Burnout in the Skies: An Exploratory Study of Pilot Profiles and Related Psychosocial Variables

Esther Cuadrado[1,2,3], Mohamed Yousuf Alnuaimi[2], María Marí-Núñez[2],
Miguel A. Maldonado[1,2,3], José F. Jurado-Del-Pozo[2,4], and Manuel Moyano[1,2,3]

[1] Maimonides Biomedical Research Institute of Cordoba (IMIBIC), Cordoba, Spain.
[2] Department of Psychology, University of Cordoba, Spain.
[3] Reina Sofia University Hospital, Cordoba, Spain.
[4] Guardia Civil, Cordoba, Spain.

Título: El burnout en el cielo: un estudio exploratorio de los perfiles de los pilotos y variables psicosociales relacionadas.

Resumen: El agotamiento es una preocupación en cualquier profesión, pero es especialmente frecuente en trabajos físicamente exigentes y de alta responsabilidad, como la aviación. Tomando como marco las teorías multidimensionales que identifican tres elementos de burnout (agotamiento emocional, cinismo y disminución de la eficacia profesional), y considerando estudios previos que sugieren que las personas que sufren burnout no forman un grupo homogéneo, este trabajo tiene como objetivo identificar perfiles que reflejen subtipos de burnout en los pilotos, y comprender cómo difieren en función de ciertas variables de interés. A través de un estudio transversal con muestreo no probabilístico, 164 pilotos de avión (edad media = 39.31, *DT* = 10.4; 92.1% hombres) respondieron a un cuestionario. El análisis de conglomerados en dos etapas arrojó tres perfiles de pilotos: los comprometidos, los ineficaces y los que experimentan agotamiento. El análisis comparativo por grupos mostró que a) un mayor porcentaje de mujeres pilotos se ajustó al perfil de burnout en comparación con los hombres, b), se produjo una relación curvilínea entre la edad, el agotamiento y los perfiles comprometidos, de modo que los pilotos de mediana edad asumieron con mayor frecuencia el perfil de agotamiento y los pilotos mayores el perfil comprometido, y c), los niveles más altos de resiliencia, positividad y seguridad, y menos estrés y menos accidentes laborales explicaron el perfil comprometido con más frecuencia que el perfil de agotamiento. Además, no se encontraron diferencias entre el perfil ineficaz y el perfil de burnout en los niveles de resiliencia, positividad, seguridad o el número de accidentes laborales. Estos hallazgos revelan la necesidad de prestar atención no solo a los pilotos que se ajustan al perfil de burnout, sino también a aquellos que coinciden con el perfil ineficaz.

Palabras clave: Burnout. Pilotos. Perfiles. Análisis de conglomerados.

Abstract: Burnout is a concern in any profession but is especially prevalent in physically demanding and highly responsible jobs such as aviation. Taking as a framework the multidimensional theories that identify three elements of burnout (emotional exhaustion, cynicism, and reduced professional efficacy), and considering previous studies that suggests people who suffer from burnout do not form a homogeneous group, this work aims to identify profiles that reflect burnout subtypes in pilots, and to understand how they differ based on certain variables of interest. Through a cross-sectional study with non-probability snowball sampling, 164 airplane pilots (mean age = 39.31, *SD* = 10.4; 92.1% men) answered a questionnaire. The two-stage cluster analysis produced three profiles of pilots: the committed, the ineffective, and those who experience burnout. Comparison analysis by groups showed that a), a higher percentage of female pilots conformed to the burnout profile compared to men, b), a curvilinear relationship occurred between age, burnout, and committed profiles such that middle-aged pilots more frequently assumed the burnout profile and older pilots the compromised profile, and c), higher levels of resilience, positivity and security, and less stress and fewer work accidents accounted for the compromised profile more often than the burnout profile. In addition, no differences were found between the ineffective profile and the burnout profile in the levels of resilience, positivity, safety, or the number of accidents at work. These findings reveal the need to pay attention not only to pilots who fit the burnout profile, but also to those matching the ineffective profile.

Keywords: Burnout. Pilots. Profiles. Cluster analysis.

Introduction

Society is changing at breakneck speed, largely due to scientific advances and the prevailing economic system. The drive for productivity at the lowest possible cost, combined with socio-labor variables such as precarious conditions, less autonomy, diffuse work roles and objectives, work overload, and/or increased emotional demands, increases tensions among employees, which exacerbates vulnerability to stress and professional burnout (Rodríguez-Carvajal and Rivas-Hermosilla, 2011). Considering these developments, burnout must be considered an emerging psychosocial threat (Montero-Marín et al., 2016).

* **Correspondence address [Dirección para correspondencia]:**
Esther Cuadrado. Department of Psychology, University of Cordoba, C. San Alberto Magno, s/n, 14071 Córdoba, Spain.
E-mail: esther.cuadrado@uco.es

Similar to air traffic controller, firefighter, police officer, and nuclear plant operator, airline pilot is considered a risky profession (Butcher et al., 2018) due to the high impact these employees' actions and decisions have on the safety of passengers and crew members, the aircraft and its cargo, and of course, oneself (Holford, 2022). These stressors have compounded in recent years, as increased competition among airlines has degraded working conditions (Demerouti et al., 2019) and reduced job satisfaction and involvement and organizational commitment of workers (Geisler et al., 2019).

Airline pilots must meet multiple demands during journeys. Among them: piloting and coping with decisive phases of the flight (mainly take-off and landing), handling complex on-board control systems, collaborating with air traffic controllers and crew, and adapting to unfavorable environmental conditions and emergency situations as needed (Demerouti et al., 2019). This combined with flight duration, jetlag, rotating shifts characteristic of the workday, and being away from family and friends for extended periods, can promote mental

fatigue and professional attrition (Özel and Hacıoğlu, 2021), and accentuate job exhaustion.

Examples include the highly competitive environment where commercial aircraft operate (Demerouti et al., 2019), or flying near armed conflict zones where pilots must face stressful situations and make complex decisions. On many occasions, when these situations are prolonged over time, they can end up generating burnout syndrome (Özel and Hacıoğlu, 2021).

Burnout as a construct: development and definition

The phenomenon of being "burned out" by work was first described by the author Graham Greene (1960) in his 1960 novel, "A Burnt-Out Case," starring an eminent architect who lost pleasure in his profession and life itself. Years later, the psychologist Freudenberger described burnout as the frustration, fatigue, and exhaustion produced by a professional activity that does not generate the expected expectations. In 1986, Maslach and Jackson (1986) proposed a definition of burnout that is widely used today. They called it a psychological syndrome of multifactorial origin consisting of three dimensions: emotional exhaustion, depersonalization or cynicism, and lack of professional realization or effectiveness (Edú-Valsania et al., 2022).

Emotional exhaustion refers to a lack of energy and emotional resources, leading to fatigue and increased sensitivity to stressors that make it difficult to perform professional tasks (Čigarská and Birknerová, 2021). Cynicism is defined as the interpersonal distancing from customers or other colleagues, which results in decreased empathy and negative attitudes toward them (Čigarská and Birknerová, 2021). Low self-realization occurs when an employee evaluates their job performance negatively, experiences feelings of incompetence, or perceives a lack of achievement or productivity, often resulting in the inability to cope with job requirements (Mengenci, 2014).

To increase the visibility and legitimize a common pathological condition, the WHO (World Health Organization, 2019) has included burnout in its International Statistical Classification of Diseases (ICD-11). The term is placed in the category "Problems associated with employment or unemployment," and is referred to as occupational burnout syndrome. It is conceptualized as a phenomenon exclusive to the work context and includes symptoms derived from exposure to chronic stress and the inability to manage it successfully. The three elements that characterize the WHO's definition of burnout are lack of energy (exhaustion), increased mental distance and negative feelings toward work (depersonalization or cynicism) and a sense of ineffectiveness (lack of self-realization).

Burnout in aviation pilots

Burnout can develop in all work environments, although the prevalence varies according and within the profession.

For instance, in a sample of 248 pilots working for American companies, Fanjoy et al. (2010) found that 32.6% presented a high level of burnout. Similar results were obtained by Demerouti et al. (2019), who found that in a sample of 1,147 pilots of European pilots' professional association, 40% presented a high level of exhaustion (according to the normal scores of active populations) and 20% presented clinical symptoms of burnout. However, Rosado-Tapia and Almanza-Muñoz (2011) found that only 6.4% of Mexican military pilots presented with burnout. These data suggest burnout prevalence varies according to the aviation context.

