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AIRLINE PILOTS' DECISION-MAKING PROCESSES IN NON-PRESCRIPTIVE SITUATIONS

Marcia Fajer [1]*
Frida Marina Fischer[2]

Summary

The study assessed the complexity of the aviation decision-making process, highlighting factors that influenced airline pilots' decision-making strategies in unexpected events involving situations not anticipated by the rules. The objective was to analyze the determining factors for pilots' successful decision-making, considering the decision model used and the cognitive aspects involved. To understand decision-making strategies in these situations, 10 airline pilots were interviewed. The interviews were semi-structured, based on the *Applied Cognitive Task Analysis (ACTA) method*, which systematizes the understanding of situations in which people make judgments, make decisions, and solve problems using their cognitive abilities. Subsequently, the information from the 12 reported events was analyzed and classified into 121 segments, according to the *Schema World Action taxonomy. Research Method (SWARM*), developed specifically for aeronautical decision analysis. The combined methods revealed that decision-making processes were based on experiences and information present in the environment, resulting in a dynamic and ecological process, unlike the prescriptive analytical approach present in pilot training. This study demonstrated that understanding naturalistic decision-making processes in situations not prescribed by regulations is a predictive factor for flight safety, considering the protagonism of those performing the work and their ability to build safety using their knowledge, experience, and incorporating new approaches.

Keywords: Airline pilot, Decision processes, Naturalistic decision, Cognitive task analysis.

1. Introduction

Pilot decision-making has been recognized as one of the causes of aviation accidents, and errors in judgment are constantly present in accident analysis reports. Human error, repeatedly cited as a major contributing factor or cause of accidents, is used in engineering for probabilistic risk assessment when addressing the reliability of complex systems, resulting in a widespread perception that error is a human problem. Most people accept the term human error as a category of potential causes for unsatisfactory activities or results (Woods, Dekker, Cook, Johannesen, & Sarter, 2017).

Dekker (2019) argues that, from the beginning of the 20th century onward, the pursuit of security perceived humans as the cause of problems. Interventions aimed at adapting humans through selection processes and training were developed, and it began to be considered that problems could be solved by controlling people. In the second half of the century, security was

[1] Brazilian Association of Aviation Psychology (ABRAPAV) https://orcid.org/0000-0002-2782-6561* marcia.fajer@gmail.com
[2]University of São Paulo (Department of Environmental Health, School of Public Health). https://orcid.org/0000-0001-9403-6300

focused on the system, and interventions focused on technology that should take human limitations into account.

Security, previously defined by the absence of negative events, is now perceived by the presence of human capabilities and skills in recognizing and adapting to challenges, and the basic commitment of human factors is now considered to be: “making the world a better place, a more viable place for survival, a more pleasant place. And perhaps, more recently, a more sustainable place” (Dekker, 2014, p. 22).

The change in the conception of safety, however, brings with it a setback and, according to Dekker (2019), a return to behavioral safety, as the technology and procedures that made the system excellent are not enough to reduce the number of injuries and accidents.

Piloting an aircraft is a complex operation that requires a specialized skill set and discipline to follow procedures. Many of the actions a pilot performs are performed in pre-established sequences, occurring before, during, and after a flight and systematically repeated during training.

The training processes they undergo take place in training rooms, in the flight simulator, and on the aircraft, involving the development of technical skills such as knowledge of aircraft systems or navigation procedures, as well as non-technical skills such as crew resource management training. In addition to initial training, periodic training is conducted to ensure skills are not lost or forgotten due to disuse (Martinussen & Hunter, 2017).

The pilot's task is highly prescriptive; however, it also requires making judgments in the face of considerable uncertainty and risk, and choosing which actions to take at the appropriate time. Adaptations are necessary that imprint each pilot's "signature" on various parts of the process, resulting in decisions that must be made quickly and prudently to avoid errors that could lead to accidents. Pilots need to understand the potential interactions between the different parts of the system, the consequences of their actions, and the scope of their impact, as these combinations can pose risks related to reliability and safety.

The conditions under which decisions are made do not always present all the elements easily perceptible, or may be difficult to understand immediately and occur in conditions where there may be time pressure or restrictions on available resources.

Perrow (2011) considered the aviation system to be complex, as it presents close connections between several of its parts, and allows interactions originated by unknown or unplanned and unexpected sequences.

