HUMAN FACTORS IN AVIATION:
CRM (CREW RESOURCE MANAGEMENT)

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Uno de los campos aplicados a los que más ha contribuido la ciencia psicológica es, sin lugar a dudas, el de la aviación. El análisis y estudio de los factores humanos constituye actualmente uno de los puntos fuertes en el sector aeronáutico de cara a la reducción de los accidentes aéreos. Desde su aparición en 1979, los programas de Gestión de Recursos de la Tripulación (CRM) han sido una de las herramientas que con mayor éxito han gestionado el denominado "error humano". El presente artículo realiza un breve recorrido por la historia de estos programas globales de entrenamiento que suponen uno de los grandes logros de la Psicología Aplicada.
Palabras clave: Gestión de Recursos de la Tripulación (CRM), Entrenamiento de vuelo, Factores humanos, Psicología de la Aviación, Seguridad Aérea.

Without a doubt, aviation is one of the applied fields to which psychological science has most contributed. The analysis and study of human factors is currently one of the strong points in the aeronautical sector in reducing accidents in aviation. Since their appearance in 1979, crew resource management (CRM) programs have been one of the most successful tools for dealing with what is known as "human error". This paper gives a brief tour through the history of these global training programs that represent one of the great achievements of applied psychology.
Key words: Crew resource management (CRM), Flight training, Human factors, Aviation psychology, Aviation safety.

Aviation has become one of the basic pillars on which social life and economic activity are based, and psychology has contributed significantly to this development. Applied psychology appeared in response to the demands of the great social and technological change that took place in the last decades of the 19th century and the beginning of the 20th century (Sáiz & Sáiz, 2012), and aviation became one of the most interesting fields of application of psychological science to questions of a practical nature (Dockeray & Isaacs, 1921).

World War I was the trigger that prompted the introduction of psychology in the world of aviation, initially focusing on the search for the characteristics that the "ideal" aviator should have (Muñoz-Marrón, in progress). This initial stage was characterized by the development of psychological tests and examinations of aptitude (Baumgarten, 1957) and personality, the objective of which was to understand which specific qualities pilots should possess (Sáiz & Sáiz, 2012). These early studies and works mixed aspects that were closer to physiology with those of a purely psychological scope.

The period between the wars was characterized by a decrease in the interest of researchers in the application of psychological science to the armed forces, and in particular to the air force, when the urgency in the need for selecting pilots disappeared.

In the psychological field, World War II brought progress in the study of the selection and training of aviators, caused by their increasingly difficult adaptation to more complex and fast machines (Alonso, 1997). Training evaluations were introduced and a progression was observed from the approach of more cognitive and motor aspects to others of a motivational nature. Once the fighting was over, the objective of the research changed radically, moving from a specifically wartime environment to one in which civilian research prevailed. As a result, in 1949 the leading airlines began to hire the first psychologists (Alonso, 1997).

At the end of the seventies an event took place that would radically change the relationship between psychological science and aviation (Muñoz-Marrón, in progress). As will be described later, in a meeting sponsored by the National Aeronautics and Space Administration of the United States (NASA), the concept of Cockpit Resource Management (CRM) appeared as a training program for air crews, which after several stages of development has reached the current crew resource management (Helmreich, Merritt, & Wilhelm, 1999). CRM was a new form of teamwork for air crews and basically referred to the optimal management of available resources in terms of aircraft technology, flight crew, passenger cabin, air traffic control, navigation aids, etc. (Turner, 1995).

WHAT IS CRM?

Designed to reduce the mistakes and increase the effectiveness of air crews (Wiener, Kanki, & Helmreich, 1993), CRM can be defined as the optimal use, by an air crew, of all available resources (information, material equipment and human resources) for the achievement of safe and efficient flight operations (Lauber, 1984). It encompasses a set of behaviors and strategies that the flight crew possesses and has to follow (Helmreich & Foushee, 1993), for the sake of safety, and constitutes the formal recognition by the aeronautical sector of the importance of the study of human factors in the optimization of air operations and flight safety.

Used in both commercial and military aviation, CRM is actually a global program of preparation and training in management skills and abilities, evidence-based, and designed to improve communication, decision making and adaptation among team members in critical situations (Salas, Burke, Bowers, & Wilson, 2001; Shuffler, DiazGranados, & Salas, 2011); a tool to combat accidents in which deficient teamwork in the cockpit could be a precipitating factor (Salas, Wilson, & Edens, 2009). The objective of the program is to combine technical and human skills in order to achieve safer and more efficient air operations (Federal Aviation Administration [FAA], 2012).

