How to improve training programs for the management of complex and unforeseen situations?

Marie-Pierre Fornette, Françoise Darses, & Marthe Bourgy
Institut de Recherche Biomédicale des Armées
France

Abstract

Maintaining adequate performance in the face of complex and unforeseen situations is of fundamental importance in aeronautics. Such situations are often ill-defined. Therefore pilots must first determine which aspects of the situation are relevant to process and control. One major difficulty stems from the fact that this process of “situation structuration” must be performed on the basis of current constraints rather than preconceived knowledge. Thus, the key question is “What to process and control?”. Currently, most unforeseen-situation management training programs do not help pilots to answer this question. Rather, by improving the ability to control the relevance of thought processes, they concentrate on another question “How to process and control?”. Recent studies on thinking dispositions (Stanovich, 2011) and on mindfulness (Kabat-Zinn, 2003) are opening new avenues for training. By focusing on the development of openness and acceptance attitudes, these approaches could help pilots to efficiently structure complex and unforeseen situations. We present studies carried out in risky work environments, the results of which indicate that trainings that seek to foster an open state of mind provide a necessary complement to trainings centered on the control of thought processes, to improve pilots’ ability to manage complex and unforeseen situations.

The management of the complex and the unforeseen among pilots

Aeronautic environments are traditionally characterized by multiple (physiological, psychological, and organizational) constraints. Moreover, during the last decade, the context in which military pilots operate has changed dramatically, becoming at the same time more complex and more unpredictable. Technological innovations, restructurings, and the ever-increasing complexity and diversity of airborne systems and military operations require from pilots that they be able to deal with highly complex and often unforeseen situations.

In this context, it is important to examine how pilots are able to handle such situations. In a recent study, Casner, Geven, and Williams (2013) confronted airline pilots with three abnormal events: (a) aerodynamic stall, (b) low-level wind shear, and (c) engine failure on takeoff. Each of these events was presented to pilots in two different ways under: (a) the familiar circumstances used during airline training, or (b) unexpected circumstances, as might occur during a flight. The results showed that, for approximately one third of the pilots, performance was severely hampered

when the event occurred in unusual circumstances. In the context of military aviation, a recent study by Bourgy (2012), in which fighter pilots faced an unforeseen situation in a simulator, found a similar proportion of failures: one third of the pilots failed at grasping the dysfunctions that they encountered, leading them to eject in a rushed and dangerous manner. Only two thirds of the pilots avoided such an unsatisfactory ending owing to their use of adaptive solutions. Moreover, an analysis of recent reports from the French Defense Air Accident Investigation Board reveals that some pilots are unable to use adequate adaptation skills to deal successfully with complex and unforeseen situations (BEAD-Air, 2004, 2006, 2007). In particular, pilots failed to recognize and understand the high stakes involved in these situations, or to take into account all of the constraints associated with the situation when making decisions.

Training pilots to better deal with unforeseen circumstances is increasingly being recognized as a need by the aeronautics community. In 2002, the French Air and Space Academy acknowledged that the training of civil-aviation pilots was incomplete because it did not sufficiently train pilots to cope with unforeseen situations (AAE, 2002). In 2011, the same academy organized a colloquium entitled “Air transport pilots facing the unexpected” (AAE, 2013), the aim of which was to survey ways of improving the management of complex and unexpected situations at the organizational, team, and individual levels. During this colloquium, colonel Rabeau (2011) pointed out that “the missions of [military] pilots in hostile environments, by nature, involve the unexpected” (p. 115), and that the training curriculum of military pilots seeks to prepare them for this by taking into account, not just technical skills, but also “an ability to step back from the mission, as well as analytic and decisional abilities” (p. 119). However, we suggest that, to further improve the training of pilots, it is essential to try to better understand the processes underlying the ability to manage unforeseen situations.

How to train pilots to manage complex and unforeseen situations?

What is at stake in complex and unforeseen situations?

In the studies cited above (Bourgy, 2012; Casner et al., 2013), the observed differences in performance could not be explained by differences in expertise because the pilots who participated in these studies all had the same high level of qualification. Complex and unforeseen situations that call for prompt responses seem to fall outside the scope of pilot’s immediate expertise. These situations cannot be processed solely on the basis of fast associations and of easily applicable procedures. Achieving cognitive adaptation involves gathering situational cues, noticing patterns, activating relevant knowledge and heuristics, adapting strategies, and learning from the results of action (Ployhart & Bliese, 2006; Schunn & Reder, 1998). Pilots must be able to recognize atypical situations, for which no easily applicable procedure exists. They must be able to accept the unknown, and the fact that there does not always exist a predefined pattern which they can rely upon. In addition, in order to “structure” the situation, pilots must be able to grasp relevant aspects of it, even when those aspects are not salient. One major difficulty stems from the fact that this “structuration” process must take into account current constraints associated with the situation; it cannot be performed solely on the basis
of pre-established knowledge. In the face of complex and unforeseen situations, one of the key issues seems to be “What to process & control?”