In work environments such as aviation, where potentially life-threatening situations can occur, it is essential to have a team of professionals who are in optimal health (Kumari and Aithal, 2020; Li et al., 2020). But burnout can threaten the physical and psychological state of pilots, generating a negative impact on their performance, flight safety, and individual well-being (Li et al., 2020). For these reasons, understanding the phenomenon of burnout and its related variables and profiles, and exploring and implementing effective programs to reduce or prevent burnout in pilots, is a priority for the aviation sector (Li et al., 2020).

Burnout subtypes

Traditionally, people with burnout have been conceptualized as a homogeneous group (Potard and Landais, 2021). However, there is an increasing emphasis within the literature on identifying different variants or profiles of burnout, as has been proposed in teachers (Martínez et al., 2020; Buonomo et al., 2017), psychologists (Berjot, et al., 2017), healthcare workers (Gillet et al., 2021; Potard and Landais, 2021), and risky professions such as professional firefighters or air traffic controllers (Makara-Studzińska et al., 2022), among others. Employing a person-centered approach and attending to the scores obtained in the three dimensions of burnout can increase understanding of the pathological picture and provide practical utility for its intervention.

By applying cluster analysis, it is possible to identify between three (Martinez et al., 2020) and five different profiles based on burnout factors (Gillet et al., 2021). Berjot et al. (2017), for example, detected four distinct profiles: "high burnout risk," "burnout risk due to high exhaustion," "burnout risk due to low self-realization" and "absent burnout." Potard and Landais (2021), meanwhile, identified five profiles: overextended (referring to employees with high exhaustion, medium self-realization and relatively low cynicism), committed (present in staff with low exhaustion and cynicism, but high self-realization), dis-committed (workers with high self-realization, moderate cynicism, and low exhaustion), ineffective (referring to employees with low scores on all three dimensions of burnout) and burnout (characterized by high exhaustion and depersonalization, but low self-realization).

Therefore, taking multidimensional theories as a framework, we investigate possible burnout profiles present in the

airline pilot population to try and detect pilots who are at higher risk of burnout.

Variables related to burnout

Fanjoy et al. (2010) found that pilots younger than 50 have elevated burnout levels compared to older pilots. In general, inverse relationships have been found between age and burnout, although the results are not consistent (Demerouti et al., 2019). Similarly, past studies have found inconsistencies on burnout differences between men and women (Purvanova and Muros, 2010), and dimension scores vary by sex (Demerouti et al., 2019; Purvanova and Muros, 2010). In a meta-analysis, Puranova and Muros (2010) found that women tend to experience slightly higher levels of emotional exhaustion, while men tend to suffer slightly higher levels of depersonalization. Similar research has found that women tend to experience greater levels of inefficacy, while men tend to present more negative attitudes toward work (Demerouti et al., 2019).

Differences in burnout levels have also been found among employees in the same profession according to work context; McCormack et al. (2018) reported that workers in the private sector experience less burnout than those in the public sector. It is likely that differences in work-related variables are transferred to contexts such as military and civilian, given the differential characteristics of both (Blais et al., 2020). In this sense, Blais et al. (2020) found above-average levels of work fatigue in a sample of military personnel, a result they attribute to the constant exposure to stressful situations of military personnel.

The mitigating effect of resilience is another variable that has been related to burnout (Shoss et al., 2018). In this regard, several studies have shown the protective role of resilience in different work settings (Kutluturkan et al., 2016; Taku, 2014; West et al. 2020). Cherng et al. (2022) found positive relationships between resilience, psychological well-being, and job performance in a sample of civilian pilots from China. Liu et al. (2016), meanwhile, demonstrated how dispositional resilience prevents burnout in pilots. Thus, it seems likely that there are significant differences between burnout profiles of pilots, with higher levels of resilience associated with lower burnout risk.

Resilience and positivity traits have also been connected to lower burnout risk (De la Fuente et al., 2021), and the negative relationship between positivity and burnout could be direct, as shown by Sestili et al. (2018). However, recent research conducted with Polish police officers and firefighters (Basińska and Gruszczyńska, 2017) reveals the existence of a "U" shaped curvilinear relationship between positivity and burnout. In such a case, positivity would only act as a protective factor up to certain levels. Once these are exceeded, it could enhance burnout (Basińska and Gruszczyńska, 2017).

Another variable intrinsically related to burnout is stress. In fact, burnout has been defined as a reaction resulting from chronic exposure to stressors at work (Maslach, 1998). Stressful working conditions are common in the aviation sector (Ozturk, 2020), and in the case of pilots, have been linked to sleep problems and fatigue that can lead to burnout (Venus et al., 2022). Mengenci (2014) found a positive association between stress and burnout dimensions (exhaustion, depersonalization, and low self-realization) among pilots from different Turkish airlines. Therefore, it seems logical to find differences in the stress levels of different pilot burnout profiles, so that more "burned out" profiles show higher levels of stress.

Also, burnout has been shown to be negatively related to the performance of safety behaviors and the execution of safe work practices (Smith et al., 2020; Zhang and Zhang, 2022). In the aviation field, burnout is one of the psychological factors that influences the execution of unsafe behaviors by personnel (Zhang and Zhang, 2022). In turn, employees' perception of job security is positively related to safety behaviors and negatively related to job stress (Hayes et al., 1998), so similar results could be inferred for burnout. Hayes et al. (1998) evidenced that supervisor and peer safety was strongly associated with employees' compliance with safety behaviors. Likewise, Fanjoy et al. (2010) reported a significant relationship between pilot burnout and perceived management pressure to continue flying under questionable safety conditions (short rest periods), with equipment problems, or in severe weather conditions. Based on these references, it is reasonable to assume that pilot profiles with higher burnout levels coincide with pilots who perceive higher levels of job insecurity and lower levels of participation in safe work practices by coworkers and superiors.

Similarly, Yang et al. (2021) found that variables related to safety compliance and safety participation by workers are negatively associated with occupational accidents, with burnout acting as an indispensable moderator in this relationship. When fatigue and symptoms derived from burnout are experienced, performance and responsiveness decrease (Brezonakova, 2017). This poses a potential threat, especially in safety-critical environments such as aviation because it can lead to serious accidents (Brezonakova, 2017). Although accidents caused by aircraft failures have been significantly reduced over the last decades (Li et al., 2021), 75% of aircraft accidents and incidents worldwide are caused by human error (Kharoufah et al., 2018). Given this, the relationship between burnout levels and accident prevalence has been widely documented in the scientific literature, with burnout having been shown to pose a risk for the occurrence of occupational accidents both in general (Kotti et al., 2017) and in the field of transportation (Chung and Wu, 2013; Useche et al., 2017), especially aviation (Mengenci, 2014).

Present study: objectives and hypotheses

An in-depth understanding of the burnout phenomenon in airline pilots is of vital importance due to the critical role these professionals play in the field of safety. The present re-

search has two objectives. First, taking as a basis the theories that conceive burnout not as a unitary construct but as heterogeneous, with individuals categorized according to different burnout profiles (Berjot et al., 2017; Gillet et al., 2021; Martínez et al., 2020; Potard and Landais, 2021), the main objective is to identify possible burnout profiles in airline pilots. In this sense, according to Potard and Landais (2021) we hypothesize (H) according to which *burnout* has a multiple cluster structure and not a unitary one, being possible to identify profiles reflecting *burnout* subtypes in airline pilots, which will also differ in the three main dimensions of *burnout* (H1).

Second, we intend to explore the sociodemographic and psychosocial differences between the selected profiles. Based on our literature review, which found significant differences in sociodemographic variables such as gender, age, and different work contexts, we expect to find that specific *burnout* profiles present differences in these variables (H2), so that women (H2a), younger people (H2b), and military pilots (H2c) predominate in the profiles corresponding to higher levels of burnout. Furthermore, in light of the literature reviewed, which reveals that positivity, resilience, and perceived safety are related to lower levels of burnout, while stress and number of occupational accidents are related to higher levels of burnout, we hypothesize (H3 and H4) that pilot burnout profiles associated with higher burnout levels show lower levels of resilience (H3a), positivity (H3b), and perceived safety (H3c), but higher levels of stress (H4a), and more work accidents (H4b).

Method

An anonymous *online* self-reported survey in English was constructed to study *burnout* in pilots from different countries and different aviation contexts, including military, commercial, and civilian. Survey participants were recruited through emails to pilot agencies, associations, and other entities. Data collection was conducted during July and August 2022. A brief description of the study was attached at the beginning of each survey, and before the questionnaire could be completed, participants were required to accept informed consent. All participants completed the questionnaires in the same order and without remuneration.

This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Research Ethics Committee of Córdoba (Spain) through reference number ECBURNOUT.