It is a method created to optimize performance by reducing the effect of human error through the use of all resources to solve problems, including people, technology and processes (Marshall, 2010). In a more detailed way, Marshall himself (2010) based his definition of the program on three fundamental pillars that we summarize below:

✔ A systems approach to security, which emphasizes the inherent nature of error, promoting a non-punitive culture and focusing on specific and standardized work procedures.

✔ A comprehensive system based on practice and operationally aimed at the proactive application of human factors in order to improve team performance.

✔ A system characterized by: (1) defining the crew as a whole, rather than the individual, as a standard training unit; (2) focusing on how the attitudes of crew members and their behaviors affect safety; (3) employing a methodology of active and practical training, based on participation and mutual learning; (4) including leadership techniques, work skills and team management; (5) promoting the creation of participatory work teams, preserving authority and the chain of command; and, (6) providing individuals and teams the opportunity to review and analyze their own performance and introduce the appropriate improvements.

CRM programs emphasize the nature of error in that they recognize that to err is inherent in human behavior. In order to reduce errors as much as possible, clearly defined work procedures are created, while crews are provided with methods to freely report the errors committed, without these being accompanied by a sanction. These communications help to develop a proactive performance improvement system, in that the aim is to create "barriers to error" before they occur. Taking the team as a unit of action, and through the use of a practical methodology, based on active participation and mutual learning, the program seeks to modify attitudes and establish real work teams in which, without damaging the chain of command, the participants can analyze their own performance and introduce the relevant improvements in order to optimize performance and achieve safer flight operations.

Training programs in CRM are, in short, a fundamental tool created to improve the performance of a team with the aim of reducing the effect of what is known as "human error" and optimizing execution through the use of all available resources.

The appearance of CRM was a key milestone in the psychology-aviation relationship and it brought about a radical change in the study of aviation security, thanks to which psychological science has become an essential pillar in the search for flight safety and an ally of the aviation industry in the development of training programs aimed at reducing human error and increasing the effectiveness of flight crews.

For this reason, CRM is one of the success stories of modern psychology and cognitive engineering (Cooke & Durso, 2007) and an essential prevention tool in the current world of aviation (Maurino, 1999), created within the world of psychology. CRM strategies are currently used with the aim of improving safety, reducing human error and providing crews with the necessary training to enable them to make use of all of the resources at their disposal (Salas & Cannon-Bowers, 2001).

Currently, CRM programs include different modules that address key concepts based on a design that includes three major areas of work: Command (direction, communication processes and decision making), leadership (management, work climate and team organization) and resource management (management of resources, workload and situation analysis).

Introductory CRM courses, which are carried out by the different airlines and the air force units of the Armed Forces, generally last between two and five days, and are run by psychologists and pilots who work together in their development. Teaching methods include lectures, practical exercises, role playing, case studies and accident recreation videos (O'Connor & Flin, 2003), among other work techniques. Although there is no standardized methodology for their development (Salas, Fowlkes, Scout, Milanovich, & Prince, 1999), the courses usually address topics such as teamwork, leadership, situational awareness, decision making, communication and personal limitations (Flin & Martin, 2001), although there is significant variability in this respect, mainly due to the fact that their design is adapted to the needs of the air operator that carries them out.

THE ORIGIN OF CRM

A series of accidents that occurred in aviation in the 1970s (Helmreich et al., 1999), as well as the high incidence of cases in which such disasters were due to human error, led to the implementation of CRM training programs. NASA, already a pioneer in the study of human factors in aeronautics and astronautics, began its program on human factors for aviation safety in 1973 (Marshall, 2010). From its Ames Research Center (Moffett Field, CA) the researchers, Charles K. Billings and John K. Lauber, together with the test pilot, George E. Cooper, began to investigate by directly questioning the pilots who had been involved in an accident, with the aim of obtaining detailed information on their version of events. The objective was to develop a research program aimed at analyzing the human errors that could be behind the accidents and to identify the factors that were present in what are known as accidents due to "pilot error" (Alkov, 1989).