The predictability of human behavior at work is limited to the chain of events in the immediate interface with technical systems. The further away from the technical core, the greater the possibilities for behavioral adjustments. Consequently, the references for classifying behavior as normal or appropriate, when making a judgment about an error, may be less accurate for the worker (Rasmussen, 1985).

Woods, Dekker, Cook, Johannesen, & Sarter (2017) argue that workers, in order to achieve their goals, are always trying to anticipate failure. In their attempt to avoid failure, they seek out possible trajectories where failure might occur. This strategy, however, can be misguided, making it necessary to calibrate perception regarding the best path. One way to increase safety in complex systems is not only to create opportunities for individuals to recognize that a trajectory is approaching a bad outcome, but also to offer recovery options before undesirable consequences occur.

Workers make decisions by making intelligent and rational choices. Because decision-making is a process that does not occur in isolation, it is necessary to consider a system of complex relationships, in which people both interact and influence one another, due to their particular way of perceiving events, and are simultaneously influenced by changes occurring in the dynamic environment. Judgment is involved in decision-making processes, and therefore, the psychological mechanisms responsible for how we frame problems produce significant changes in the assessment of probabilities and outcomes, indicating a significant need to understand their formulation (Tversky & Kahneman, 1981).

Rasmussen (1985) already questioned decision-making methods considering the need for research more focused on strategies and abstraction hierarchies of decision-making processes.

In the early 1990s, Klein (2008) considered that decision analysis theories, although quite adequate, were limited in understanding how people decide in real-world contexts, where conditions are dynamic and continually changing, where there is time pressure, where tasks may not always be well defined and there are personal consequences for errors.

O'Hare (2003) argues that aviation requires the intelligent use of decision-making processes; there is no single approach that addresses the different strategies used by each pilot, and the same decision-maker may use different strategies. For this author, the question is whether the emphasis should be on the decision-maker or on the representation of the problem.

More experienced pilots can identify underlying causes of problems and use more complex models and acuity, in addition to understanding the problem and the environment. The biggest difference between experts and novices, in this case, is their ability to assess the situation, rather than their ability to generate and choose among options (Orasanu & Martin, 1998). Studies of accident analyses have shown that pilots' decisions were not based on or evaluated in terms of the cost-benefit of alternatives, but rather on prior experience (Strauch, 2016).

Workers make decisions by making choices. Identifying the processes used to make decisions is recognizing part of people's contribution to the safety of work systems. To better understand the processes involved in decision-making and how we appropriate them, Kahneman (2012) proposed two modes of thinking and deciding, which he called reasoning and intuition. He considered reasoning to be the performance of a mathematical operation or filling out a form, for example. And intuition to be the understanding of a joke or the creation of irony. Reasoning is done deliberately and with effort; intuition appears to be spontaneous, or effortless.

The conditions that favor intuitive decision-making are situations that require greater speed due to time pressure. These situations are dynamic and trainable, and while prescriptive decision-making cannot be dispensed with, complex systems like those in aviation can benefit from both approaches to improve decision-making processes.

The origins of naturalistic decision-making arose from the realization that people make decisions in real-world environments without generating a set of probability estimates and that they rarely employ systematic techniques. Naturalistic decision-making is a process by which knowledge gained through experience is used to make decisions. It is the basis for understanding how people make decisions in natural environments using intuition, which can be quickly applied, producing decisions that are almost as good as those obtained prescriptively. These are the focus of training and decision support systems based on formal standards (Klein, 2008).

Research on *Naturalistc Decision Making (NDM*) seeks a different approach in understanding decision models, trying to discover strategies based on people's ability to decide in difficult moments and not based on previous procedures (decision errors), significantly expanding the way of understanding the process, including the perception and recognition of situations (Klein, 2008).

There are many ways to make decisions and many factors that influence the decision-making process. It's important to consider the conditions under which the decision is made and what will determine the outcome. Can a pilot's decision in an emergency follow the same process as an investor in the financial market? Should pilots' decision-making process, based on repeated training and protocols, be a choice based on rationality, reflecting the best option, as if they were an information processor constantly vigilant? Or can scenarios be unpredictable and require other strategies from the pilot?

The strategies pilots use to maintain flight safety in critical situations unforeseen by regulations were evaluated. We investigated how and which cognitive aspects were present in the pilots' decision-making process and could facilitate action, based on the naturalistic decision-making approach.

