

## Article

# Studies on the Relationship between Occupational Stress and Mental Health, Performance, and Job Satisfaction of Chinese Civil Aviation Pilots

Yanzeng Zhao <sup>1</sup>, Yanlong Wang <sup>1</sup>, Wei Guo <sup>1</sup>, Lin Cheng <sup>1</sup>, Jialu Tong <sup>2,3</sup>, Ruipeng Ji <sup>4</sup>, Yizhi Zhou <sup>5</sup>, Ziyu Liu <sup>1,2,\*</sup> and Lijing Wang <sup>1,\*</sup>

- <sup>1</sup> Fundamental Science on Ergonomics and Environment Control Laboratory, School of Aeronautic Science and Engineering, Beihang University, Beijing 100191, China; zhaoyanzeng@buaa.edu.cn (Y.Z.); wyllaf@sina.com (Y.W.); guowei2@comac.cc (W.G.); chenglin1@caict.ac.cn (L.C.)
- <sup>2</sup> Beijing Advanced Innovation Centre for Biomedical Engineering, School of Engineering Medicine, Beihang University, Beijing 100191, China; tongjl005@avic.com
- <sup>3</sup> China National Aeronautical Radio Electronics Research Institute, Shanghai 200241, China
- <sup>4</sup> Flying College, Beihang University, Beijing 100191, China; waterjrp@buaa.edu.cn
- <sup>5</sup> Flight of China Southern Airline Company Limited, Guangzhou 510406, China; zhouyizhi@csair.com
- \* Correspondence: liu\_ziyu@buaa.edu.cn (Z.L.); wanglijing@buaa.edu.cn (L.W.)

**Abstract:** This research work delves into the potential impact of occupational stress on the mental health, performance, and job satisfaction of civil aviation pilots. To explore this triadic relationship, a battery of six distinct scales was employed, including the Chinese Civil Aviation Pilot Occupational Stress Scale, the Symptom Check List-90 (SCL-90), the Flight Performance Scale, the Job Satisfaction Scale, the Minnesota Satisfaction Questionnaire (MSQ), and the Simplified Coping Style Questionnaire (SCSQ). A total of 131 valid questionnaires were collected for analysis, yielding a valid response rate of 65.5%. The findings demonstrate a negative correlation between occupational stress experienced by Chinese civil aviation pilots and their mental health, performance, and job satisfaction. Notably, a positive coping style was identified as a moderator in the relationship between occupational stress and flight performance, effectively mitigating the negative impact of stress on flight performance. Similarly, a negative coping style was found to moderate the relationship between occupational stress and job satisfaction, attenuating the adverse effects of occupational stress on job satisfaction. This study underscores the predictive utility of investigating the occupational stress experienced by pilots for understanding their mental health, performance, and job satisfaction. Furthermore, it highlights the potential for adjusting the negative impact of occupational stress on flight performance and job satisfaction through interventions that target pilots' coping styles.

**Keywords:** occupational stress; mental health; flight performance; job satisfaction; civil aviation pilots; questionnaire; negative coping style



**Citation:** Zhao, Y.; Wang, Y.; Guo, W.; Cheng, L.; Tong, J.; Ji, R.; Zhou, Y.; Liu, Z.; Wang, L. Studies on the Relationship between Occupational Stress and Mental Health, Performance, and Job Satisfaction of Chinese Civil Aviation Pilots.

*Aerospace* **2023**, *10*, 896. <https://doi.org/10.3390/aerospace10100896>

Academic Editor: Julius Keller

Received: 26 August 2023

Revised: 25 September 2023

Accepted: 4 October 2023

Published: 20 October 2023



**Copyright:** © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

Piloting is a unique profession that requires individuals to operate in high-altitude, high-speed, and high-risk environments, dealing with a multitude of complex situations and challenges [1–3]. Pilots must possess exceptional skills and knowledge, alongside strong mental resilience and adaptability. However, this profession comes with its share of pressures, including irregular schedules, frequent time zone changes, extended separation from family, demanding workloads, stringent safety requirements, and unforeseeable flight incidents. According to a stress survey conducted by CareerCast.com and the Bureau of Labor Statistics, commercial pilots now rank third among all professions in terms of occupational stress [4].

Occupational stress can significantly affect a pilot's mental health, job performance, and satisfaction—collectively referred to as outcome variables [5–7]. Additionally, individual coping strategies play a pivotal role in either mitigating or intensifying the negative impacts of stress [8,9]. Nevertheless, research on occupational stress and outcome variables among Chinese commercial pilots remains limited, particularly regarding the examination of coping strategies.

Internationally, there have been studies on occupational stress and outcome variables among pilots. For example, Cooper et al. conducted a survey in 1985 involving 442 British commercial pilots, using multiple regression analysis to investigate the impact of various stressors and coping strategies on mental health, performance, and job satisfaction [10]. Their findings revealed that mental health was primarily influenced by occupational stress and coping strategies, while job satisfaction was affected by both occupational and family stress. Performance, on the other hand, was largely influenced by occupational stress. Beyond pilots, similar research on the relationship between occupational stress and outcome variables exists in other fields [11,12]. For example, Rohland BM explored the link between occupational stress and the mental health of physicians, offering suggestions to address psychological issues resulting from occupational stress [13]. Furthermore, Lulu et al. investigated occupational stress among Chinese police officers, analyzing its impact on job satisfaction and proposing measures to enhance their job satisfaction [14]. Advances in statistical methods, particularly those incorporating moderating variables, have revealed more precise relationships between occupational stress and outcome variables, aiding a deeper understanding of underlying theoretical mechanisms and intervention strategies.

In addition, in Lulu's study, it was revealed that 37% of Chinese police officers reported experiencing stress, a notably higher figure compared to simultaneous research among Italian police officers [14,15]. This paper attributes the increasing occupational risk among Chinese police officers to stricter regulations on gun management and usage imposed by Chinese laws. Bochen Pan et al. [16] conducted a survey among Chinese university teachers, resulting in a job satisfaction score of 69.55, whereas Fu J's [17] investigation of doctors in the same region yielded a job satisfaction score of 65.86. This suggests that Chinese commercial pilots may face higher occupational stress levels, warranting further examination.

Regarding Chinese pilots, some scholars have studied the influence of personality traits on stress and mental health [18], and some have explored the impact of coping strategies on psychological well-being [19]. However, there is currently a lack of research that comprehensively investigates the role of coping strategies as a crucial variable in the relationship between occupational stress and three significant outcome indicators: performance, mental health, and job satisfaction. This paper aims to investigate the occupational stress experienced by Chinese commercial pilots and its impact on their mental health, performance, and job satisfaction, as well as the role of individual coping strategies in moderating this relationship. Employing a questionnaire survey method, this study samples Chinese commercial pilots and measures their occupational stress, outcome variables, and coping strategies, analyzing the data using statistical models for moderation analysis. This research work offers valuable insights into managing occupational stress among Chinese commercial pilots.