This program of interviews led to the creation of NASA's Aviation Safety Reporting System (ASRS) (Alkov, 1989; Amézcua González, Lareo, & Amézcua Pacheco, 2001). From their testimonies, the pilots made it clear that the training programs did not cover the needs that arose during the flight. What is really significant, as far as psychology is concerned, is that this complaint did not refer to flight training techniques, but fundamentally to aspects directly related to human behavior, with special emphasis on decision making, leadership and interpersonal communication. The researchers found that to be a good pilot it was not enough to have good dexterity at the controls of an aircraft. Ruffel-Smith analyzed the behavior of different crews in a flight simulator, in both routine and emergency situations, and showed that the better the crew's use of resources and the more efficient the communication between its members, the better the performance (Ruffel-Smith, 1979). The conclusions of various investigations enabled the identification of a number of indications for the subsequent creation of what we know today as training in CRM.

HISTORICAL IMPORTANCE AND DEVELOPMENT OF CRM

Training in CRM, with the variants that it has presented over time, originated in June 1979 (FAA, 2012; Helmreich et al., 1999; Marshall, 2010; McKeel, 2012), specifically in a meeting conducted under the sponsorship of NASA (Alkov, 1989) and entitled Resource Management on the Flight Deck (Cooper, White, & Lauber, 1980; Helmreich, 2006). This event was organized –in part, because of the accident suffered by United Airlines flight 173 in December 1978– by the United States National Transportation Safety Board (NTSB). The accident was attributed mainly to an error made by the aircraft commander in failing to comply with the instructions of his crew, as well as the lack of assertiveness on the part of the latter (NTSB, 1978). The accident is a clear example of poor management of human resources in the flight deck and terrible teamwork in a situation of system failure of the aircraft, caused primarily by the use of an authoritarian leadership style by the commander of the aircraft.

During this meeting, NASA presented the results of the investigation that it had conducted into the causes underlying the accidents in air transport. These results included the identification of the aspects of human error present in most air accidents, such as failures in interpersonal communication or errors in decision making and leadership management. It was at that time when the term CRM was coined to define the training program aimed at reducing pilot error based on an improved use of human resources in the flight deck.

Initially, the abbreviation CRM referred to Cockpit Resource Management, but shortly afterwards (at the end of the eighties) it was changed to stand for Crew Resource Management, substituting the term *cockpit* for that of *crew* and moving the focus of attention from the *pilot* as an individual element to that of the *crew* as a group element or work team.

In the early eighties, research on the causes of aviation accidents enabled the introduction of structured training programs in CRM in civil aviation (Helmreich, 2006). In January 1981, the company United Airlines created the first specific training program in CRM (Helmreich et al., 1999). Later KLM followed suit in Europe as did Ansett in Australia (Helmreich, 2006). Since then, the most important airlines, the Air Force, the Army, the Navy and the Coast Guard of the USA have developed and used CRM programs, albeit in some cases under another name (Alkov, 1989). These training programs have continued to spread, first in the USA and later throughout the world, while their use has been generalized to other work areas, both ones belonging to aviation, such as maintenance (Taylor & Thomas, 2003) or air traffic control, and ones in other fields, such as medicine (Gordon, Mendenhall, & O'Connor, 2013), surgery (Helmreich, 2006), oil platforms (O'Connor & Flin, 2003), the rail sector (Sebastián, 2002, 2009), the submarine force (Acuña, 2013) or that of military divers (O'Connor & Muller, 2006).

The process followed by CRM has undergone an evolution that has seen it pass through different stages each with their own characteristics. Following Helmreich (2006) and Marshall (2010), we can distinguish six major stages in the development of CRM training programs, each one based on the successes and lessons learned from the previous one. We summarize below the most significant psychological aspects that are contemplated in each stage, reflecting in each case the ideas of the cited authors.

First generation: Cockpit Resource Management

The program initiated by United Airlines in 1981 (Helmreich et al., 1999) was called Command-Leadership-Resource

Management (CLR) (Helmreich, 2006). It consisted of a series of seminars during which the participants analyzed their own management styles. Contributions made for NASA were used by Blake and Mouton, pioneers in management consulting, whose work acquired relevance in the field of work and organizational psychology, to the point that their theory, known as the managerial grid (Blake & Mouton, 1964, 1985) appears in any self-respecting manual. The managerial grid consists of a numerical matrix to identify the different styles of leadership, depending on the two dimensions that are considered fundamental: the interest in people and the interest in production or results. The theory of these authors considers that the optimal management style harmoniously combines concern for people and for results, following on from the then famous Theory Y, by McGregor (1960), a key work of organizational psychology.

Soon other airlines carried out similar programs focused on modifying the styles diagnosed as erroneous and correcting deficiencies associated with individual behaviors, such as excessive authority shown by aircraft commanders over the rest of the crew, or lack of assertiveness demonstrated by pilots with less experience compared to the authoritarian behavior of their commanders.