Inclusion criteria consisted of being an aviation pilot of legal age and with spoken English. Exclusion criteria included retirees and pilots not in active service at the time of data collection.

Participants

A total of 164 aviation pilots participated in the study with a mean age of 39.31 years (SD = 10.40; range = [18, 62]) of which 7.9% (N = 13) were female and 92.1% (N = 151) were male. Ninety-eight military pilots (59.8%), 31 commercial pilots (18.9%), and 35 civilian pilots (21.3%) participated. The mean number of years spent as a pilot was 17.14 (SD = 10.57) within a range of 0-41 years and its median was 17. The participants were mostly from the United Arab Emirates (78%, N = 128). Of the remaining participants, 11.5% (N = 19) were from Asia, 7.2% (N = 12) from Europe, and 2.4% (N = 4) from North America. Also, 0.6% (N = 1) of the participants did not provide an answer to location. Regarding the level of education prior to certification to fly, 4 (2.4%) had primary education, 9 (5.5%) had secondary education, 100 (61%) had a university degree, 48 (29.3%) had a postgraduate degree, and 3 had a doctorate (1.8%). All participants received specific and common training required to practice the profession. In addition, most were married or in a domestic partnership (71.3%, N = 117), 23.8% (N = 39) were single, and 4.9% (N = 8) were divorced.

Measures

At the beginning of the questionnaire, the participants answered sociodemographic questions regarding their age, sex, country of residence, educational level, professional context/field, number of years dedicated to the profession, and marital status. The remaining questions corresponded to psychosocial variables and were formulated in Likert-type format according to frequency and following a scale from 0 (never) to 6 (always).

Burnout

The three dimensions of burnout were assessed using the Spanish version of the Maslach Burnout Inventory-General Survey (MBI-GS; Schaufeli et al., 1996; Gil-Monte, 2002) on a Likert scale from 0 to 6. The reliability of each of the three factors was adequate ($\alpha_{\text{emotional exhaustion}}$ = .89; $\alpha_{\text{realization}}$ = .96; α_{cynicism} = .87).

Resilience

The extent to which individuals had a functioning style characterized by high dispositional resilience was assessed using Bartone's (2007) Dispositional Resilience Scale 15 (DRS-15) on a 7-point Likert scale. The reliability of the scale was adequate (α = .78).

Positivity

Participants' willingness to view life in a positive way was assessed using the Positivity Scale by Caprara et al. (2012) on a 7-point Likert scale. The reliability of the scale was adequate (α = .89).

Safety at work

Safety in the workplace was measured with an abbreviated version of the Work Safety Scale (WSS) of Hayes et al. (1998). Three items were used for the perceived job safety dimension (e.g., "The work I do is risky"), three items for the coworker safety dimension (e.g., "Co-workers follow safety rules"), four items for the supervisor safety dimension (e.g., "Supervisors promote job safety"), and five items for the safety from management dimension (e.g., "Management promptly repairs damaged equipment"). Both the reliability of the scale (α = .91) and each of the four factors were adequate, ranging from .79 to .96.

Stress

To measure stress experienced by participants in the previous 15 days, the Perceived Stress Questionnaire of Levenstein et al. (1993) was adapted and abbreviated for the objectives of the study. The final scale used in the study consists of four items ("I have had trouble relaxing," "I have been irritable," "I have been tense," and "I have been stressed") and shows adequate reliability (α = .93). Factor analysis with promax rotation and maximum likelihood method showed that the four items are grouped into a single factor that explains 72.57% of the variance.

Accidents

Following the format of Wallace and Chen (2005), participants were asked how many accidents they caused in the previous three years. To operationalize the concept of accident, the definition provided by the Civil Aviation Accident and Incident Investigation Commission of the Ministry of Transport, Mobility, and Urban Agenda (Comisión de Investigación de Accidentes e Incidentes de Aviación Civil del Ministerio de Transportes, Movilidad y Agenda Urbana, n.d.) was used. Again, using Wallace and Chen (2005), a square root transformation was performed to normalize the data.

Data analysis

A two-stage cluster analysis was performed to identify different burnout profiles based on the three dimensions of the construct (Schaufeli et al., 1996). For this purpose, the Z-scores of the three dimensions were selected as the clustering variables and a two-step analytical process was initiated. This allowed for the identification of clusters without having to preselect the number of clusters. The log-likelihood criterion was used to establish the distance measure and the optimal number of clusters was determined according to the Bayesian information criterion (BIC). The maximum number of clusters requested was kept at 15, which is the SPSS default value. Outlier treatment (25%) was also selected to ensure the best possible fit between cases. In addition, the validity of the solution provided by the cluster analysis was checked by analyzing whether the silhouette coefficient (range = -1.00 to 1.00) was $\geq$ .05 (Carbone et al., 2019). Next, to determine the extent to which the three profiles differed as a function of sociodemographic and psychosocial variables, one-factor Anova analyses (with post-hoc analysis using Bonferroni's test) or χ^2 analyses were performed depending on whether the variables were continuous or categorical, respectively. To analyze possible age differences, a categorical variable of age was created with three groups: those under 35 (N = 60), those aged between 36 and 45 (N = 54), and those over 45 (N = 50).

Results

Before testing the study hypotheses, basic descriptive statistical analyses of burnout symptoms were performed. Since no previous studies have established relevant scores on the MBI-GS scale (Schaufeli et al., 1996) for burnout profiles, we determined cut-off points by calculating the mean +/- one standard deviation. In our sample of pilots, we found moderate levels of exhaustion were between 1.70 and 3.58, moderate levels of realization were between 2.23 and 5.77, and moderate levels of cynicism were between 0.21 and 3.07. Following this categorization, Figure 1 shows the percentage of pilots with low, medium, and high levels of each of the three burnout symptoms. The majority of the pilot sample (59.1%) had a low level of risk of developing burnout (none of the three dimensions were at a high level), 28% had a moderate level of risk (one of the three dimensions was high), 10.4% had a high level of risk (two of the three dimensions was high) and 2.4% had a very high level of risk (high levels in all three dimensions).

Figure 1
Percentage of pilots in the study with low, medium, and high levels of each of the three dimensions of burnout
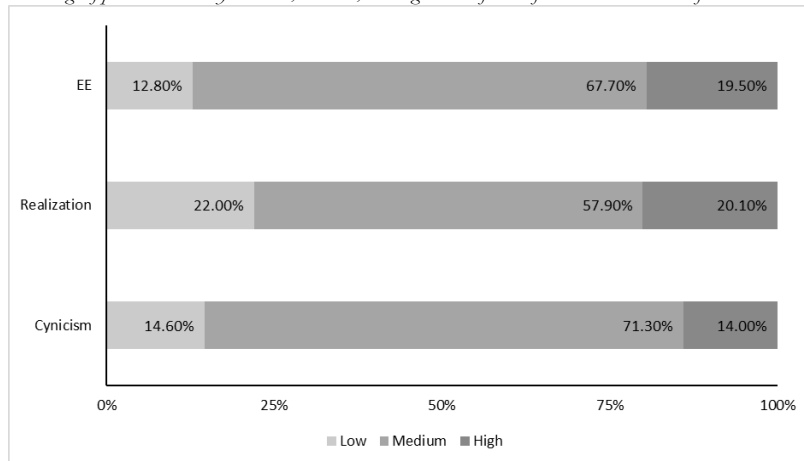

Cluster analysis

Firstly, a hierarchical cluster analysis was performed with Ward's method. As can be observed in the dendrogram (Supplementary Figure 1), the results seem compatible with a 3-profile model.

Congruently with the results of the hierarchical cluster analysis, the two-stage cluster analysis resulted in three distinct groups or profiles (BIC = 251,630, ratio size = 1.804).

The average silhouette coefficient was .60, evidencing good cluster quality (Carbone et al., 2019). The significance of each predictor for cluster formation was 1.00 for exhaustion, .92 for realization/efficacy, and -0.60 for cynicism. Figure 2 shows the three burnout profiles obtained in the cluster analysis based on the standardized values. Each profile represents a specific group of pilots according to their levels in the three burnout dimensions.