## 2. Literature Review and Hypothesis Formulation

The World Health Organization (WHO) defines mental health as “a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community” [20]. The mental health of pilots directly impacts critical qualities such as their flying skills, decision-making abilities, and emergency response capabilities. Numerous studies have indicated that mental health issues among pilots, such as anxiety, depression, insomnia, and psychosis, are significant contributors to aviation accidents [21,22]. Therefore, maintaining the mental health of pilots is a fundamental prerequisite for ensuring flight safety. According to stress theory, when individuals face stressors beyond their adap-

tive capacity, stress reactions occur, leading to physiological, psychological, and behavioral changes [23,24]. If these stress reactions persist or become too intense, they can result in adverse consequences for individuals, including physical ailments, mental disorders, and impaired social functioning. Consequently, occupational stress can be regarded as a chronic source of stress, continuously stimulating and depleting the physical and psychological resources of pilots, leaving them in a state of tension and unease. Thus, this paper hypothesizes that:

**H1a** . *Occupational stress is negatively correlated with the mental health of Chinese pilots.*

Performance refers to the results or level of achievement exhibited by an individual in their work, typically influenced by factors such as an individual's knowledge, skills, and attitudes [25,26]. For pilots, performance reflects the efficiency and quality they achieve when carrying out flight tasks and is a critical criterion for assessing their competence in their aviation roles. Occupational stress can impact a pilot's cognitive functions, including attention, memory, and reaction time, thereby reducing their ability to handle complex and emergency situations. Furthermore, occupational stress can lead to emotional fluctuations and loss of emotional control among pilots, resulting in unsafe or non-compliant flying behavior [27]. Thus, this paper hypothesizes that:

**H1b** . *Occupational stress is negatively correlated with the performance of Chinese pilots.*

Job satisfaction among pilots refers to their degree of contentment with various aspects of their work, including job content, environment, conditions, income, and more. Since occupational stress can impact a pilot's psychological well-being, work efficiency, attitude towards work, and overall quality of life, higher levels of occupational stress tend to result in lower job satisfaction among pilots [28,29]. Thus, this paper hypothesizes that:

**H1c** . *Occupational stress is negatively correlated with the job satisfaction of Chinese pilots.*

During the action of occupation stress to the outcome variables, the relationship between occupational stress and outcome variables can be explained comprehensively through the study of coping styles [29,30]. Furthermore, Lazarus and Folkman hold that different types of occupational stress lead to different coping styles, while different coping styles result in different stress outcomes. Therefore, a desired result can be reached by changing the coping style [31]. When studying the nurses' occupational stress and job satisfaction degree, it was found that a negative coping style is obviously related to the work stress but by no means reduces the nurses' sense of pressure [32]. The interactive effect of a positive coping mode on the job satisfaction degree is conspicuous, thus herein suggesting that enhancing nurses' positive coping mode in response to problems will help to reduce the effect of work stress to the job satisfaction degree. In light of Felste's study of university students, occupational stress and mental health are presented as having a the negative correlation, which can be aggravated by a negative coping mode [33]. Thus, this paper hypothesizes that:

**H2** . *An individual's positive or negative coping style in response to stress will play a moderating role in the impact of occupational stress on mental health, performance, and job satisfaction.*

### **3. Methods**

#### **3.1. Study Design and Sample**

We conducted a cross-sectional survey of Chinese civil aviation pilots. Paper-based questionnaires were distributed to pilots in the lounge of a specific airline company in China, and they were invited to participate in the survey. Prior to completing the questionnaire, we provided pilots with a thorough explanation of the research objectives and assured them of the anonymity of the study. Informed consent was obtained from all participants, who

also signed informed consent forms. A total of 200 Chinese civil aviation pilots participated in the questionnaire survey, and after verifying the completeness of the responses and checking items such as “Please choose 4 for this question,” 131 questionnaires were deemed eligible for analysis. This represents a response rate of 65.5% out of the 200 distributed questionnaires. The study received approval from the Ethics Review Committee of the Department of Aerospace.

### 3.2. Study Methods and Tools

#### 3.2.1. Characteristics of Pilots

This study constituted a statistical survey focused on gathering fundamental demographic data pertaining to Chinese civil aviation pilots. The variables under investigation encompassed age, gender, educational attainment, marital status, years of experience in the aviation industry, occupational roles, total flight hours, and current employment status. A comprehensive survey was conducted to collect and categorize these data, as presented in Table 1 below.

**Table 1.** Survey and classification.

Survey		Classification			
Gender		Male		Female	
Age (years)	≤25	26–35		36–45	≥45
Marital status	Single	Married		Other	
Educational level	Junior College	Undergraduate		Above undergraduate	
Years of service	1–5	6–10		11–15	≥15
Post	Flying Cadet	Co-Pilot	Trainee Pilot	Captain	Flight Instructor
Flight time (h)	≤1000	1001–5000	5001–10,000	10,001–15,000	≥15,000
Work status	Normal Route	Recurrent		Modification	

#### 3.2.2. Occupational Stress Measurement

Although there are many stress questionnaires that have been used overseas, their applicability to Chinese pilots has not been supported by theory and practical application. A new concept of stress load was put forward, and the scale for occupational stress of Chinese civil pilots based on it was developed by means of open-ended questionnaires and interviews, referring to the stress research literature in this paper. A total of 385 copies of the scale were sent to pilots coming from a same Chinese airline company, and 304 copies were collected. According to the results of analysis, the stressor subscale comprised 64 items. Seven factors were extracted from the subscale, and the validity and reliability were confirmed. The inner consistency also reached a satisfactory level. The individual characteristic scale comprised 40 items. The 64-item stressor of occupational stress subscale included seven dimensions: intrinsic to the job, relationships with other people, organizational structure and climate, the managerial role, home/work interface, career and achievement and work environment. The 40-item stressor of personal characteristics subscale included seven dimensions: psychological capital appreciation, operational capability, attitude towards life, self-efficacy, hope, resilience and optimism. Each item was scored based on a Likert scale on which 1 represents strongly disagree and 6 represents strongly agree. The Cronbach’s alpha coefficients of this scale were 0.757 and 0.916, respectively.

#### 3.2.3. Mental Health Measurement

This paper employed the simplified Symptom Checklist 90 (SCL-90) to assess the mental health of civil aviation pilots [34,35]. The SCL-90 is a comprehensive 90-item ques-

tionnaire encompassing ten dimensions, which include somatization, obsessive-compulsive traits, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, psychoticism, and an additional scale. Respondents provided responses on a 5-point scale, ranging from 1 (not at all) to 5 (extremely). Higher scores indicate lower levels of mental health. The Cronbach's alpha coefficients of this scale was 0.993.

#### 3.2.4. Performance Measurement

The performance of pilots was assessed using a 13-item Performance Questionnaire, a tool developed by Cooper [36]. For the purposes of this study, the questionnaire was translated into Chinese, and a 5-point scale was employed to evaluate pilot performance, with higher scores indicating superior performance. The Cronbach's alpha coefficients of this scale was 0.914.