Reactions to these first generation programs were reasonably positive (Helmreich, 2006), although some pilots showed some reluctance to them, accusing them of trying to manipulate their personalities (Helmreich et al., 1999) and fundamentally showing some potential fear of losing control of the cockpits due to the interference of other external professionals, mainly psychologists, until then completely outside the field of aviation.

Second generation: Crew Resource Management

In May 1986, NASA, who had been involved in the development of CRM since its inception, organized a meeting for the aeronautical industry (Helmreich, 2006; Orlady & Foushee, 1987), which became the ideal place for the communication and subsequent analysis of the results obtained by the air operators in their first approaches to CRM. The conclusions indicated the modification of the CRM programs, such that they should cease to be an isolated element in the training of the crews to become an essential component of a more complex training program. This new program, carried out periodically, would combine theoretical training with practical sessions in the flight simulator, called LOFT (Line Oriented Flight Training) (Helmreich et al., 1999), in which training would be given in the interpersonal skills addressed in the classroom.

The programs of this second generation incorporate the practical application of various concepts to the work dynamics that occur among the crew components, such as cockpit group dynamics, mainly oriented towards the work of the crew as a team, and training in decision-making strategies or how to break the chain of error. The concepts dealt with previously now became more operational, thus bringing the training closer to real air operations. Thanks, in part, to the latter, the acceptance of these programs by the crews was greater than that of the first generation programs, eliminating a large part of the resistance that the crews displayed towards the intervention of psychology in their training.

Third generation: CRM training programs extend their reach

CRM programs reached such relevance that their use began to extend unceasingly. CRM began to take into account the systems used in aviation (Salas et al., 2001) and its design began to incorporate characteristics of the air sector, which produced a breakthrough in the specific training of flight crews, while also overcoming one of the most significant criticisms of the models of previous generations. Efforts were now focused on the integration of CRM with technical training, paying special attention to the specific skills and behaviors that crews could perform during the development of any real flight in order to achieve a more efficient execution.

During these years, the aeronautical industry evolved at a rapid pace, substantially improving aircraft design, while the reliability of airplanes was also increasing (Alkov, 1989). The aircraft cockpits underwent major modernizations with the inclusion of increasingly safe and complex systems, so the need to achieve the correct matching of crews to the new cockpits became essential. For this reason, many airlines begin to include CRM modules designed specifically for the correct use of the different elements of the cockpits in their modern planes. The training programs also began to go into more depth in other aspects, such as the identification and assessment of critical elements in human factors or the analysis of the aspects of the organizational culture related to safety. Specific training programs were designed for aircraft commanders, focused on the leadership role inherent in this position within the crew and advanced training in CRM was introduced for the professionals responsible for the training and assessment of technical and human factors in the airline companies.

This last aspect is characteristic of the third stage, during which training in CRM began to extend to other groups of aviation professionals (Helmreich, 2006), such as flight attendants and maintenance personnel (Taylor & Thomas, 2003), among others. In addition, air operators began to conduct joint CRM training for cockpit and cabin crew, so this third generation extends the concept of *flight crew*, covering some of the gaps in the second-generation programs.

Fourth generation: Integration of CRM in flight operations

In 1990, the FAA went one step further and made CRM a regulatory requirement for all US airlines. Shortly thereafter, in 1994, the US Air Force required all members of its flight crews to receive training and evaluation in CRM (O'Connor, Hahn, &

Nullmeyer, 2010). It was also at the beginning of this decade when the FAA began its Advanced Qualification Program (AQP) (Birnbach & Longridge, 1993; Helmreich, 2006), which was one of the biggest changes in the training of flight crews. The AQP allows the creation of "customized" CRM training, enabling each operator to fulfill its specific needs (Salas et al., 2001). Thanks to the AQP, the training plans were made more flexible and adaptable to the particularities of each company, and even to each type of aircraft, enabling a specific response to the particular problems, related to human factors, of each operator.

Additionally, as part of the integration of CRM in flight operations, many companies began to protocolize concepts, introducing specific behaviors to their checklists (Helmreich, 2006). The aim of this was that the performance of each member of the crew would be set in advance, so each professional had what to do and how to do it clearly defined in each of the maneuvers to be performed or even in the case of any emergency events that could occur. The objective was to ensure that decisions and actions were made taking into account the master guidelines, ensuring that the fundamentals of CRM were always present, particularly in unusual situations (Helmreich et al, 1999; Marshall, 2010). The standardization of the procedures of action and checklists, together with the declared acceptance of their use by the air crews, have been, in the fourth generation CRM programs, an important field of work as a critical element with which to reduce air accident rates.