Figure 2
Graphical representation of the three profiles derived from the Two-step cluster analysis, showing the Z scores in each of the three factors of the MBI-GS scale
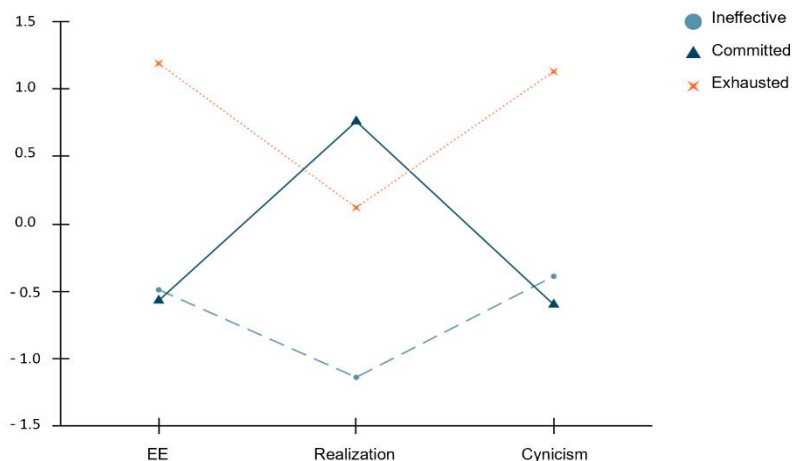
Note. EE = Emotional exhaustion

Based on the mean scores in each cluster and taking as a reference the typologies developed by Leiter and Maslach (2016) and Lee et al. (2010), cluster 1 ($N = 48$, 29.3%) was termed ineffective for its low scores on each of the three burnout dimensions (exhaustion: $M = -0.49$, $SD = 0.44$; efficacy: $M = -1.14$, $SD = 0.52$; cynicism: $M = -0.39$, $SD = 0.48$); cluster 2 was termed committed ($N = 65$, 39.6%) for its low scores on both emotional exhaustion and cynicism and high on efficacy (exhaustion: $M = -0.57$, $SD = 0.54$; efficacy: $M = 0.75$, $SD = 0.36$; cynicism: $M = -0.60$, $DT = 0.44$); and cluster 3 was labeled burnout ($N = 51$, 31.1%) for its high scores in both exhaustion and cynicism and low in efficacy (exhaustion: $M = 1.19$, $SD = 0.79$; efficacy: $M = 0.12$, $SD = 0.93$; cynicism: $M = 1.13$, $SD = 0.94$).

To increase the robustness of the obtained results, we also performed a K-means cluster analysis and a discriminant

analysis. When performing the K-means cluster analysis by entering 3 clusters, the results of the final cluster centers where very similar to the results performed with the two-stage cluster analysis (Supplementary Figure 2). Cluster 1 corresponded to the ineffective profile, cluster 2 to the exhausted profile and cluster 3 to the committed profile.

When preforming the discriminant analysis by including all the items of the burnout scale as independent variables and cluster belonging as the grouping variable, the results show that the coincidence by profiles between the K-means analysis and the discriminant analysis was very high (between 95.8% and 97.7%), and 96.3% of the originally grouped cases were correctly classified (Supplementary Table 1). Moreo-

ver, as can be observed in Supplementary Figure 3, the three different clusters were clearly differentiated along the canonical discriminant functions.

To validate the three-cluster solution provided by the two-stage cluster analysis, a 1-factor Anova (with post-hoc analysis using Bonferroni's test) was performed to examine whether the different pilot profiles (ineffective, committed, and burnout) differed on each of the three dimensions of burnout. Significant differences were found between clusters in emotional exhaustion, professional efficacy, and cynicism, which provided statistical support for the three-profile solution. Post hoc comparisons show significant differences between most pairs of profiles (Table 1).

Table 1
Differences in the three burnout profiles as a function of sociodemographic and psychosocial variables

	Ineffective Cluster (C1) (N = 48, 23.30%)		Committed Cluster (C2) (N = 65, 39.60%)		Cluster Exhausted (C3) (N = 51, 31.10%)		Comparisons between groups				
							X²	p	Post-hoc comparisons		
Categorical variables	**N**	**%**	**N**	**%**	**N**	**%**			**C1-C2**	**C1-C3**	**C2-C3**
Sex											
Male	46	30.50	62	41.10	43	28.50	6.114	**.047**	ns	ns	***p* < .05**
Female	2	15.40	3	23.10	8	61.50					
Work context											
Civil	11	31.4	15	42.9	9	25.7	2.416	.660	ns	ns	ns
Commercial	6	19.4	13	41.9	12	38.7					
Military	31	31.6	37	37.8	30	30.6					
Age											
Under 35 (AG1)	20	33.3	23	38.3	17	28.3	13.44	**.009**	ns	ns	*p* < .05 between AG2 and AG3
Between 36 and 45 (AG2)	15	27.8	14	25.9	25	46.3					
Over 45 (AG3)	13	26.0	28	56.0	9	18.0					

Continuous variables	**N**	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**	**F (df)**	**p**	**C1-C2**		**C1-C3**		**C2-C3**	
									ΔM	**p**	**ΔM**	**p**	**ΔM**	**p**
Years of dedication	45	15.73 (11.15)	65	19.32 (11.55)	50	15.58 (8.13)	2.368 (2,157)	.097	-3.59	.238	0.15	1.00	3,74	.179
Emotional exhaustion	48	-0.49 (0.44)	65	-0.57 (0,54)	51	1,19 (0.79)	142.883 (2,161)	**<.001**	0.08	1.00	-1.68	**<.001**	-1.75	**<.001**
Realization	48	-1.14 (0.52)	65	0,75 (0.36)	51	0.12 (0.93)	126.019 (2,161)	**<.001**	-1.89	**<.001**	-1.25	**<.001**	0.63	**<.001**
Cynicism	48	-0.39 (0.48)	65	-0.60 (0.44)	51	1.13 (0.94)	114.032 (2,161)	**<.001**	0.20	0.295	-1.52	**<.001**	-1.73	**<.001**
Resilience	48	3.44 (0.69)	65	4.20 (0.70)	51	3.46 (0.85)	20.021 (2,161)	**<.001**	-0.77	**<.001**	-0.02	1.00	-0.74	**<.001**
Positivity	48	3.58 (1.28)	65	4.75 (1.01)	51	3.82 (1.23)	16.461 (2,161)	**<.001**	-1.71	**<.001**	-0.81	.887	-1.46	**<.001**
Safety at work	48	3.06 (0.96)	65	3.44 (1.14)	51	2.87 (1.34)	3.758 (2,161)	**.025**	-0.39	.246	0.19	1.00	-0.57	**.026**
Colleagues safety	48	3.92 (1.43)	65	4.81 (1.04)	51	3.88 (1.30)	10.497 (2,161)	**<.001**	-0.89	**<.001**	0.04	1.00	0.93	**<.001**
Safety of superiors	48	3.61 (1.66)	65	4.47 (1.33)	51	3.81 (1.73)	4.734 (2,161)	**.010**	-0.85	**0.14**	-0.19	1.00	0.66	.077
Management safety	48	3.50 (1.80)	65	4.36 (1.39)	51	3.53 (1.93)	4.928 (2,161)	**.008**	-0.87	**.024**	-0.04	1.00	0.83	**.029**
Stress	47	1.30 (1.15)	65	1.60 (1.14)	51	3.45 (1.17)	52.461 (2,160)	**<.001**	-0.30	.541	-2.15	**<.001**	-1.85	**<.001**
Accidents	46	0.54 (0.71)	65	0.02 (0.18)	49	0.37 (0.64)	14.018 (2.157)	**<.001**	0.52	**<.001**	0.18	.318	-0.34	**.002**

Note: C = Cluster; Years of dedication = years of dedication to the profession; AG = Age group.

Moreover, a 3-D scatterplot was performed by including, in the three axes, each of the dimensions of burnout, and by

setting the markers for the cluster belonging variable of the two-stage cluster analysis. As can be observed in Figure 3,

the three clusters are clearly differentiated regarding the average values they present in each of the three burnout dimensions. This provides additional graphical evidence of the identification of the three differentiated clusters.

Figure 3
Graphical representation of the distribution of thee three clusters in function of the average values of individuals in each dimension
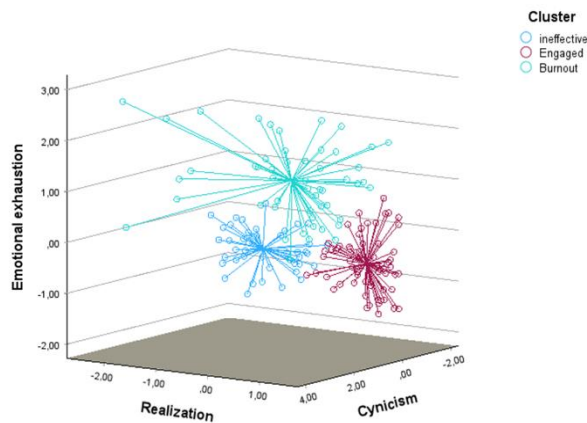
Differences between burnout profiles according to sociodemographic and psychosocial variables

As evidenced in Table 1, the results show that, (a) in relation to the sociodemographic variables analyzed (age, years of dedication to the profession, sex, and work context), significant differences were only found in the sex and age variables; and (b) significant differences were found between the three burnout profiles in the different psychosocial variables analyzed (resilience, positivity, safety at work, safety of colleagues, safety of superiors and management safety, stress, and occupational accidents).