#### 3.2.5. Job Satisfaction Measurement

The Minnesota Satisfaction Questionnaire (MSQ) serves as an instrument to assess job satisfaction [37]. This questionnaire comprises 20 items, utilizing a 5-point scale ranging from 1 (very dissatisfied) to 5 (very satisfied). It encompasses both intrinsic and extrinsic facets of job satisfaction. The total job satisfaction score falls within the range of 20 to 100, with 60 indicating a neutral level of satisfaction and 80 indicating a state of satisfaction [38]. The Cronbach's alpha coefficients of this scale was 0.958.

#### 3.2.6. Coping Styles Measurement

In this study, the Simplified Coping Style Questionnaire (SCSQ), developed by Yaning Xie and tailored to consider the characteristics of China's population, was employed to assess the coping styles of civil aviation pilots [39]. This self-report questionnaire utilizes a multilevel rating system with four response options (not chosen, chosen several times, chosen sometimes, chosen usually), each corresponding to a numerical value (0, 1, 2, 3). Participants selected one of these options to indicate their response. The positive coping style comprises items 1 to 12, while the negative coping style encompasses items 13 to 20. Finally, the scores for these two styles were calculated to reflect the subjects' overall coping style. The Cronbach's alpha coefficients of this scale was 0.911.

### 3.3. Statistical Analysis

The data underwent statistical analysis using established mathematical methods. Analysis of variance (ANOVA) was employed to examine the relationships between individual characteristics and their impact on mental health, performance, and job satisfaction. Pearson's correlation analysis was conducted to evaluate the associations among participants' characteristics, occupational stress, mental health, performance, and job satisfaction. Hierarchical regression models were utilized to explore the mediating role of coping styles between occupational stress and the three outcome variables. All statistical analyses were conducted using SPSS 17.0, and statistical significance was determined at  $p < 0.05$  (two-tailed).

## 4. Results

### 4.1. Participant Characteristics

The interrelationships among pilots' characteristics, mental health, performance, and job satisfaction are illustrated in Table 2. It was observed that participants aged under 25 exhibited significantly better performance compared to their counterparts ( $p < 0.01$ ). Marital status also exerted a substantial influence on job satisfaction, with married pilots reporting lower levels of job satisfaction in comparison to those who were single ( $p < 0.01$ ). Additionally, pilots at different ranks demonstrated statistically significant variations in job satisfaction ( $p < 0.05$ ). Captains displayed the lowest job satisfaction score (71.50), while flying cadets exhibited the highest job satisfaction score (85.21).

**Table 2.** Participants' characteristics and differences in mental health, performance and job satisfaction.

Variables	N (%)	Mental Health	Performance	Job Satisfaction
		Mean (SD)	Mean (SD)	Mean (SD)
Age (years)		$p > 0.05$	$p > 0.05$	$p < 0.01$
≤25	33	102.79 (16.19)	50.03 (5.64)	81.85 (11.69)
26–35	82	111.81 (30.00)	49.66 (6.97)	71.62 (11.26)
36–45	8	118.67 (25.99)	50.22 (3.87)	68.56 (13.80)
≥45	8	105.67 (26.53)	51.17 (3.19)	72.00 (14.25)
Marital status		$p > 0.05$	$p > 0.05$	$p < 0.01$
Single	58	108.87 (26.55)	49.93 (6.36)	78.90 (11.54)
Married	72	110.01 (26.76)	49.83 (6.36)	70.29 (11.96)
Other	1	131.00	48.00	68.00
Educational level		$p > 0.05$	$p > 0.05$	$p > 0.05$
Junior College	8	103.25 (13.24)	49.00 (2.45)	78.86 (7.77)
Undergraduate	122	110.21 (27.22)	49.92 (6.51)	73.78 (12.71)
Master or above	1	94.00	49.00	72
Years of service		$p > 0.05$	$p > 0.05$	$p > 0.05$
1–5	76	109.47 (25.54)	49.50 (6.43)	76.19 (12.92)
6–10	34	109.82 (30.95)	49.73 (6.91)	71.79 (10.74)
11–15	11	109.90 (29.23)	51.36 (5.51)	68.54 (12.06)
≥15	10	110.40 (1.638)	51.40 (3.84)	71.90 (12.82)
Post		$p > 0.05$	$p > 0.05$	$p < 0.05$
Flying Cadet	14	107.50 (24.73)	51.21 (8.12)	85.21 (12.20)
Co-Pilot	82	111.54 (29.32)	49.21 (6.11)	72.95 (11.98)
Trainee Pilot	4	106.00 (10.68)	50.75 (5.12)	73.50 (9.74)
Captain	18	106.61 (24.32)	49.94 (5.95)	71.50 (11.86)
Flight Instructor	13	105.67 (15.04)	52.08 (6.38)	73.00 (12.74)
Flight time		$p < 0.05$	$p > 0.05$	$p < 0.01$
0–1000 (h)	32	103.81 (19.65)	49.78 (5.95)	82.66 (12.29)
1001–5000 (h)	61	116.11 (32.11)	49.00 (6.81)	70.37 (11.33)
5000–10,000 (h)	20	98.45 (8.70)	51.20 (6.34)	73.95 (8.78)
10,001–15,000 (h)	16	112.81 (25.02)	52.06 (4.75)	71.00 (17.46)
≥15,000 (h)	2	94.00 (2.82)	46.50 (3.53)	76.50 (12.45)
Work status		$p > 0.05$	$p < 0.05$	$p < 0.01$
Normal Route	114	109.62 (26.87)	49.80 (6.18)	72.91 (12.22)
Recurrent	2	151.5 (37.48)	39.50 (0.70)	63.00 (5.65)
Modification	15	104.46 (18.16)	51.66 (7.66)	84.47 (9.41)

Note: SD: standard deviation.

Furthermore, distinct levels of total flight time were associated with varying degrees of job satisfaction. Pilots with flight hours ranging from 1001 to 5000 h scored higher on the SCL-90 index compared to their counterparts ( $p < 0.05$ ), and they also reported lower job satisfaction. Additionally, pilots undergoing recurrent training exhibited significantly lower performance levels than those on regular routes and in modification roles ( $p < 0.01$ ), and they also reported significantly reduced job satisfaction compared to others.

#### 4.2. Descriptions of Occupational Stress, Mental Health, Job Satisfaction, Performance and Coping Styles

The means and standard deviations for the variables under investigation in this study are presented in Table 3, including occupational stress, mental health, job satisfaction, performance, and coping styles. The mean score for the SCL-90 among Chinese civil aviation pilots was 109.67 ( $\pm 26.53$ ), while the mean score for performance was 49.86 ( $\pm 6.37$ ). Additionally, the mean score for overall job satisfaction among Chinese civil aviation pilots was found to be 74.08 ( $\pm 12.45$ ).