2. Methods

Two methods were used to identify the cognitive aspects present in the decision: a) cognitive analysis of the task, *Cognitive Tasks Analysis (CTA),* which aims to study macrocognition to understand how people reason about complex problems when the context is high-risk and conditions change rapidly; b) taxonomy, *Schema World Action World Research Method (SWARM),* developed to provide a detailed description of aeronautical decision-making. Both methods are based on naturalistic decision-making frameworks that frame the decision-making process from a descriptive perspective and consider real-life situations and decisions.

Data were collected through interviews designed to identify decision-making strategies, problem-solving, planning, and situational awareness. The information gathering process was conducted through cognitive probes in a retrospective semi-structured interview. The interviews covered four areas: task diagram, knowledge audit, critical point, and participant knowledge. Each stage was subdivided into 28 items and subitems (Klein & Armstrong, 2004).

SWARM taxonomy was developed based on Neisser 's [3]*Perceptual Cycle Model* (PCM) , according to Plant and Stanton (2013). The model is based on the interaction between the person and the world, with an emphasis on the role of schemas, through a reciprocal and cyclical relationship. It assumes that an individual's knowledge of the world leads them to anticipate certain types of information (SCHEMAS) and directs their behavior (ACTION) in the search for and interpretation of information, influencing, updating, and modifying cognitive schemas and, in turn, their interaction with the environment (WORLD). The SWARM taxonomy allows for an understanding of the process, not just the results, of a decision, inserting the individual and their schemas within the decision-making environment, supporting the notion that cognition is distributed throughout a broader system.

Plant and Stanton (2013) developed a model to facilitate the identification of the elements of the perceptual cycle model, designed and validated specifically for aeronautical decision-making, to capture the interaction between internal schemas and information from the external world. The taxonomy was developed through an iterative process of inductive analysis that resulted in 29 subtypes for each category, and within each subtype, it is possible to extract

[3]Neisser U. Cognition and reality: principles and implications of cognitive psychology. San Francisco: WHFreeman and Co.1976. 230 p.

more information about decision-making. Figure 1 illustrates the division of subtypes according to the perceptual cycle.

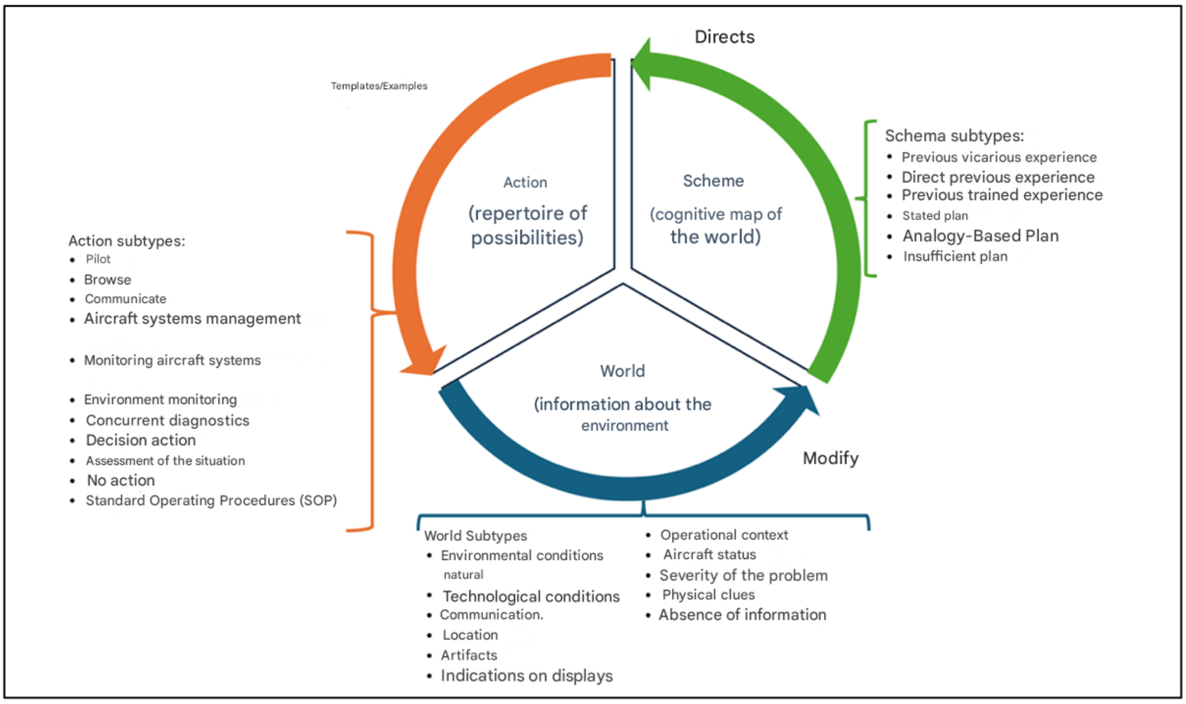

Figure 1 – Distribution of subtypes of the perceptual cycle for aeronautical decision-making.