Fifth generation: Error management and normalization

The fundamental aspect of this period was the consideration of CRM as a strategy of error management and reduction (Helmreich, 2006). Now the training programs aimed at standardizing the error and developing strategies for dealing with it (Helmreich, 1997). This is based on the idea that the error is inevitable (Salas et al., 2001), so the interest is focused on the generation of "barriers" to avoid its appearance and the creation of the necessary tools to deal with it adequately if it should occur. It is considered that a well-managed error is an indicator of effective performance, with training in teamwork skills as a tool to achieve this becoming of paramount importance (Salas et al., 2001).

The avoidance of human error was already present in the first training programs in CRM. However, its justification and implementation had not been as desired. This stage was based on the premise that human error, in addition to being unavoidable, is ubiquitous, so we must live with it. But it is also considered a valuable source of information. If the error is unavoidable and ubiquitous, CRM is defined as a set of countermeasures to stop this error, with three fundamental lines of defense. The first, of course, is the avoidance of the error's occurrence; the second is the anticipation or search for incipient errors before they are committed; and the third and final one is the mitigation of the consequences associated with the errors that have occurred and that we have not been able to avoid. CRM thus becomes a methodology that includes a set of effective countermeasures or strategies to successfully resolve the situations that could lead an aircraft to disaster. The difference in its mode of use lies simply in the moment in which the error is detected.

Fifth generation CRM emphasized the collection and analysis of data as a method to promote the understanding of errors. To this end, the FAA launched the Aviation Safety Action Program (ASAP), an initiative whose objective was to promote the reporting of incidents within airline companies, in order to address safety issues proactively (FAA, 1997), which was a resounding success (Helmrich et al, 1999).

Sixth generation: Error management and the threat inherent in the field of operation. The current situation of CRM

Training programs in CRM have continued their evolution, conditioned mainly by the events that have occurred in the world of aviation and by the development of psychological science in recent years. The relevance of CRM training in the operational context is primordial (Maurino, 1999) and, currently, the evidence on the effectiveness of CRM training is impressive, although not perfect (Salas et al., 2001). Following Helmreich (2006) and Marshall (2010), we can affirm that we are within what is now known as the sixth generation of CRM training programs, which has emerged as a logical continuation of the previous generation and reflects the fact that air crews no longer only face human error within the cockpit, but they also deal with external threats from the field of operation (Helmreich, 2006). The fundamental characteristic of this stage is that there is a greater awareness of the contextual risks that must be managed. Flight crews must now also deal with threats to flight safety that arise from the work environment as a whole, that is, those that come from the operating environment (for example, a miscalculation of fuel at the time of refueling by airline personnel or a communication error by the air traffic controller).

As a consequence of this, the focus of attention is no longer set solely on the pilot (as in the first-generation trainings), nor on the crew (typical of the second and subsequent generations), nor only on the specific training in the use of automation and the leadership role of aircraft commanders (highlighted in the third generation). It is not even only focused on the error management approach (of the fifth generation), which reinforced the AQP training approach of the fourth generation. The management of the threat and therefore of security now covers a much broader field, the one in which air operations are developed.

Therefore, at present, CRM methodology aims not only to eliminate, stop or mitigate errors, but also to identify and deal with the systemic threats to security that arise in the complex

world of aviation. The qualitative leap that occurred between the fifth and sixth generation is the awareness of a new aspect, the external threat, which poses new challenges for psychological science applied to aviation.

However, and in spite of the vast progress made, there is still much to be done, since there are differences in the training among the different companies. Although in 1998 CRM training became mandatory for all the airlines in the world (International Civil Aviation Organization, ICAO, 1998), until recently not all aviation crews received this training (FAA, 2012). To this we must add that there are important aspects that CRM does not include and that may be essential to help the crews in their work and thereby reduce air accidents even further (Muñoz-Marrón, in progress; Muñoz-Marrón, Gil, & Lanero, in progress). On the other hand, although the action procedures or checklists constitute a very useful and effective tool for routine flight situations or in the case of systems failures or aerial emergencies of low danger, their use in situations of extreme danger characterized by their novelty, low probability of occurrence and unpredictable nature has been questioned, since it may involve some loss of initiative on the part of the crew in terms of effective decision making (Muñoz-Marrón, Gil, & Lanero, in progress). Perhaps for this reason or due to the lack of evidence to support the idea that CRM training is having a direct effect on the accident rate (O'Connor, Jones, McCauley, & Buttrey, 2012), the relationship between CRM and the increase in aviation security is tenuous (Maurino, 1999) or not very evident. This lack of evidence is caused largely by the small sample size of the different studies carried out, as well as by the (fortunately) low rate of air accidents that occur nowadays, which have made it impossible, currently, to establish a direct relationship between CRM training and the reduction of aerial accident rates.