**Table 3.** Descriptions of occupational stress, mental health, job satisfaction, performance and coping styles.

Measure	Items	Mean	SD
Occupational Stress	104	0.84	0.15
Mental health (SCL-90)	90	109.67	26.53
Performance	13	49.86	6.37
Job Satisfaction	20	74.08	12.45
Coping Styles	20	2.33	0.72
Positive Coping Styles	12	2.12	0.42
Negative Coping Styles	8	1.54	0.49

#### 4.3. Correlations among Occupational Stress, Mental Health, Job Satisfaction, Performance and Coping Styles

The outcomes of Pearson correlation analysis are presented in Table 4. Occupational stress exhibited a significant negative correlation with both performance and job satisfaction ( $p < 0.01$ ), while demonstrating a positive correlation with the SCL-90 scores ( $p < 0.01$ ). It is evident that H1a, H1b, and H1c have all been confirmed.

**Table 4.** Correlations among occupational stress, SCL-90, job satisfaction, performance and coping styles.

Variable	1	2	3	4	5	6	7
1. Age	1						
2. Years of service	0.754 **	1					
3. Flight time	0.775 **	0.834 **	1				
4. Occupational stress	0.243 **	0.287 *	0.204 **	1			
5. SCL-90	0.110	0.010	−0.009	0.238 **	1		
6. Performance	0.014	0.097	0.096	−0.399 **	−0.436 **	1	
7. Job Satisfaction	−0.294 **	−0.177 **	−0.233 *	−0.609 **	−0.299 **	0.358 **	1
8. Coping Styles	−0.189 *	−0.148	−0.162	−0.351 **	−0.260 **	0.236 **	0.347 **

\*  $p < 0.05$ , \*\*  $p < 0.01$  (two-tailed).

#### 4.4. Analysis of the Moderate of Positive Coping Style and Negative Coping Style

The subsequent research questions were examined through the utilization of hierarchical regression models [40]. To explore potential moderating effects, two variables—a positive coping style and a negative coping style—were introduced to assess their impact on the relationship between pilot occupational stress and the variables of interest: SCL-90 scores, performance, and job satisfaction. Subsequently, the central processing of occupational stress, positive coping style, and negative coping style was conducted. In this study,  $X$  denotes occupational stress,  $M_1$  denotes a positive coping style, and  $M_2$  denotes a negative coping style.  $\bar{X}$  represents the central processed occupational stress data,  $\bar{M}_1$  represents the central processed positive coping style data, and  $\bar{M}_2$  represents the central processed negative coping style data.

The test results are presented in Table 5. It is observed that the positive coping style moderates the relationship between occupational stress and performance ( $\Delta R^2 = 0.037$ ,  $p < 0.05$ ), while the negative coping style moderates the interaction between occupational stress and job satisfaction ( $\Delta R^2 = 0.022$ ,  $p < 0.05$ ). These findings serve as the basis for constructing regression equations to illustrate the two distinct moderating effects. The results are presented in Table 6, where  $Y_1$  represents performance,  $Y_2$  represents job satisfaction,  $M_1$  represents a positive coping style, and  $M_2$  represents a negative coping style.

**Table 5.** Result of hierarchical regression models.

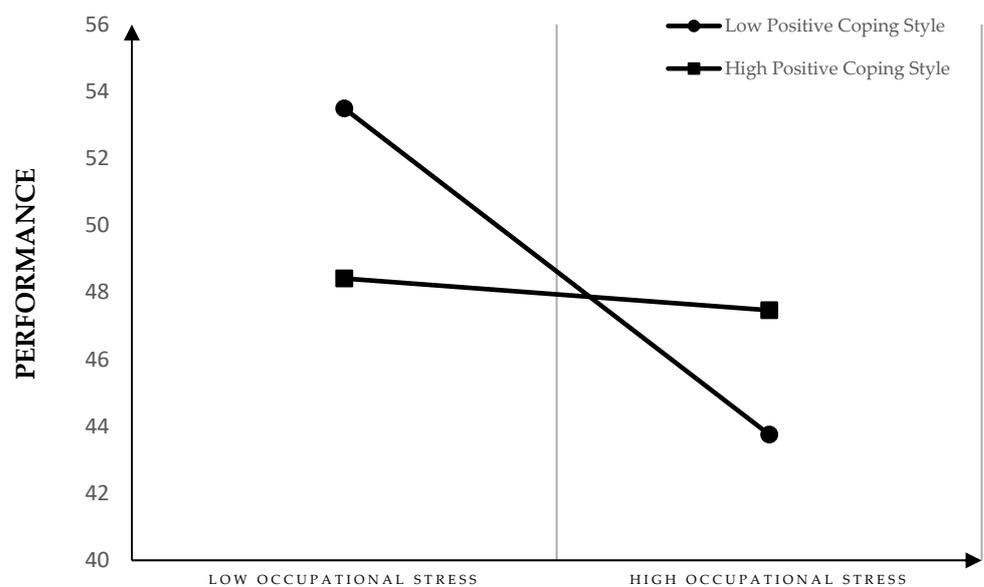
Variable	SCL-90		Performance		Job Satisfaction	
	$\beta$	$\Delta R^2$	$\beta$	$\Delta R^2$	$\beta$	$\Delta R^2$
Step 1						
Occupational stress (X)	29.423		-10.550 **		-43.757 **	
Positive coping style (M <sub>1</sub> )	11.296		-3.375 *		-4.762 *	
Step 2						
Occupational stress (X)	29.933		-10.895 **		-43.680 **	
Positive coping style (M <sub>1</sub> )	11.038	0.005	-3.200 *	0.037*	-4.801 *	0.000
$\bar{X} \times \bar{M}_1$	-30.143		20.438 *		-4.528	
Step 1						
Occupational stress (X)	40.139 **		-13.761 **		-48.268 *	
Negative coping style (M <sub>2</sub> )	-4.075		34.461 **		0.460	
Step 2						
Occupational stress	39.951 **		-13.782 **		-48.123 **	
Negative coping style	-4.907	0.008	3.370 *	0.002	1.103 **	0.022 *
$\bar{X} \times \bar{M}_2$	-33.368		-3.650		25.789*	

\*  $p < 0.05$ , \*\*  $p < 0.01$  (two-tailed).