Discussion

This study advances the identification of burnout subgroups in airline pilots. Exploring and understanding risk factors that predispose pilots to burnout, as well as its consequences, is of vital importance for regulators and researchers, given the responsibility involved in this profession. With its corresponding negative impacts on personal, societal, and economic health, governments at all levels have an interest in understanding this phenomenon.

This study also represents an opportunity to open new lines of future research focused on identifying pilots who suffer or are at risk of experiencing *burnout* and how to remedy its impact through preventive and psychotherapeutic interventions. Likewise, these findings could be useful in the administration of selective processes for aircraft pilot certification.

Taking as reference Maslach's multidimensional theory (1998) and other research that conceptualizes burnout as a heterogeneous construct that can materialize in different

profiles (Berjot, et al., 2017; Martínez et al., 2020; Potard and Landais, 2021; Makara-Studzińska et al., 2022), this study reaffirms the concept by applying it to the field of aviation. In the present sample of pilots, three clusters with varying levels of burnout dimensions are evident: ineffective, committed, and burnout. Slightly more than a third of the pilots (39%) fell into the committed profile, characterized by high levels of self-realization and low levels of exhaustion and cynicism. Slightly less than a third (31%) were in the burnout profile, characterized by high levels of emotional exhaustion and cynicism and low levels of self-realization. And slightly less than a third (29%) were in the ineffective profile, characterized by low levels of emotional exhaustion and cynicism, but also low levels of self-realization.

Within the three dimensions of burnout, significant differences were found between the profiles. Specifically, we highlight that higher scores of emotional exhaustion and cynicism were found in the burnout cluster compared to the other two (ineffective and committed). Such a result could suggest that these two dimensions are the most determinant of the syndrome in pilots and the ones that would help to discern which employees are truly "burned out." This is consistent with Maslach and Goldberg (1998), who affirmed that exhaustion is the central dimension of burnout.

Likewise, statistically significant differences in self-realization were also observed among the three clusters, with the committed group having higher scores, followed by the burnout group and, finally, the ineffective group. This suggests that ineffective pilots, as opposed to committed pilots, are characterized by not feeling fulfilled at work, while employees experiencing burnout feel less fulfilled than committed pilots but more than ineffective pilots. These results support our first hypothesis (H1) concerning the multiple cluster structure of burnout and the differences in the three dimensions that characterize the syndrome. Such a heterogeneous view helps deepen the understanding of burnout and may facilitate the control of burnout at different moments in an aircraft pilot's professional career through selective processes, preventive training, and psychotherapeutic interventions.

On the other hand, we explored the differences in different demographic variables related to burnout among the three clusters found (H2). In relation to the sex differences (H2a), despite the low percentage of women in this work sector, eight of the 13 women in our sample (61.50%) are located within the burnout cluster, compared to 28.50% of men. In addition, 41.10% of the men, compared to 23.10% of the women, are in the committed profile. These results seem to be in line with the results of Purvanova and Muros (2010), who found that women tend to experience greater emotional exhaustion and lower self-realization at work. Furthermore, these results could be related to the findings of Yanıkoğlu et al. (2020), who concluded that female pilots bear an extra psychological burden due to gender bias and stereotypes and even discrimination when working in a male-dominated profession, a phenomenon that influences their

behavior and performance. Gender stereotypes in the aviation industry often translate into prejudice toward women by questioning the suitability of their pilot skills, leading to inequalities in treatment and increasing the perception of female pilots to cover up their feminine traits to fit into the male aviation culture (Yanıkoğlu et al., 2020). At the same time, Yanıkoğlu et al. (2020) found that female pilots experience difficulties in work-family reconciliation, especially in certain countries and after getting married and/or becoming mothers.

Based on previous research on age (Fanjoy et al., 2010; Demerouti et al., 2019) and work context (Blais et al., 2020), we expected that among the profiles with higher burnout levels would be younger pilots (H2b) and pilots in the military (H2c). But in our case, the results show significant differences between age groups in the burnout and committed profiles, but not in the ineffective profile. More specifically, only 18% of those over 45 years of age were in the burnout profile while 46.3% of pilots between 36 and 44 fit this profile, with significant differences between both groups. However, no differences were found between young people 35 and under (28.3% of them were incorporated in the burnout profile) and the profile's other two age groups, which shows that they seem to be halfway between the two groups.

The same differences are repeated in the committed profile, but in reverse, so that a significantly higher number of people (56%) over 45 were in this cluster compared to the 36-45 age group (25.9%), although no significant differences were found between both groups and the group of people under 35 (38.3% of the latter group are included in the committed profile). This seems to indicate that there is a curvilinear, inverted-U-shaped relationship between burnout and age in airline pilots. Such a phenomenon could explain the inconsistent results between age and burnout found in previous scientific literature. Cheng et al. (2013) found similar results in their sample of Taiwanese employees across sector, where a nonlinear relationship existed between exhaustion and age among workers between 30-40 years who presented with higher burnout rates.

Our findings track with previous research and suggests burnout varies according to the life stage in which workers find themselves, their job requirements and demands, and any conflicts between work and family. Middle-aged adults face various stressors and normative changes that could explain why this age group more frequently integrates into the burnout profile. Examples include work events (promotion and career advancement or labor market volatility), physical health (onset of chronic diseases) and family matters (decision to couple, start a family, buy a house and/or have children, or take care of a parent) (Infurna et al., 2020).

At the same time, young adults are in a stage of exploration in terms of their professional careers and family life. Younger workers who finish their training and enter the workforce tend to be more enthusiastic, innovative, ambitious, and committed at work (Priyadharsan and Saravanabawan, 2021), possibly due to their eagerness to succeed

and overcome difficulties. Finally, older people may benefit from more work experience and fewer life stressors, which may explain the results obtained.

Taken together, these results have practical organizational implications in the aviation industry, highlighting the importance of considering a pilot's life history when seeking to increase workplace motivation or introduce therapeutic interventions for burnout.

We also investigated possible differences in psychosocial variables related to burnout among the three clusters detected (H3 and H4). After assessing resilience between groups, lower scores were observed for both the ineffective group and the burnout group with respect to the committed group. That is, individuals in the committed profile showed higher levels of resilience than those in the ineffective and burnout profiles. These results are consistent with the reviewed literature (Kutluturkan et al., 2016; Liu et al., 2016; Shoss et al., 2018; Taku, 2014; West et al. 2020) and our stated hypothesis (H3a), illustrating the protective factor of resilience for burnout.

The lack of difference in resilience levels between pilots in the ineffective profile and those in the burnout profile is noteworthy and indicates a related pattern between groups.

Similar results were obtained for the positivity variable. Ineffective and burnout profiles are significantly less positive than the committed profile, and ineffective and burnout profiles show comparable levels of positivity. Therefore, our hypothesis (H3b) is confirmed because profiles with higher levels of burnout dimensions were also less positive. This result is in agreement with studies that have found an inverse relationship between positivity and burnout (De la Fuente et al., 2021; Sestili et al., 2018).

The perceived security variable was evaluated on four dimensions: job security, coworker security, supervisor security, and management security. In all but the supervisors' security variable, significant differences were found between the burnout and ineffective cluster and the committed cluster. Specifically, burnout pilots and ineffective pilots perceived less job security from peers and management. These findings are consistent with past research that associated burnout with worse levels of perceived safety (Fanjoy et al. 2010; Hayes et al., 1998; Smith et al., 2020; Zhang and Zhang, 2022), and are in line with our hypothesis (H3c).

Also, based on previous studies (Mengenci, 2014; Ozturk, 2020; Venus et al., 2022) we postulated that people within the burnout profile would be characterized by higher levels of stress (H4a). The analyses corroborated this hypothesis, since significantly higher stress scores were observed in the pilots of the burnout group with respect to the other two groups. Therefore, it is inferred that burnout may be a risk factor for suffering or being involved in occupational accidents (Yang et al., 2021) by decreasing the performance and responsiveness of employees (Brezonakova, 2017). When analyzing this possible relationship, we found that burnout profile pilots and ineffective pilots have more

accidents at work than committed pilots, confirming our last hypothesis (H4b).

