life skills training: A theoretical proposal and challenges for the future]. In: Aroni, A., Fernandes, A., Ferreira, F., Bortolai, L. (eds.), *Pensando a Educação na atualidade: Olhares múltiplos*, pp. 137–152. Itapetinga: Edições Hipótese.
- Gomes, A.R., Simões, C., Morais, C., Couto, A.: Occupational stress and cognitive appraisal profiles as predictors of students' burnout. In: Arezes, P.M., et al. (eds.), *Occupational and Environmental Safety and Health III: Studies in Systems, Decision and Control*, vol. 406, pp. 505–520. Springer, Cham, (2022). [https://doi.org/10.1007/978-3-030-89617-1\\_45](https://doi.org/10.1007/978-3-030-89617-1_45)
- Gomes, A.R., Teixeira, P.: Stress, cognitive appraisal, and psychological health: testing instruments for health professionals. *Stress. Health* **32**, 167–172 (2016). <https://doi.org/10.1002/smi.2583>
- Hair, Jr. J.F., Black, W.C., Babin, B.J., Anderson, R.E.: *Multivariate data analysis* (7th ed.). Pearson Prentice Hall (2009)
- Hudd, S., Dumlao, J., Erdmann-Sager, D., Murray, D., Phan, E., Soukas, N., Yokozuka, N.: Stress at college: effects on health habits, health status, and self-esteem. *Coll. Stud. J.* **34**(2), 217–227 (2000)
- Jordan, R.K., Shah, S.S., Desai, H., Tripi, J., Mitchell, A., Worth, R.G.: Variation of stress levels, burnout, and resilience throughout the academic year in first-year medical students. *PLoS ONE* **15**(10), e0240667 (2020). <https://doi.org/10.1371/journal.pone.0240667>
- Karaman, M.A., Lerma, E., Vela, J.C., Watson, J.C.: Predictors of academic stress among college students. *J. Coll. Couns.* **22**(1), 41–55 (2019). <https://doi.org/10.1002/jocc.12113>
- Labrague, L.J., McEnroe-Petite, D.M., Gloe, D., Thomas, L., Papathanasiou, I.V., Tsaras, K.: A literature review on stress and coping strategies in nursing students. *J. Ment. Health* **26**(5), 471–480 (2017). <https://doi.org/10.1080/09638237.2016.1244721>
- Lazarus, R.S.: *Emotion and adaptation*. Oxford University Press (1991)

- Lazarus, R.S.: *Stress and Emotion: A New Synthesis*. Springer (1999)
- Leppink, E.W., Odlaug, B.L., Lust, K., Christenson, G., Grant, J.E.: The young and the stressed. *J. Nervous Mental Disease* **204**(12), 931–938 (2016). <https://doi.org/10.1097/NMD.00000000000000586>
- Marôco J (2014) *Análise de equações estruturais: fundamentos teóricos, software & aplicações* (2ªed.). ReportNumber
- Maslach, C., Leiter, M.P.: Understanding the burnout experience: Recent research and its implications for psychiatry. *World Psychiatry* **15**(2), 103–111 (2016). <https://doi.org/10.1002/wps.20311>
- Muzafar, Y., Khan, H.H., Ashraf, H., Hussain, W., Sajid, H., Tahir, M., Rehman, A., Sohail, A., Waqas, A., Ahmad, W.: Burnout and its associated factors in medical students of Lahore, Pakistan. *Cureus*, **7**(11):e390 (2015). <https://doi.org/10.7759/cureus.390>
- Pitt, A., Oprescu, F., Tapia, G., Gray, M.: An exploratory study of students' weekly stress levels and sources of stress during the semester. *Act. Learn. High. Educ.* **19**(1), 61–75 (2017). <https://doi.org/10.1177/1469787417731194>
- Ramaprabou, V., Dash, S. K.: Effect of academic stress on achievement motivation among college students. *J. Educat. Psychol.* **11**(4), 32–36 (2018). <https://doi.org/10.26634/JPSY.11.4.14219>
- Reddy, K.J., Menon, K.R., Thattil, A.: Academic stress and its sources among university students. *Biomed. Pharmacol. J.* **11**(1), 531–537 (2018). <https://doi.org/10.13005/bpj/1404>
- Shdaifat, E., Jamama, A., Al-Amer, M.: Stress and coping strategies among nursing students. *Global J. Health Sci.* **10**(5), 33–41 (2018). <https://doi.org/10.5539/gjhs.v10n5p33>
- Shirom, A., Melamed, S.: A comparison of the construct validity of two burnout measures in two groups of professionals. *Int. J. Stress. Manag.* **13**(2), 176–200 (2006). <https://doi.org/10.1037/1072-5245.13.2.176>
- Singer, J.D., Willett, J.B.: Methodological issues in the design of longitudinal research: principles and recommendations for a quantitative study of teachers' careers. *Educ. Eval. Policy Anal.* **18**(4), 265–283 (1996). <https://doi.org/10.3102/01623737018004265>
- Steiger, J.H.: Structural model evaluation and modification: an interval estimation approach. *Multivar. Behav. Res.* **25**(2), 173–180 (1990). [https://doi.org/10.1207/s15327906mbr2502\\_4](https://doi.org/10.1207/s15327906mbr2502_4)
- Vizoso, C., Arias-Gundín, O., Rodríguez, C.: Exploring coping and optimism as predictors of academic burnout and performance among university students. *Educ. Psychol.* **39**(6), 768–783 (2019). <https://doi.org/10.1080/01443410.2018.1545996>
- Wahed, W.Y.A., Hassan, S.K.: Prevalence and associated factors of stress, anxiety, and depression among medical fayoum university students. *Alexandria J. Med.* **53**(1), 77–84 (2017). <https://doi.org/10.1016/j.ajme.2016.01.005>
- Weber, J., Skodda, S., Muth, T., Angerer, P., Loerbroks, A.: Stressors and resources related to academic studies and improvements suggested by medical students: a qualitative study. *BMC Med. Educ.* **19**(1), 1–14 (2019). <https://doi.org/10.1186/s12909-019-1747-z>
- World Health Organization: ICD-11 International classification of diseases for mortality statistics (2019). <https://icd.who.int/browse11/l-m/en#/http://id.who.int/icd/entity/129180281>