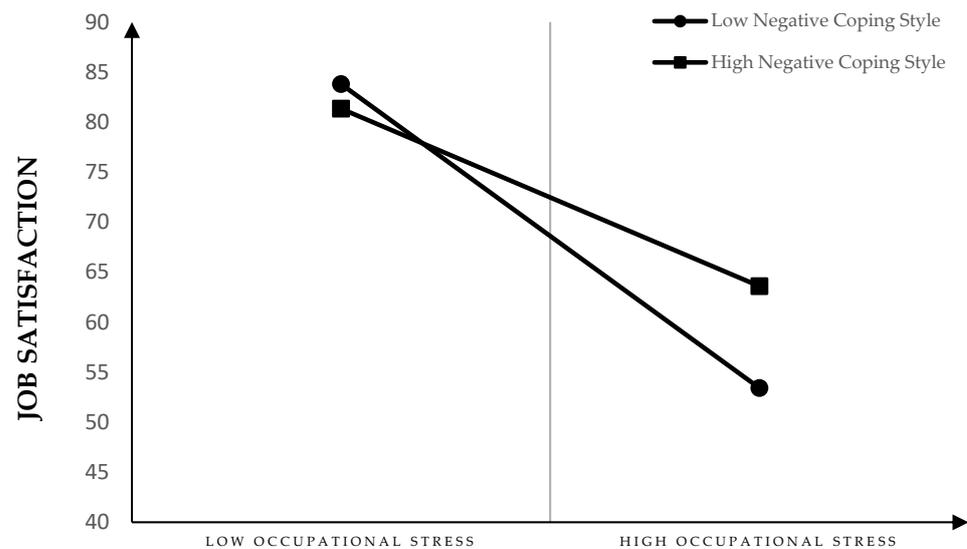
**Table 6.** Moderating effects' regression equation.

		Regression Equation	R <sup>2</sup>	$\Delta R^2$	p
Equation 1	Step 1	$Y_1 = 65.874 - 10.550X - 3.375M_1$	0.158		
	Step 2	$Y_1 = 65.319 - 10.895X - 3.200M_1 + 20.438\bar{X} \times \bar{M}_1$	0.195	0.037	0.018
Equation 2	Step 1	$Y_2 = 114.678 - 48.268X + 0.460M_2$	0.371		
	Step 2	$Y_2 = 114.553 - 48.123X + 1.103M_2 + 25.789\bar{X} \times \bar{M}_2$	0.393	0.022	0.035

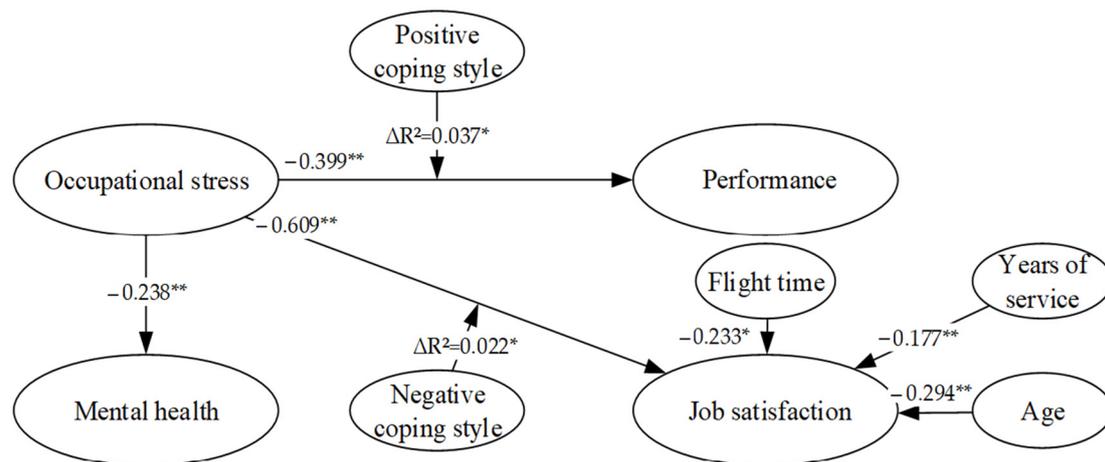
According to the regression equations, moderating effect diagrams of coping styles are presented. Figure 1 illustrates the moderating effect of a positive coping style on the interaction between occupational stress and performance, while Figure 2 depicts the moderating effect of a negative coping style on the interaction between occupational stress and job satisfaction. The final model with the moderating effect of a positive coping style and negative coping style is shown in Figure 3.



**Figure 1.** Positive coping style moderate interaction between occupational stress and performance.



**Figure 2.** Negative coping style moderate interaction between occupational stress and job satisfaction.



**Figure 3.** The final model with the moderating effect of a positive coping style and a negative coping style. Note: \*  $p < 0.05$ ; \*\*  $p < 0.01$ .

## 5. Discussions

This paper explores the correlation between occupational stress among Chinese civil aviation pilots and its impact on mental health, performance, and job satisfaction. Additionally, it examines the influence of individual coping styles on this triadic relationship, as depicted in Figure 3. In comparison to other professions, there has been relatively limited research conducted on the interplay between occupational stress among pilots and its effects on mental health, performance, and job satisfaction [10,36,41]. Historically, studies regarding civil aviation pilots have predominantly originated from Western countries, with relatively fewer investigations focused on Chinese civil aviation pilots.

This study reveals a statistically significant and negative correlation ( $p < 0.05$ ) between the occupational stress experienced by civil aviation pilots and their mental health. In this research work, the Symptom Checklist 90 (SCL-90) symptom score is utilized as an indicator of pilots' mental health levels. Elevated levels of occupational stress among pilots are associated with higher SCL-90 symptom scores, signifying lower mental health levels. This finding aligns with previous research findings in various occupational fields [5,42], highlighting the detrimental impact of occupational stress on mental health among pilots. Furthermore, the mental health levels of civil aviation pilots vary significantly based on their total flight duration ( $p < 0.05$ ). Notably, pilots with total flight durations ranging

from 1001 h to 5000 h exhibit the highest SCL-90 scores (116.11), significantly surpassing the average score of 109.3. This can perhaps be considered from a perspective of career development [43]. In contrast to pilots who have accumulated 0–1000 flight hours, who are in the initial stages of more independent operational roles and contend with heightened occupational stress, necessitating adjustment to the rigorous demands of commercial aviation, pilots who have amassed 5001–10,000 flight hours may still be in the process of accumulating coping experiences and skills, and despite being in the peak of their careers, they may grapple with insecurities pertaining to their responsibilities, coupled with the fear that errors in their performance might lead to aviation incidents. Therefore, airlines should pay particular attention to monitoring and managing the psychological stress levels of pilots who have accumulated 1001–5000 flight hours.

The relationship between occupational stress among civil aviation pilots and their performance is statistically significant and negative ( $p < 0.01$ ). Elevated levels of occupational stress in civil aviation pilots are associated with a decline in their flight performance. The correlation coefficient between occupational stress and flight performance is  $-0.399^{**}$ , supporting the applicability of the theory proposed by Van Scotter [44] and Allen R [45], which suggests a negative correlation between occupational stress and performance within the civil aviation pilot profession. Moreover, it can be observed that, in comparison to mental health and job satisfaction, performance remains consistent across various demographic characteristics. This observation may potentially serve as strong evidence to support the notion that the airline company's standardized operational procedures and management protocols have minimized the impact of individual differences on performance. It also underscores the effectiveness of the company's pilot professional training, as pilots from diverse backgrounds have received highly systematic training, resulting in a relatively balanced skill level.