In terms of similarities and discrepancies between groups, one conclusion is that committed workers are better adapted than ineffective and burnout employees. Committed pilots experience less exhaustion and cynicism than burnout pilots and feel more fulfilled at work than the other groups. In turn, committed pilots have more resilience, a more positive attitude, a greater perception of job security, the perception that coworkers and management act more safely, show lower levels of stress, and are involved in fewer work-related accidents.

With respect to ineffective pilots and those suffering from burnout, we found similar scores in resilience, positivity, and in variables related to job security and safety. Both profiles of workers were more likely to have accidents at work. However, disparities were found between the two clusters that make it possible to discern burned out workers from ineffective ones. The central difference is that pilots with burnout are more emotionally exhausted, more cynical, and experience less self-realization at work – that is, they have more extreme scores on the three dimensions that make up the syndrome. Another difference is that employees with burnout experience and/or are much more vulnerable to stress than those who are ineffective and committed.

The results show that while people in the burnout profile have the lowest occupational health indicators, pilots in the ineffective profile also have poor health indicators. Both profiles also exhibited similar rates of occupational accidents. For these reasons, it is especially relevant to pay attention not only to people who show levels indicating burnout in the three dimensions of the syndrome, but also to those who show only low levels of self-realization, even though they do not present with high levels of emotional exhaustion or cynicism.

In this sense, self-realization seems to be a dimension of burnout that, at low levels, can negatively influence the occupational health of pilots, and is therefore a variable to be considered carefully when developing strategies to prevent or reduce burnout in this group.

Limitations and future lines of study

The method employed, and the sample chosen, make this pioneering research in the field of aviation. However, a limitation lies in the application of a cross-sectional design that prevented us from drawing causal conclusions and determining what variables precede or succeed *burnout*. To overcome this limitation, future research should be longitudinal, using this study as a reference. Additionally, variables related to mental health (such as anxiety or depression) and flight hours would be useful data to include.

At the same time, the data was self-reported by participants, leaving it vulnerable to common biases (e.g., acquiescence, social desirability, central tendency, or extreme response, among others). Also, despite collecting 164 ques-

tionnaires, 78% of the participants were from the UAE, 92.1% were male, from the civil and commercial sectors. The fact that the study sample is mainly composed of pilots from the UAE and predominantly males may limit the generalizability of the results to other geographic and demographic contexts. Thus, future studies should seek to recruit a more representative sample and explore the replicability of the results with this more representative sample. Finally, since the sample was primarily composed of military pilots, we found no significant differences between work settings. Results regarding differences in this variable should be interpreted with caution.

Moreover, with regard to future research, the inclusion of additional variables such as workload, flight hours, and specific working conditions could enrich the analysis, provide a more detailed understanding of the factors that contribute to burnout in pilots, and allow making more generalized statements. In this sense, flight hours and specific conditions of the context of aviation pilots are additional specific factors that have not been considered, and they could enhance the understanding of pilot burnout profiles. Finally, future research could include other instruments, such as interviews or observations, that address different aspects of burnout and their consequences to enrich the results.

Conclusions

There is extensive literature on burnout and the psychological and socio-labor variables associated with this construct. However, studies on burnout in airline pilots are sparse, despite the great responsibility that the profession requires. This research provides a novel view into this knowledge gap, demonstrating the multicomponent structure of the phenomenon. By using cluster analysis, we identify different burnout profiles based on its three basic dimensions and associate them with different demographic and psychosocial variables. Specifically, three distinct groups, or profiles, of pilots are identified: the committed, the ineffective, and those experiencing burnout.

The committed profile was characterized by low levels of emotional exhaustion and cynicism, and high levels of professional effectiveness; consequently, pilots in this profile tend to be more satisfied and engaged with their work. The ineffective profile was characterized by low levels in all dimensions of burnout (emotional exhaustion, cynicism and professional effectiveness); thus, these pilots may feel less fulfilled and engaged with their work. Finally, the burnout profile presented high levels of emotional exhaustion and cynicism, and low levels of professional effectiveness. Therefore, pilots in this profile are at greater risk of suffering the negative consequences of burnout, such as stress and possible accidents in the workplace.

Results suggest that pilots in the committed profile are more resilient and positive than pilots in the other two profiles. Committed aviators also perceive higher levels of safe-

ty, lower levels of stress, and have fewer work-related accidents.

But while aviation personnel in the burnout profile suffer more stress and present more extreme scores in two of the dimensions of the syndrome (emotional exhaustion and cynicism), their levels of self-realization are higher than the ineffective profile. Pilots suffering burnout also show similar levels of resilience, positivity, perception of safety, and the same number of accidents as those in the ineffective profile.

Furthermore, people in the ineffective profile show similarly low levels of psychological and occupational health as those in the burnout profile.

Given what is at stake, regulators and government agencies must pay close attention to pilots in both the burnout profile and the ineffective profile when designing and implementing interventions. In summary, the results suggest personalized preventive and psychotherapeutic mitigations are needed to protect public safety and ensure pilots' rights and well-being.

Statements

References

Bartone, P. T. (2007). Test-retest reliability of the dispositional resilience scale-15, a brief hardiness scale. *Psychological reports*, *101*(3), 943-944. https://doi.org/10.2466/pr0.101.3.943-944

Basińska, B. A., & Gruszczyńska, E. (2017). Positivity and job burnout in emergency personnel: examining linear and curvilinear relationship. *Polish Psychological Bulletin*, (2), 212-219. https://doi.org/10.1515/ppb-2017-0024

Berjot, S., Altintas, E., Grebot, E., & Lesage, F. X. (2017). Burnout risk profiles among French psychologists. *Burnout research*, *7*, 10-20. https://doi.org/10.1016/j.burn.2017.10.001

Blais, A. R., Gillet, N., Houle, S. A., Comeau, C. A., & Morin, A. J. (2020). Work fatigue profiles: Nature, implications, and associations with psychological empowerment. *Frontiers in Psychology*, *11*, 596206. https://doi.org/10.3389/fpsyg.2020.596206

Brezonakova, A. (2017). Pilot burnout as a human factor limitation. *Transportation research procedia*, *28*, 11-15.

Buonomo, I., Fatigante, M., & Fiorilli, C. (2017). Teachers' burnout profile: Risk and protective factors. *The Open Psychology Journal*, *10*(1). https://doi.org/10.2174/1874350101710010090

Butcher, J. N., Front, C. M., & Ones, D. S. (2018). Assessing psychopathology in high-risk occupations. In J. N. Butcher & J. M. Hooley (Eds.), *APA handbook of psychopathology: Psychopathology: Understanding, assessing, and treating adult mental disorders* (pp. 245–272). American Psychological Association. https://doi.org/10.1037/0000064-011

Caprara, G. V., Alessandri, G., Eisenberg, N., Kupfer, A., Steca, P., Caprara, M. G., ... & Abela, J. (2012). The positivity scale. *Psychological assessment*, *24*(3), 701. https://doi.org/10.1037/a0026681

Carbone, E. A., Pugliese, V., Bruni, A., Aloi, M., Calabrò, G., Jaén-Moreno, M. J., ... & De Fazio, P. (2019). Adverse childhood experiences and clinical severity in bipolar disorder and schizophrenia: a transdiagnostic two-step cluster analysis. *Journal of affective disorders*, *259*, 104-111. https://doi.org/10.1016/j.jad.2019.08.049

Cheng, Y., Chen, I. S., Chen, C. J., Burr, H., & Hasselhorn, H. M. (2013). The influence of age on the distribution of self-rated health, burnout and their associations with psychosocial work conditions. *Journal of psychosomatic research*, *74*(3), 213-220. https://doi.org/10.1016/j.jpsychores.2012.12.017

Cherng, C. F. G., Sher, J. S., Chu, H., & Yu, L. (2022). The relationship between civil pilots' resilience, psychological well-being and work performance. *Transportation research procedia*, *66*, 16-25. https://doi.org/10.1016/j.trpro.2022.12.003

Chung, Y. S., & Wu, H. L. (2013). Effect of burnout on accident involvement in occupational drivers. *Transportation research record*, *2388*(1), 1-9. https://doi.org/10.3141/2388-01

Čigarská, B. N., & Birknerová, Z. (2021). Burnout syndrome and Coping strategies: knowledge, approaches, foundations concerning its incidence among entrepreneurs. *The Poprad Economic And Management Forum 2021*, 98-110.