Source: Plant & Stanton (2013), adapted by authors.

The classified subtypes may vary in frequency according to the event development timeline in six phases: pre -incident, problem onset, immediate action, decision making, subsequent actions and event containment.

This study was submitted to the Ethics Committee of the Faculty of Public Health of USP, via Plataforma Brasil and approved in accordance with opinion 3,692,937, dated November 8, 2019. All study participants signed the free and informed consent form in writing or electronically, in accordance with resolution n°466, dated December 12, 2010, of the National Health Council.

3. Results

The study population consisted of airline pilots, considering the criteria defined by the Brazilian regulation of the National Civil Aviation Agency (ANAC) in accordance with the Brazilian Aeronautical Homologation Regulation 61 (RBAC 61) – Licenses, qualifications and certificates for pilots, dated July 21, 2013. Initially, 15 pilots responded positively to the invitation to participate in this study through an *online advertisement* on the website of ABRAPAC – Brazilian Association of Civil Aviation Pilots – and through active search. This was due to the restrictions imposed by the COVID-19 pandemic.

The interviews took place from March 5 to August 14, 2020. One interview was conducted in person and the others were conducted via WhatsApp, using both audio and video calls, depending on the interviewee's preferences. Of these, 10 pilots reported experiencing a critical event whose outcome was not anticipated by the rules. Based on the reports of these ten pilots, it was possible to identify and analyze 12 events that addressed the basic research question.

The study participants were all male, aged between 26 and 62. Their pilot experience ranged from 6 to 42 years, and their airline pilot experience ranged from one year and six months to 25 years.

The data reported in the interviews considered critical events were classified according to the type of situation: aircraft mechanical problems (seven events); meteorological problems (three events); and passenger-related problems (two events). The narratives were classified into 121 segments, using the *SWARM taxonomy*, following the phases: pre -incident, considered the onset of the problem; immediate actions, decision-making, subsequent actions, and incident containment.

The segments were related to the three elements of the perceptual cycle: schema (use of prior knowledge, experience, and expectation), world (potential or actually available information, including physical objects, conditions, and actual situations), and action (such as performing an action or discussing potential actions that could be performed). Table 1 presents the proportion of elements identified by phase and element of the perceptual cycle for the 12 critical events studied. Figure 2 presents the number of critical events reported and classified into segments, according to the *SWARM taxonomy* and by element of the perceptual cycle.

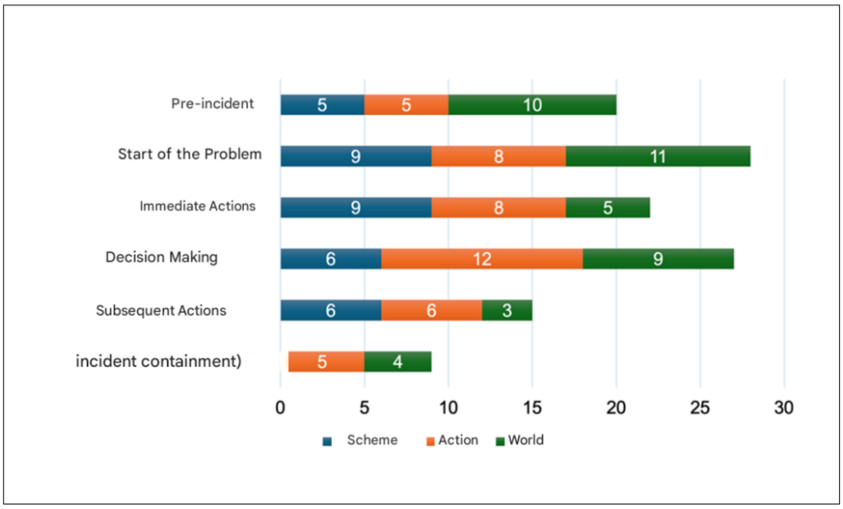

Figure 2 - Number of critical events reported and classified into segments by phases according to the *SWARM Taxonomy* and by element of the perceptual cycle.