The relationship between occupational stress among civil aviation pilots and their job satisfaction was found to be statistically significant and negative ( $p < 0.01$ ). The results indicate that as the level of occupational stress increases among civil aviation pilots, their job satisfaction decreases, consistent with previous research findings [28]. Additionally, marital status was found to have a significant impact on job satisfaction among civil aviation pilots ( $p < 0.01$ ), aligning with Cooper's study [10] and highlighting distinctions from other industries [46]. Notably, married pilots exhibited significantly lower job satisfaction compared to their single counterparts. This disparity can be attributed to the need for civil aviation pilots to reside at overnight bases, resulting in prolonged separation from their families. Furthermore, the demanding workload often leads to reduced time spent with family members, contributing to diminished communication, strained marital relationships, indifferent parenting, and increased family conflicts. Job satisfaction is also influenced by several other factors, including age, length of service, and total flight hours. Data analysis reveals that the decline in job satisfaction among pilots is primarily associated with the total flight duration, consistent with findings from a study of 100 air force training instructors conducted by Carbone EG [47]. The cumulative total flight duration signifies an extended period during which pilots experience high levels of stress. Prolonged confinement in a cramped and pressurized cockpit, coupled with recurrent exposure to various high-stress situations, leads to a reduction in work enthusiasm and a decrease in job satisfaction among pilots.

Coping style refers to the cognitive and behavioral strategies employed by individuals to modify the context of an event or regulate their emotions when confronted with stressful situations. Coping styles typically encompass both positive coping styles (also known as confrontive coping styles) and negative coping styles (also known as avoidant coping styles) [48]. A significant negative correlation ( $p < 0.01$ ) was observed between positive coping styles and occupational stress among pilots, suggesting that a positive problem-solving approach significantly mitigates occupational stress levels in this group. Additionally, positive coping styles were found to act as a moderating factor in the relationship between occupational stress and flight performance ( $p < 0.05$ ), reducing the adverse impact of stress

on flight performance. Proactive coping strategies refer to taking action to prevent or minimize the impact of stressors before they occur [49]. When facing equivalent levels of occupational stress, pilots with higher scores in positive coping strategies may proactively address stress, problem-solve, and maintain a positive mindset, thereby safeguarding their job performance and mitigating the impact of occupational stress on their performance [50]. Coping styles emerge as pivotal variables that modify the strength and direction of the relationship between pilot occupational stress and job performance, serving as crucial regulators in this context.

A negative coping style serves as a mediator in the relationship between occupational stress among civil aviation pilots and their job satisfaction ( $p < 0.05$ ). It functions to mitigate the adverse impact of occupational stress on job satisfaction and, consequently, enhances the job satisfaction levels of civil aviation pilots. There exists a debate regarding the moderating role of avoidant coping styles. One perspective suggests that the avoidant coping style perpetuates the status quo, allowing problems to persist [51]. Conversely, another viewpoint contends that certain passive coping methods, such as psychological counseling, relaxation techniques, and avoidance strategies, can facilitate more effective coping, reduce self-imposed stress, and alleviate negative emotions [52]. The findings presented in Table 2 of this study support the latter perspective, indicating that the adoption of an avoidant coping style by pilots is conducive to reducing the emotional impact resulting from occupational stress. This observation aligns with the notion that a significant number of Chinese individuals possess introverted and conservative traits, valuing solitude. When confronted with stressful situations, Chinese individuals often tend to employ avoidance as a problem-solving strategy [53,54]. Consequently, Chinese civil aviation pilots may be inclined to alleviate the effects of occupational stress through self-psychological counseling and self-soothing techniques.

## 6. Theoretical Contribution

This study employed hierarchical regression analysis to statistically elucidate the relationships between occupational stress and the mental health, performance, and job satisfaction of pilots, as well as the mediating role of coping strategies in these associations. This research contributes to the field of aviation psychology by expanding our understanding of the factors at play in the context of pilot mental health and performance. Furthermore, it offers a theoretical foundation and practical guidance for the management of occupational stress among pilots. Not only does this study provide insights into the current status and characteristics of occupational stress experienced by Chinese pilots, it also investigates the impact of different coping strategies on the mental health, performance, and job satisfaction of pilots. This information serves as a reference for pilots in selecting appropriate coping strategies, ultimately enhancing their psychological resilience and aviation safety levels.

## 7. Practical Contribution

Firstly, this study found that in China, occupational stress is indeed negatively correlated with psychological well-being, performance, and job satisfaction. Hence, aviation industry stakeholders should prioritize efforts to minimize occupational stress among pilots as much as possible. Secondly, this research revealed that positive coping strategies can moderate the negative relationship between occupational stress and performance. Those who employ positive stress-coping strategies tend to maintain more stable performance. Therefore, individuals in the aviation industry can facilitate positive stress coping among pilots by providing emotional support, offering training to enhance stress-coping skills, and encouraging employees to seek a balance between work and personal life. Furthermore, negative coping strategies can moderate the negative relationship between occupational stress and job satisfaction. In order to maintain more stable job satisfaction, current pilots might lean towards using negative coping strategies. This not only suggests that pilots may need to employ different stress-coping strategies when dealing with different events but

also highlights the need for further upgrades and enhancements in the performance evaluation systems within the current pilot profession, providing more incentive mechanisms.

## 8. Limitations

Firstly, the sample for this study was drawn from a civil aviation company in China, and it remains to be verified whether the findings are applicable to other regions or other types of pilots, such as military or general aviation pilots. In future research, expanding the sample size and scope of civil aviation pilots and considering the inclusion of data from military or general aviation pilots could facilitate cross-level or cross-category comparisons, enhancing the accuracy and generalizability of the model. Secondly, this study employed a cross-sectional approach to collect and analyze data, which lacks longitudinal data to assess causal relationships. Therefore, in subsequent research, it may be worthwhile to investigate relationships through experimental methods by manipulating variables, allowing for a more in-depth examination of causality.

## 9. Conclusions

In summary, this study establishes a negative correlation between occupational stress among Chinese civil aviation pilots and their mental health, performance, and job satisfaction. Positive coping strategies act as mediators, moderating the relationship between occupational stress and performance, effectively mitigating the adverse impact of stress on performance. Similarly, negative coping strategies serve as moderators, attenuating the negative influence of occupational stress on job satisfaction. The research findings suggest that by examining occupational stress levels among pilots, it becomes possible to predict their mental health, performance, and job satisfaction. Furthermore, adjustments to coping strategies can effectively mitigate the adverse effects of occupational stress on performance and job satisfaction. Consequently, airline companies can enhance their management systems and implement improvement measures based on the findings of occupational stress assessments, thereby enhancing the mental health, performance, and job satisfaction of their pilots.