Comisión de Investigación de Accidentes e Incidentes de Aviación Civil del Ministerio de Transportes, Movilidad y Agenda Urbana (s.f.). *Definiciones de accidente, incidente e incidente grave* [*Definitions of accident, incident and serious incident*]. Recuperado de https://www.mitma.gob.es/organos-colegiados/ciaiac/definiciones-de-accidente-incidente-e-incidente-grave

De la Fuente, J., Santos, F. H., Garzón-Umerenkova, A., Fadda, S., Solinas, G., & Pignata, S. (2021). Cross-sectional study of resilience, positivity and coping strategies as predictors of engagement-burnout in undergraduate students: implications for prevention and treatment in mental well-being. *Frontiers in psychiatry*, *12*, 596453. https://doi.org/10.3389/fpsyt.2021.596453

Demerouti, E., Veldhuis, W., Coombes, C., & Hunter, R. (2019). Burnout among pilots: psychosocial factors related to happiness and performance at simulator training. *Ergonomics*, *62*(2), 233-245. https://doi.org/10.1080/00140139.2018.1464667

Edú-Valsania, S., Laguía, A., & Moriano, J. A. (2022). Burnout: A review of theory and measurement. *International Journal of Environmental Research and Public Health*, *19*(3), 1780. https://doi.org/10.3390/ijerph19031780

Fanjoy, R. O., Harriman, S. L., & DeMik, R. J. (2010). Individual and environmental predictors of burnout among regional airline pilots. *International Journal of Applied Aviation Studies*, *10*(1), 15-30.

Geisler, M., Berthelsen, H., & Muhonen, T. (2019). Retaining social workers: The role of quality of work and psychosocial safety climate for work engagement, job satisfaction, and organizational commitment. *Human Service Organizations: Management, Leadership & Governance, 43*(1), 1-15. https://doi.org/10.1080/23303131.2019.1569574

Gillet, N., Morin, A. J., Colombat, P., Ndiaye, A., & Fouquereau, E. (2021). Burnout profiles: Dimensionality, replicability, and associations with predictors and outcomes. *Current Psychology*, 1-19. https://doi.org/10.1007/s12144-021-01807-3

Gil-Monte, P. R. (2002). Validez factorial de la adaptación al español del Maslach Burnout Inventory-General Survey. Salud Pública de México, 44, 33-40.

Greene, G. (1960). *A Burnt-Out Case.* Heinemann. https://archive.org/details/in.ernet.dli.2015.150016/mode/2up

Hayes, B. E., Perander, J., Smecko, T., & Trask, J. (1998). Measuring perceptions of workplace safety: Development and validation of the work safety scale. *Journal of Safety research, 29*(3), 145-161. https://doi.org/10.1016/S0022-4375(98)00011-5

Holford, W. D. (2022). An ethical inquiry of the effect of cockpit automation on the responsibilities of airline pilots: Dissonance or meaningful control?. *Journal of Business Ethics*, *176*(1), 141-157. https://doi.org/10.1007/s10551-020-04640-z

Infurna, F. J., Gerstorf, D., & Lachman, M. E. (2020). Midlife in the 2020s: Opportunities and challenges. *American Psychologist*, *75*(4), 470. https://doi.org/10.1037/amp0000591

Kharoufah, H., Murray, J., Baxter, G., & Wild, G. (2018). A review of human factors causations in commercial air transport accidents and incidents: From to 2000–2016. *Progress in Aerospace Sciences*, *99*, 1-13. https://doi.org/10.1016/j.paerosci.2018.03.002

Kotti, N., Hajjaji, M., Kchaou, A., Sellami, I., Masmoudi, M. L., Masmoudi, J., & Jmal, K. H. (2017). Burnout and occupational accident. *European Psychiatry*, *41*(S1), S324-S325. https://doi.org/10.1016/j.eurpsy.2017.02.253

Kumari, P., & Aithal, P. S. (2020). Stress Inducing Factors and Relevant Strategies Deployed to Overcome Stress in the Aviation Industry Sector–A Systematic Literature Review and Further Research Agendas. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, *5*(2), 283-325. http://doi.org/10.5281/zenodo.4331691

Kutluturkan, S., Sozeri, E., Uysal, N., & Bay, F. (2016). Resilience and burnout status among nurses working in oncology. *Annals of general psychiatry*, *15*, 1-9. http://doi.org/10.1186/s12991-016-0121-3

Leiter, M. P., & Maslach, C. (2016). Latent burnout profiles: A new approach to understanding the burnout experience. *Burnout Research*, *3*(4), 89-100. https://doi.org/10.1016/j.burn.2016.09.001

Levenstein, S., Prantera, C., Varvo, V., Scribano, M. L., Berto, E., Luzi, C., & Andreoli, A. (1993). Development of the Perceived Stress Questionnaire: a new tool for psychosomatic research. *Journal of psychosomatic research*, *37*(1), 19-32. https://doi.org/10.1016/0022-3999(93)90120-5

Li, Y., Chen, H., Xin, X., & Ji, M. (2020). The influence of mindfulness on mental state with regard to safety among civil pilots. *Journal of Air Transport Management*, *84*, 101768. https://doi.org/10.1016/j.jairtraman.2020.101768

Li, Y., Liu, Z., Lan, J., Ji, M., Li, Y., Yang, S., & You, X. (2021). The influence of self-efficacy on human error in airline pilots: The mediating effect of work engagement and the moderating effect of flight experience. *Current Psychology*, *40*(1), 81-92. https://doi.org/10.1007/s12144-018-9996-2

Liu, Q., Wang, Y., Guo, X., Peng, F., Zhang, Y., Bai, Y., ... & Xiong, D. (2016). A structural equation model of job burnout and stress-related personality factors in aviators. In *Man-Machine-Environment System Engineering: Proceedings of the 16th International Conference on MMESE* (pp. 105-111). Springer Singapore.

Makara-Studzińska, M., Kruczek, A., Borzyszkowska, A., Załuski, M., Adamczyk, K., & Basińska, M. A. (2022). Profiles of Occupational Burnout in the Group of Representatives of High-Risk Professions in Poland. *International Journal of Environmental Research and Public Health*, *19*(10), 6297. https://doi.org/10.3390/ijerph19106297

Martínez, J. P., Méndez, I., Ruiz-Esteban, C., Fernández-Sogorb, A., & García-Fernández, J. M. (2020). Profiles of burnout, coping strategies and depressive symptomatology. *Frontiers in psychology*, *11*, 591. https://doi.org/10.3389/fpsyg.2020.00591

Maslach, C. (1998). A multidimensional theory of burnout en C.L. Cooper (Ed.), *Theories of organizational stress* (pp. *68*-85). Oxford.

Maslach, C., & Goldberg, J. (1998). Prevention of burnout: New perspectives. *Applied & Preventive Psychology, 7*(1), 63–74. https://doi.org/10.1016/S0962-1849(98)80022-X

Maslach, C. and Jackson, S. E. (1986). Maslach Burnout Inventory Manual. Consulting Psychologists Press.

McCormack, H. M., MacIntyre, T. E., O'Shea, D., Herring, M. P., & Campbell, M. J. (2018). The prevalence and cause (s) of burnout among applied psychologists: A systematic review. *Frontiers in psychology*, *9*, 1897. https://doi.org/10.3389/fpsyg.2018.01897

Mengenci, C. (2014). Could burnout be a reason behind airlines accident. *An Emperical Research Study in Turkish Airlines Companies. hand*, *6*, 30.

Montero-Marín, J., Prado-Abril, J., Demarzo, M. M., García-Toro, M., & García-Campayo, J. (2016). Burnout subtypes and their clinical implications: A theoretical proposal for specific therapeutic approaches. *Revista de Psicopatología y Psicología Clínica*, *21*(3), 231-242. https://doi.org/10.5944/rppc.vol.21.num.3.2016.15686

World Health Organization (WHO). (2019, mayo). *CIE-11 para estadísticas de mortalidad y morbilidad*. Recuperado 7 de enero de 2023, de http://icd.who.int/browse11/l-m/es

Ozturk, Y. E. (2020). Burnout syndrome of airline crews during crisis and Covid 19 in the world and Turkey. *International Journal of Business Ecosystem & Strategy, (2687-2293)*, *2*(4), 36-42. https://doi.org/10.36096/ijbes.v2i4.232

Özel, E., & Hacıoğlu, Ü. (2021). Examining the relationship between burnout and job satisfaction of flight crew: An analysis on the critical fatigue risk factors in the aviation industry. *International Journal of Business Ecosystem & Strategy, (2687-2293)*, *3*(1), 01-20. https://doi.org/10.36096/ijbes.v3i1.246

Potard, C., & Landais, C. (2021). The use of cluster analysis to identify different burnout profiles among nurses and care assistants for older adults. *Geriatric Nursing*, *42*(5), 1135-1142. https://doi.org/10.1016/j.gerinurse.2021.07.005

Priyadharsan, S., & Saravanabawan, A. (2021). Does age matter to influence self-efficacy: review of related Literature. *Journal of Management, 16*(2),17-25.