Source: authors.

There was a predominance of segments in the problem initiation, decision-making, and immediate action phases. This was likely due to the nature of the interview stimulation, which aimed to describe critical events, pre -incident phases, subsequent actions, and incident containment. These phases may not be directly linked to the incident, but rather to what happened before and after, and may present a lower frequency of segments (Plant & Stanton, 2013).

Table 1 represents the distribution by subtypes according to each element of the perceptual cycle. The ACTION category represented the largest number of segments, with 36.6%; the most reported subtypes represented decision-making actions (14.05%), which are related to a resolution after considering the available information; and piloting (7.44%), which is the direct manipulation of the action of safely flying the aircraft, totaling (21.48%).

The WORLD category , which ranked second in number of segments, distributed across nine of its 11 subtypes, showed the importance of interaction with the environment for the decision-making process.

The SCHEMA category had the fewest segments, at 28.9%. However, the category's subtypes, such as direct previous experience (8.26%), which is represented by direct personal experience of similar events and situations from the past, and known model (8.26%), which included statements related to a descriptive scheme of facts generally related to known, available information, accounted for more than half of the category's responses; and trained previous experience (2.48%), which also makes up the secondary subtype of the schema category, was of little significance and is related to experience within a specific training situation.

According to table 1, there were no responses: systems management (which refers to technology), environmental monitoring (physical aspects), simultaneous diagnostics (cause of the problem), no action (actions related to equipment or pilot failures), technological conditions (appearance/functioning) and missing information (due to malfunctions).

Perceptual Cycle	*SWARM* Taxonomy	Subtypes		Total by category	
		N	%	N	%
Scheme	Direct previous experience	10	8.26	35	28.9
	Previous trained experience	3	2.48		
	Known model	10	8.26		
	Previous vicarious experience	3	2.48		
	Analogy-based plan	4	3.30		
	Insufficient plan	5	4.13		
Action	Pilot	9	7.44	44	36.6
	Decision action	17	14.05		
	Communicate	2	1.65		
	Assessment of the situation	4	3.30		
	Systems management	-	-		
	Monitoring systems	3	2.48		
	Environmental monitoring	-	-		
	Simultaneous diagnostics	-	-		
	Browse	3	2.48		
	No action	-	-		
	Standard operating procedures	6	4.96		
World	Natural environmental conditions	5	4.13	42	34.7
	Location	6	4.96		
	Indications on *displays*	8	6.61		
	Physical clues	3	2.48		
	Operational context	4	3.30		
	Artifacts	6	4.96		
	Information communicated	3	2.48		

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	Aircraft status	5	4.13		
	Severity of the problem	2	1.65		
	Technological conditions	-	-		
	Missing information	-	-		
Total		121	100	121	100

Table 1 - Distribution of segments classified according to the percentage cycle categories and subtypes of the *SWARM taxonomy.*

Source: authors.

The taxonomy allowed us to identify in great detail the elements involved in understanding decision-making processes, not limited to the outcome of the decision. While the decision-making process and piloting are central, it also relies on other elements. Significantly, previous experience was present in the reports, reinforcing the importance of naturalistic decision-making.

Regarding the proportional distribution of segments within the perceptual cycle, we found a balanced distribution, confirming that distributed cognition follows an organized pattern. This demonstrates the importance of understanding the role of the three elements. These elements dynamically interact in the decision-making process and the importance of an ecological approach. These results suggest that the information processing model is cyclical and that mental representation models can be triggered by environmental conditions, by direct perception, and, therefore, in interaction with the world (Maurino, 2000).

4. Discussion

Conducting work with maximum safety is part of a pilot's operational practice. To this end, the worker develops strategies that can be susceptible to failure: they attempt to anticipate the potential forms and paths that failures take, although they are only partially aware of these paths due to the constant changes in the real world and their trajectories. The strategies used to deal with these potential paths may be inconsistent or misguided. It is necessary to update and calibrate our awareness of potential paths that can lead to failure avoidance (Woods, Dekker, Cook, Johannesen & Sarter, 2017).

The choice to study critical events with successful outcomes is due to the fact that, in workplace prevention and safety, analyses are typically based on situations that had an unfavorable outcome, on errors of judgment, rather than attempting to understand success stories. The ability to identify the structuring dimension of work analysis, its living and changing nature, helps to understand its importance in the production of worker safety. The reality of work regulates all its dimensions, as does the social and collective action that determines its outcome (Tersac & Maggi, 2004).