**Author Contributions:** Conceptualization, Y.Z. (Yanzeng Zhao), Y.W. and W.G.; methodology, W.G. and Y.Z. (Yanzeng Zhao); software, J.T.; validation, Y.Z. (Yanzeng Zhao), L.C. and R.J.; formal analysis, Y.Z. (Yanzeng Zhao) and Y.W.; investigation, R.J.; resources, Y.Z. (Yizhi Zhou); data curation, W.G.; writing—original draft preparation, Y.Z. (Yanzeng Zhao), Z.L., Y.W. and L.C.; writing—review and editing, Y.Z. (Yanzeng Zhao), Z.L. and L.W.; visualization, W.G.; supervision, L.W. and Z.L.; project administration, L.W. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Data Availability Statement:** Out of respect for individual and organisational privacy, the full dataset are unable to be provided.

**Acknowledgments:** The authors would like to thank the administrators of all selected airlines who helped to obtain written informed consent from the subjects and to distribute the questionnaires to the subjects. We also thank all the civil aviation pilots who voluntarily participated in this study.

**Conflicts of Interest:** The authors completed the ICMJE Unified Competing Interest Form (available upon request from the corresponding author) and declare no conflict of interest.

## References

1. Feijó, D.; Câmara, V.M.; Luiz, R.R. Psychosocial aspects of work and common mental disorders among civil aviation pilots. *Cad. Saúde Pública* **2014**, *30*, 2433–2442. [[CrossRef](#)] [[PubMed](#)]
2. Andrew, D.; Barry, D.; Vidya, S.; Tracy, H.; Jack, N.; Stone, P.H. Comparison of myocardial ischemia during intense mental stress using flight simulation in airline pilots with coronary artery disease to that produced with conventional mental and treadmill exercise stress testing. *Am. J. Cardiol.* **2011**, *108*, 651–657.
3. Girodo, M. The psychological health and stress of pilots in a labor dispute. *Aviat. Space Environ. Med.* **1988**, *59*, 505–510. [[PubMed](#)]
4. The Job Network. The Most Stressful Jobs of 2016. Available online: <https://www.thejobnetwork.com/2016s-top-10-most-stressful-jobs> (accessed on 25 October 2022).

5. Cooper, C.L.; Marshall, J. Occupational sources of stress: A review of the literature relating to coronary heart disease and mental ill health. *J. Occup. Psychol.* **1976**, *49*, 11–28. [[CrossRef](#)]
6. Parker, D.F.; Decotiis, T.A. Organizational determinants of job stress. *Organ. Behave. Hum. Perform.* **1983**, *32*, 160–177. [[CrossRef](#)]
7. Tyson, P.D.; Rana, P.; Bela, A. Coping with organizational stress among hospital nurses in southern ontario. *Int. J. Nurs. Stud.* **2002**, *39*, 453–459. [[CrossRef](#)]
8. Welle, P.D.; Graf, H.M. Effective Lifestyle Habits and Coping Strategies for Stress Tolerance Among College Students. *Am. J. Health Educ.* **2011**, *42*, 105–196. [[CrossRef](#)]
9. Maiorano, T.; Vagni, M.; Giostra, V.; Pajardi, D. COVID-19: Risk Factors and Protective Role of Resilience and Coping Strategies for Emergency Stress and Secondary Trauma in Medical Staff and Emergency Workers—An Online-Based Inquiry. *Sustainability* **2020**, *12*, 9004. [[CrossRef](#)]
10. Williams, S.; Cooper, L. *Managing Workplace Stress: A Best Practice Blueprint*, 1st ed.; John Wiley&Son LTD: Hoboken, NJ, USA, 2002.
11. Sullivan, S.E.; Bhagat, R.S. Organizational stress, job satisfaction and job performance: Where do we go from here? *J. Manag.* **1992**, *18*, 3535–3574. [[CrossRef](#)]
12. Cooper, C.L.; Sloan, S. Occupational and psychosocial stress among commercial aviation pilots. *J. Occup. Med.* **1985**, *27*, 570–576. [[CrossRef](#)]
13. Elena, F.; Ines, G.; Cinzia, S.; Piergiorgio, A. Work engagement and occupational stress in nurses and other healthcare workers: The role of organisational and personal factors. *J. Clin. Nurs.* **2013**, *22*, 2614–2624.
14. Sun, W.; Wu, H.; Wang, L. Occupational stress and its related factors among university teachers in China. *J. Occup. Health* **2011**, *53*, 280–286. [[CrossRef](#)] [[PubMed](#)]
15. Travers, C.J.; Cooper, C.L. Mental health, job satisfaction and occupational stress among UK teachers. *Work Stress* **1993**, *7*, 203–219. [[CrossRef](#)]
16. Voltmer, E.; Rosta, J.; Siegrist, J.; Aasland, O.G. Job stress and job satisfaction of physicians in private practice: Comparison of German and Norwegian physicians. *Int. Arch. Occup. Environ. Health* **2012**, *85*, 819–828. [[CrossRef](#)] [[PubMed](#)]
17. Garbarino, S.; Magnavita, N.; Chiorri, C.; Brisinda, D.; Cuomo, G.; Venuti, A.; Fenici, R. Evaluation of operational stress in riot and crowd control police units: A global challenge for prevention and management of police task-related stress. *J. Police Crim. Psychol.* **2012**, *27*, 111–122. [[CrossRef](#)]
18. Yu, F.; Li, X.; Yang, J. Investigation of pilots' mental health and analysis of influencing factors in China: Based on structural equation model. *BMC Public Health* **2022**, *22*, 1352. [[CrossRef](#)]
19. Xu, Q.; Wu, Y.; Ji, M.; Wang, M.; Pan, C.; Ma, J.; You, X. Proactive Coping and Mental Health Among Airline Pilots During China's Regular Prevention and Control of COVID-19: The Role of Perceived Stress and Social Support. *Front. Public Health* **2022**, *10*, 890145. [[CrossRef](#)] [[PubMed](#)]
20. Galderisi, S.; Heinz, A.; Kastrup, M.; Beezhold, J.; Sartorius, N. Toward a new definition of mental health. *World Psychiatry* **2015**, *14*, 231–233. [[CrossRef](#)]
21. He, Z.; He, Y. A Review of Research on Civil Aviation Pilots' Safety Mental Health Based on Personality Traits. In Proceedings of the 2021 IEEE 3rd International Conference on Civil Aviation Safety and Information Technology (ICCASIT), Changsha, China, 20–22 October 2021; pp. 1280–1282.
22. Mulder, S.; de Rooy, D. Pilot Mental Health, Negative Life Events, and Improving Safety with Peer Support and a Just Culture. *Aerosp. Med. Hum. Perform.* **2018**, *89*, 41–51. [[CrossRef](#)]
23. Thompson, J. Stress theory and therapeutic practice. *Stress Med.* **1992**, *8*, 147–150. [[CrossRef](#)]
24. Achnak, S.; Griep, Y.; Vantilborgh, T. I Am So Tired... How Fatigue May Exacerbate Stress Reactions to Psychological Contract Breach. *Front. Psychol.* **2018**, *9*, 231. [[CrossRef](#)] [[PubMed](#)]
25. Zeng, H.; Zhao, L.; Ruan, S. How Does Mentoring Affect Protégés' Adaptive Performance in the Workplace: Roles of Thriving at Work and Promotion Focus. *Front. Psychol.* **2020**, *11*, 546152. [[CrossRef](#)] [[PubMed](#)]
26. Littlepage, G.E.; Hollingshead, A.B.; Drake, L.R.; Littlepage, A.M. Transactive Memory and Performance in Work Groups: Specificity, Communication, Ability Differences, and Work Allocation. *Group Dyn. Theory Res. Pract.* **2008**, *12*, 223–241. [[CrossRef](#)]
27. Raschmann, J.K.; Patterson, J.C.; Schofield, G. A retrospective study of marital discord in pilots: The USAFSAM experience. *Aviat. Space Environ. Med.* **1990**, *61*, 1145–1148. [[PubMed](#)]
28. Ahmadi, K.B.; Alireza, K. Stress and Job Satisfaction among Air Force Military Pilots. *J. Soc. Sci.* **2007**, *3*, 159–163. [[CrossRef](#)]
29. Fu, J.; Sun, W.; Wang, Y.; Yang, X.; Wang, L. Improving job satisfaction of Chinese doctors: The positive effects of perceived organizational support and psychological capital. *Public Health* **2013**, *127*, 946–951. [[CrossRef](#)] [[PubMed](#)]
30. Tourigny, L.; Baba, V.V.; Wang, X. Stress episode in aviation: The case of China. *Int. J. Cross Cult. Manag.* **2010**, *17*, 62–78. [[CrossRef](#)]
31. Lazarus, R.S.; Folkman, S. *Stress, Appraisal, and Coping*, 1st ed.; Springer Pub Co.: New York, NY, USA, 1984.
32. Junmin, J. Correlation Analysis about job stress of operating room nurse and coping style. *Hebei J. Tradit. Chin. Med.* **2011**, *33*, 1238–1239.
33. Felsten, G.; Wilcox, K. Influences of stress and situation-specific mastery beliefs and satisfaction with social support on well-being and academic performance. *Psychol. Rep.* **1992**, *70*, 291–303. [[CrossRef](#)]
34. Kass, F.; Charles, E.; Klein, D.F.; Cohen, P. Discordance between the SCL-90 and therapists' psychopathology ratings. *Arch. Gen. Psychiatry* **1983**, *40*, 389. [[CrossRef](#)]