Purvanova, R. K., & Muros, J. P. (2010). Gender differences in burnout: A meta-analysis. *Journal of vocational behavior*, *77*(2), 168-185. https://doi.org/10.1016/j.jvb.2010.04.006

Rodríguez-Carvajal, R., & Rivas-Hermosilla, S. de. (2011). Los procesos de estrés laboral y desgaste profesional (burnout): diferenciación, actualización y líneas de intervención. *Medicina y Seguridad del Trabajo*, *57v*(Supl. 1), 72-88. https://dx.doi.org/10.4321/S0465-546X2011000500006

Rosado-Tapia, N. B., & Almanza-Muñoz, J. D. (2011). Prevalencia del Síndrome de burnout en una muestra de Pilotos Aviadores Militares Mexicanos. *Revista De Sanidad Militar*, *65*(4), 141-147.

Schaufeli, W.B., Leiter, M.P., Maslach, C., & Jackson, S.E. (1996). The MBI-General Survey. In C. Maslach, S.E. Jackson, & M.P Leiter (Eds.), *Maslach Burnout Inventory.* Manual (3rd ed., pp. 19-26). Consulting Psychologists Press.

Sestili, C., Scalingi, S., Cianfanelli, S., Mannocci, A., Del Cimmuto, A., De Sio, S., ... & La Torre, G. (2018). Reliability and use of Copenhagen burnout inventory in Italian sample of university professors. *International journal of environmental research and public health*, *15*(8), 1708. https://doi.org/10.3390/ijerph15081708

Shoss, M. K., Jiang, L., & Probst, T. M. (2018). Bending without breaking: A two-study examination of employee resilience in the face of job insecurity. *Journal of occupational health psychology*, *23*(1), 112.

https://doi.org/10.1037/ocp0000060

Smith, T. D., Mullins-Jaime, C., Dyal, M. A., & DeJoy, D. M. (2020). Stress, burnout and diminished safety behaviors: An argument for Total Worker Health® approaches in the fire service. *Journal of safety research*, *75*, 189-195. https://doi.org/10.1016/j.jsr.2020.09.010

Taku, K. (2014). Relationships among perceived psychological growth, resilience and burnout in physicians. *Personality and individual differences*, *59*, 120-123. https://doi.org/10.1016/j.paid.2013.11.003

Useche, S., Alonso, F., Cendales, B., Autukevičiūtė, R., & Serge, A. (2017). Burnout, Job strain and road safety accidents in the field of public transportation: The case of city bus drivers. *J Environ Occup Sci*, *6*(1), 1-7. https://doi.org/10.5455/jeos.20170202074636

Venus, M., Greder, D., & grosse Holtforth, M. (2022). How professional pilots perceive interactions of working conditions, rosters, stress, sleep problems, fatigue and mental health. A qualitative content analysis. *European Review of Applied Psychology*, *72*(3), 100762. https://doi.org/10.1016/j.erap.2022.100762

Wallace, J. C., & Chen, G. (2005). Development and validation of a work-specific measure of cognitive failure: Implications for occupa-tional safety. *Journal of Occupational and Organizational Psychology*, *78*(4), 615-632. https://doi.org/10.1348/096317905X37442

West, C. P., Dyrbye, L. N., Sinsky, C., Trockel, M., Tutty, M., Nedelec, L., ... & Shanafelt, T. D. (2020). Resilience and burnout among physicians and the general US working population. *JAMA network open*, *3*(7), e209385-e209385. https://doi.org/10.1001/jamanetworkopen.2020.9385

Yang, X., Zhang, B., Wang, L., Cao, L., & Tong, R. (2021). Exploring the relationships between safety compliance, safety participation and safety outcomes: considering the moderating role of job burnout. *International journal of environmental research and public health*, *18*(8), 4223. https://doi.org/10.3390/ijerph18084223

Yanıkoğlu, Ö., Kılıç, S., & Küçükönal, H. (2020). Gender in the cockpit: Challenges faced by female airline pilots. *Journal of Air Transport Management*, *86*, 101823. https://doi.org/10.1016/j.jairtraman.2020.101823

Zhang, C., & Zhang, Y. (2022). Psychological Mechanism of Civil Aviation Staff's Unsafe Behavior. In *HCI International 2022 Posters: 24th International Conference on Human-Computer Interaction, HCII 2022, Virtual Event, June 26–July 1, 2022, Proceedings, Part II* (pp. 251-256). Springer International Publishing.
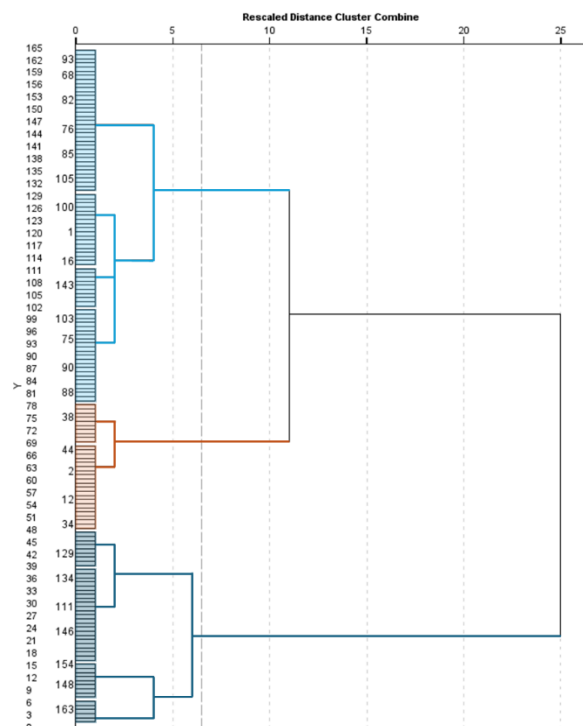
Supplementary Table 1

Classification results of the discriminant analysis

|		Cluster number of case	Predicted group belonging			Total
			1	2	3	
original	count	1	46	2	0	*48*
		2	0	42	1	*43*
		3	2	1	70	*73*
	%	1	95.8	4.2	0.0	*100.0*
		2	0.0	97.7	2.3	*100.0*
		3	2.7	1.4	95.9	*100.0*

Supplementary Figure 1

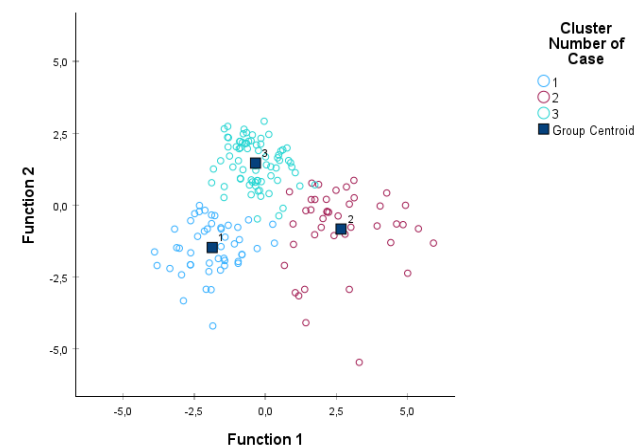Dendrogram using Ward Linkage

Supplementary Figure 2

Graphical representation of the three profiles derived from the K-Means cluster analysis, showing the Z scores in each of the three factors of the MBI-GS scale
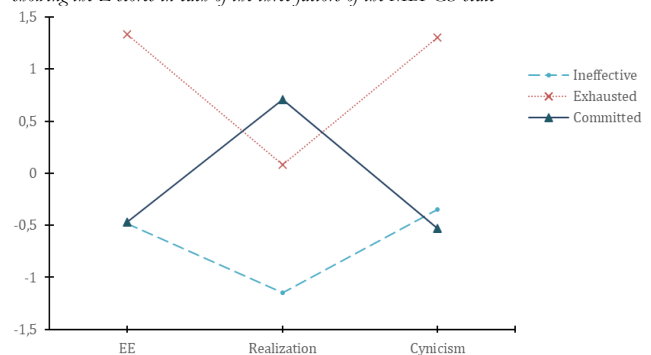
Note. EE = Emotional exhaustion

Supplementary Figure 3

Graphical representation of the canonical discriminant functions

Note. Cluster 1 = Ineffective profile; Cluster 2 = Exhausted profile; Cluster 3 = Committed profile