Understanding the decision-making process by analyzing an individual's ability to respond to change, studying the body of knowledge that encompasses cognitive processes and experience, is not new in aviation. However, previous studies have focused on incidents or accidents, not critical events with successful solutions.

From the collected and analyzed data, we identified that pilots make decisions based on dynamic relationships, based on known experiences and information present in the environment, producing a cyclical and ecological movement, different from the analytical form prescribed by the normative approach proposed by training in aeronautical decision-making.

According to Klein, Calderwood, & MacGregor (1989), one must consider the importance of understanding dynamically how mental representation models can be triggered by conditions present in the environment, through direct perception and, therefore, in interaction with the world.

The concept of distributed cognition, according to Hutchins (2000), seeks to understand how cognitive systems are organized, particularly emphasizing two principles: the limits of units of analysis and the mechanisms involved in cognitive processes. Distributed cognition is not limited to neurological processes and encompasses at least three types: those within a social group, those that contemplate relationships between the material and the environment, and the temporal perspective of the products of past events, which can lead to transformations or reorganizations.

The application of Cognitive Task Analysis to obtain data from subject matter experts enabled detailed reports that addressed significant cognitive aspects. Klein & Militello (2001) consider that this method is not a mere systematization of event data, but rather a creation of a set of questions that lead to an understanding of what was considered during the judgment and decision-making.

The purpose of cognitive task analysis is not to establish or identify a prescription for how people should think, as in a normative theory where models are built on axioms that people should consider, but rather to understand what people actually do and whether they are aware that they do it this way. This is different from analyzing what they should do, or why they didn't do it in a prescribed way. Cognitive task analysis, as used in the interviews, is a methodology that lends itself to reliably and validatedly addressing activities in the context of real-world tasks, and is not a tool for exclusive use by experts in the field of cognition. This broadens its possibilities for use, having been tested for application by laypeople and considered an easy-to-use method, with clear results, and providing useful knowledge (Plant & Stanton, 2013).

Cognitive Task Analysis is not a traditional analysis that results in a description of behaviors, but rather an accurate description of how a specialist performs their activity and goes beyond simply describing task execution. This analysis enabled data collection to be targeted toward the research objectives. We therefore believe that the cognitive task analysis method applied to data collection achieved its objective by highlighting cognitive abilities in the processes involved in decision-making and judgment in critical events.

There is no prescribed way to understand how people think or should think. Gaining a better understanding of activity in a naturalistic context can be difficult to measure. Applying a taxonomy, while questionable in its use for this type of analysis, helps to explicitly understand the data as a whole. We chose to use the *SWARM taxonomy* to analyze the data obtained, which, in addition to understanding cognitive aspects, was developed specifically for the activity of aircraft pilots. We should also consider that using a taxonomy, and in this case a specific taxonomy, facilitates data analysis, establishing a specific terminology that can aid in the standardization of future studies.

It's important to note that the four-stage interview approach, as mentioned above— task diagram, knowledge audit, critical point, and participant knowledge—was crucial for the cognitive analysis of the task. Incorporating participants' knowledge facilitated data collection, which was later used in the *SWARM taxonomy*, and enabled more precise segment identification. It's important to emphasize that the *SWARM taxonomy* enabled a dynamic understanding of the decision-making process, using coding for qualitative data based on thematic analysis.

Aviation safety management is based on prescriptive and normative premises, indicating how the system should function for everything to run smoothly. Aeronautical decision-making processes follow the same logic: how people should act to make decisions. However, the scenarios in which decisions are devised by regulatory bodies and managers can often be very different from those in the cockpit.

When examining the relationship between decision-making processes and training received, it was identified that training was not considered a facilitator in the decision-making process. Pilots are trained to make decisions considering only operational situations, but in practice, they also have to make decisions related to flight management.

We can affirm that the decision-making processes reported in the critical events studied followed the naturalistic, non-prescriptive decision-making model, and that the decision-making training processes formally used, according to the Brazilian regulatory model, follow international standards. They propose traditional, prescriptive methods for aeronautical decision-making, reinforced by repetitive conditioning-based training that does not necessarily lead to greater knowledge of the activity, limiting the possibility of improving decisions.