When we talk about CRM training programs it is easy to understand both their contributions and their limitations. What is clear is that the fundamental reason for training in human factors is as strong now, if not more so, as when the term CRM was coined for the first time (Helmreich, 1999). It is important to make it clear that "*CRM is not and never will be the mechanism to eliminate error and assure safety in a high risk endeavor such as aviation*" (Helmreich, et al., 1999, p.30), while it is also worth insisting that it is currently the most powerful tool that air operators have in terms of training in human factors. Its development is in continuous evolution; it is becoming more and more complete and sophisticated, integrating aspects of a rapidly-progressing industry and being assisted by the contributions that other sciences, such as psychology, offer in the ceaseless attempt to progress in the direction of the reduction of air accidents. The inevitable consequences of the loss of human lives that air accidents entail, make continuous efforts on the part of the aeronautical industry necessary, to which psychology as a science can no longer be alien.

AREAS OF PSYCHOLOGY THAT HAVE CONTRIBUTED MOST TO THE DEVELOPMENT OF CRM

Although it is relatively easy to identify psychological aspects in the development of CRM, since these are the ones that make up its central core, it is not so easy to isolate the presence of these aspects at each stage, since the events take place in a not exactly regular or methodical way, and with great variations depending on the countries in which the training programs are introduced at different times. *A posteriori,* when we attempt to locate the aspects in order to obtain relevant information, we can talk about a certain logical evolution. This occurs in all processes, and ours is not an exception. We will attempt, however, to extract from the information provided by the process of developing and establishing CRM the elements that more directly refer to the aspects in which, due to their content, the last word from the scientific point of view corresponds to psychological science.

The problems around which CRM revolves are very varied, the following topics being outstanding specifically: leadership, human resources management, teamwork, communication, interpersonal skills, training and education, decision making and effective management of the error or effective performance. The whole subject, whose objective is always focused on an attempt to achieve an effective performance or execution to avoid errors and, consequently, accidents, has its origin in social psychology, precisely in the pioneering works of Lewin (1940, 1945, 1947) and collaborators (Lewin, Lippitt, & White, 1939) on leadership and study of group management, with all of the interpersonal problems that come with teamwork and the need to study in further depth the interpersonal skills that come into play when working in this way. Much emphasis was placed on group dynamics (typical of the second generation of CRM) and its application in the classroom methodology or training in situations that simulate real situations, with the development of case studies, the training group (Lewin, 1945) and the technique of role playing (Maier, Solem, & Maier, 1975). Subsequently, social psychology continues to deepen our knowledge of these problems, being enriched with the contributions of work and organizational psychology, historically known under denominations such as industrial psychology, human resources psychology, occupational psychology, organizational psychology, or the more interdisciplinary denomination of organizational behavior and human resources management.

We can say, without a doubt, that the greatest contribution of psychology to the world of aviation has been CRM programs. The incursion of professionals of psychological science into this world, not well received at first by the pilots (Helmreich et al., 1999), was instigated with the primary objective of combating human error. The initial interest in developing this facet, at the time almost unexplored in aviation, from the Ames Research Center of NASA and the emergence of psychologists such as

Lauber, Blake, Mouton or Helmreich himself and his team of collaborators at the University of Texas, caused the creation of a branch of applied psychology with great future potential: aeronautical psychology or aviation psychology.

Given that the objective of CRM has been well identified and that the process is going in the desired direction in order to achieve a higher level of aviation security based on a decrease in human error, it is to be expected that psychology will continue to have the importance it has had until now. We could even suppose, without the slightest hint of exaggeration, that in future research the contribution of psychology will be even greater, with a special impact on the improvement of the training of all airline personnel (an aspect that began in the fourth generation, as it included the entire crew in the training programs), and the selection, preparation and training of crews in areas such as flexibility and creativity, given the key importance of these qualities when implementing effective behavior in emergency situations and the evidence of the gap that is found in the current training on these matters (Muñoz-Marrón, in progress).

CONFLICT OF INTERESTS
There is no conflict of interest.

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