35. Derogatis, L.R.; Rickels, K.; Rock, A.F. The SCL-90 and the MMPI: A step in the validation of a new self-report scale. *Br. J. Psychiatry* **1976**, *128*, 280–289. [[CrossRef](#)] [[PubMed](#)]
36. Cooper, C.L.; Sloan, S. Job and Family Stress as Predictors of Pilot Health, Job Satisfaction and Performance. University of manchester inst of science and technology (england) dept of management sciences. *Job Fam. Stress Predict. Pilot Health Job Satisf. Perform.* **1984**, 243.
37. Weiss, D.J.; Dawis, R.V.; England, G.W. Manual for the Minnesota satisfaction question. *Minn. Stud. Vocat. Rehabil.* **1967**, *22*, 120.
38. Sharp, T.P. Job satisfaction among psychiatric registered nurses in New England. *J. Psychiatr. Ment. Health Nurs.* **2008**, *15*, 374–378. [[CrossRef](#)] [[PubMed](#)]
39. Yaning, X. Reliability and validity of the simplified coping style questionnaire. *Chin. J. Clin. Psychol.* **1998**, *6*, 114–115.
40. Kemp, F. Applied multiple regression/correlation analysis for the behavioral sciences. *J. R. Statist. Soc.* **1975**, *52*, 227–229. [[CrossRef](#)]
41. Cooper, C.L. *Managerial, Occupational and Organizational Stress Research*; Routledge: London, UK, 2001.
42. Barling, J.; Kelloway, E.K.; Frone, M.R. *Handbook of Work Stress*; Sage Publications Inc.: Thousand Oaks, CA, USA, 2005.
43. Gushulak, C.A.; Bodmer, P.; Carvalho, C.R.; Gladstone-Gallagher, R.V.; Lee, Y.P.; Lowman, H.E.; Oguguah, N.M.; Meinikmann, K.; Rii, Y.M.; Rodríguez-Cardona, B.M.; et al. The Silent Mental Health and Well-Being Crisis of Early Career Researchers in Aquatic Sciences. *Limnol. Oceanogr. Bull.* **2023**, *32*, 16–17. [[CrossRef](#)]
44. Scotter, J.R.; Motowidlo, S.J. Interpersonal facilitation and job dedication as separate facets of contextual performance. *J. Appl. Psychol.* **1996**, *81*, 525–531. [[CrossRef](#)]
45. Allen, R.D.; Hitt, M.A.; Greer, C.R. Occupational stress and perceived organizational effectiveness in formal groups: An examination of stress level and stress type. *Person. Psychol.* **1982**, *35*, 359–370. [[CrossRef](#)]
46. Lam, T.; Zhang, H.; Baum, T. An investigation of employees' job satisfaction: The case of hotels in Hong Kong. *Tour. Manag.* **2001**, *22*, 57–165. [[CrossRef](#)]
47. Carbone, E.G.; Cigrang, J.A. Job satisfaction, occupational stress, and personality characteristics of air force military training instructors. *Mil. Med.* **2001**, *166*, 800–802. [[CrossRef](#)] [[PubMed](#)]
48. Aldwin, C.M. *Stress, Coping, and Development: An Integrative Perspective*, 2nd ed.; Guilford Press: New York, NY, USA, 2009.
49. Kuznetsova, A.S.; Gushchin, M.V.; Titova, M.A. Work stress and proactive coping strategies in hospital nurses during the first wave of COVID-19 pandemic. *Mosc. Univ. Psychol. Bull.* **2021**, *2*, 199–236. [[CrossRef](#)]
50. Setor, T.K. The effect of job stress on job performance amongst IT professionals: The moderating role of proactive work behaviours. In Proceedings of the SIGSIM-CPR'14, Singapore, 29–31 May 2014.
51. Xiao-me, R. Analysis investigation on Status Quo and influencing factors of Stress Coping Styles among Secondary Nursing Students. *J. Nongken Med.* **2015**, *37*, 231–233.
52. Li, J.; Wang, T.; Wang, J. Research on the Relationship between College Students' Psychological Resilience and Coping Style under the Perspective of Positive Psychology. In Proceedings of the 2019 4th International Conference on Modern Management, Education Technology and Social Science (MMETSS 2019), Dalian, China, 20–22 September 2019.
53. Chen, L.; Qu, L. From Stressful Experiences to Depression in Chinese Migrant Children: The Roles of Stress Mindset and Coping. *Front. Psychol.* **2021**, *12*, 601732. [[CrossRef](#)] [[PubMed](#)]
54. Ho, H.C.; Yeung, D.Y. Effects of occupational future time perspective on managing stressful work situations. *Int. J. Psychol.* **2016**, *51*, 261–268. [[CrossRef](#)]

**Disclaimer/Publisher's Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.