Experience was also considered a relevant factor when using the *SWARM taxonomy,* classifying segments in the Scheme category, related to the phases of immediate action and decision-making. Experience facilitates decision-making processes and does not necessarily need to be linked to time spent working or personal experience. Knowledge can significantly increase problem-solving ability and, therefore, is a factor to be considered, especially in understanding what is happening. Therefore, simply repeating what is already known is not enough to develop knowledge; a novice can develop good problem-solving strategies if they have some understanding of them. What differentiates the strategy used by an expert from an experienced one is the organization of knowledge, which can enable a faster response to a given situation. When the strategy used is communicated, it can result in improved problem-solving (Sternberg, 2008).

Daniellou, Simard, and Boissières (2013) consider that safety is based on two pillars: standardized safety, which defines foreseeable scenarios in advance, and safety in action, which is based on operator competencies and adaptation. By analyzing the pilots' reports, we identified the importance of understanding how recognizing intuitive decision-making processes can enrich learning and decision-making possibilities, increase the chance of improving safety, and take into account that we do not have control over all processes.

Gigerenzer (2008) assesses intuition as an important tool in the decision-making process, due to its adaptive aspects, and as a flexible construct developed according to the environment in which we live and the knowledge we store. Essentially, intuition emerges very quickly in our conscious mind. Fundamental reasons are not fully accessible to this conscious mind, but they are strong enough to motivate action (Streck, 2014).

Aviation safety in the 21st century is being rethought. The rationality of technology seems to have dominated prevention systems, and there is a concern about transforming safety issues into a bureaucratic responsibility. Surveillance over prevention systems, which presuppose constant monitoring, error counting systems, and recording systems, appears to be a step backward, moving toward the judicialization of error issues (Dekker, 2014).

The concept of *Safety* - I, described by Hollnagel (2018, p. 49) as "a condition in which the number of adverse outcomes (accidents, incidents, and near misses) is as low as possible," can have a moral and ethical cost. It implies centralized, procedurally determined control over what is safe, identifying and eliminating errors or creating barriers to prevent their propagation.

It draws a parallel with prescriptive decision-making processes, in which metrics determine the best alternatives, as in a game of probabilities.

In contrast to the concept of *Safety* - I *,* the Hollnagel (2018) argues that we can view safety as an ability to succeed under varying conditions, focusing on an understanding of why things work and attempting to understand everyday activities. This author calls this new concept *Safety* -II *,* assuming that things work because people are able to identify failures and adjust their performance.

We return here to the concept of variability, which presupposes the ability to identify failures and correct them. Dekker (2014) proposes a different way of thinking about safety (*Safety Differently).* This author sees people as a source of trust and diversity, capable of creating workplace safety. We can consider that non-prescriptive, or naturalistic, decision-making processes, when better understood, are a factor that adds to safety, not a factor of insecurity or improvisation.

5. Final Considerations

Aviation activity operates within a complex system and produces few catastrophic events, which doesn't necessarily mean it's a safe activity. Aviation safety is now understood as a management process, a matter of quality assurance. And, regardless of whether we assess the effectiveness of these processes, they often occur far removed from the people performing the activity and how they react within the system.

There has long been a focus on valuing workers' knowledge and understanding how they contribute daily to building safety, making the necessary adjustments to ensure successful completion of the work. Decision-making situations for which pilots are not trained or are not prescribed by regulations must be analyzed. It is essential to understand the impacts of activity prescriptions in these situations, how decisions are made, and how this impacts the safety produced by pilots in their daily work. This study demonstrated that understanding naturalistic decision-making processes in situations not prescribed by regulations is a predictive factor for flight safety, considering the protagonism of those performing the work and their ability to build safety using their knowledge, experience, and incorporating new approaches.

The taxonomy used allowed for a detailed identification of the elements involved in understanding decision-making processes, not limited to the outcome of the decision. While the decision-making process and piloting are central, the former is also based on other elements. Significantly, previous experience was present in the reports, reinforcing the importance of naturalistic decision-making.

This study demonstrated an understanding of the mechanisms involved in situations in which pilots must deal with variability, resulting in naturalistic decision-making processes. It recognizes that experience is relevant in organizing knowledge, leading to appropriate solutions. Pilot experience was a key determinant of the decision-making processes analyzed, highlighting the importance of naturalistic decision-making.

Throughout our lives, we incorporate information, whether formally or as a necessity imposed by the environment, out of a need to survive. This gives new meaning to understanding, which can be shared, becoming a unifying element in preventing aircraft accidents and recognizing the importance of people over processes .

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