Traditional training programs focused on “how to process and control?”

Today, most unforeseen-situation management training programs focus on the question “How to process and control?”, which is also essential to cope efficiently with complex and unforeseen situations. These trainings usually concentrate on enhancing cognitive control. They aim at improving the conscious and deliberate regulation processes used by individuals to check the validity of their representations and cognitive processes, in order to improve decision-making or stress management.

For example, Helsdingen, van den Bosch, van Gog, and van Merriënboer (2010) proposed a training based on Critical Thinking Instruction. This training provides operators with a formalized questioning scheme for looking at the relevance of their cognitive processes and representations used to manage a situation. Another type of training aims to familiarize operators with reflexivity in order to lead them to think critically upon their practices (see for instance Decision-Making Training, Chauvin, Clostermann, & Hoc, 2009). Moreover, various stress-management techniques (Driskell, Salas, Johnston, & Wollert, 2008) can be taught to pilots to help them to efficiently manage the stress experienced in complex and unforeseen situations. Some techniques are based on physiological control, such as relaxation and biofeedback, to gain control over negative stress reactions (Orasanu & Backer, 1996). Other techniques are based on cognitive control or cognitive change (Gross, 2002). They seek to improve access to more adaptive thinking modes or representations by teaching pilots metacognitive techniques, such as cognitive restructuring. These techniques, which have been first introduced in clinical psychology, have demonstrated their efficacy in occupational settings (for review, Richardson & Rothstein, 2008) as well as in military personnel (e.g., Cohn & Pakenham, 2008).

By improving the ability to control the relevance of thought processes, these training programs help operators to answer the question “How to process and control?”. However, in complex, real, and unexpected situations, it is difficult to determine rapidly and precisely, based on prior knowledge or cues, what to focus attention and control capacities onto, in other words, to answer the question “What to process and control?”.

New approaches to improve the management of complex and unforeseen situations

Recent studies concerned with “thinking dispositions” (Stanovich, 2011) and with “mindfulness” (Kabat-Zinn, 2003) are opening new avenues for training. By focusing on the development of openness and of acceptance attitudes, these approaches could help pilots to efficiently structure complex and unforeseen situations. They may also reinforce abilities that were identified at the “Air transport pilots facing the unexpected” (AAE, 2013) colloquium. Experts who participated in this meeting suggested that pilots should be trained to learn to: (1) accept to be surprised and to face unknown and uncertain circumstances, (2) be open to new experiences, (3) know how to act outside of predefined procedures, and (4) beyond
Trainings focused on task or situation management, develop trainings focused on general adaptation skills (which are useful for all tasks and situations).

**New approaches and training designs for the management of complex and unforeseen situations**

*The concept of thinking dispositions*

In 2011, Stanovich proposed to distinguish two aspects of adaptation to complex and unforeseen situations. On the one hand, there are the executive processes which allow effective processing of information identified as relevant, referred to as the *algorithmic mind*. On the second hand, reflective processes allow the individual to structure a situation, to assign meaning to it, and to build relevant frameworks given, not only the particulars of the situation, but also, the individual’s own goals, values, and priorities (referred to as the *reflective mind*). The former processes address the “How to process and control” question, whereas the latter address the “What to process and control” question. According to Stanovich, processes underlying the reflective mind depend on individual characteristics referred to as thinking dispositions. The notion of thinking dispositions denotes a state of mind, tightly related to different individual cognitive propensities, such as: dogmatism and absolutism, actively open-minded thinking and openness, need for cognition, flexible thinking, or belief identification (Stanovich, 2011). Thinking dispositions refer to the way in which an individual interacts with the world. They predict inter-individual differences in complex reasoning tasks (e.g., Stanovich & West, 2008). These dispositions might play a crucial role in helping pilots formulate relevant goals and thinking frameworks in complex and new situations.

*Training programs integrating thinking dispositions*

To our knowledge, few studies have examined the effects of training programs that seek to promote thinking dispositions that favoring adaptation to complex and unforeseen situations. A first study of the effects of this type of training on flight performance and stress management was carried out in French Air Force pilot cadets (Fornette et al., 2012). The proposed cognitive-adaptation training is called *Mental Mode Management* training (Fradin, Aalberse, Gaspar, Lefrançois, & Le Moullec, 2008; Fradin, Lefrançois, & El Massioui, 2006). It aims at improving adaptation capabilities in occupational settings by allowing participants to question, and possibly, to modify their relationship with, complex and stressful situations. This training had two goals: firstly, to increase participants’ awareness of their “mental mode” (i.e., the state of mind with which they approach a situation); secondly, to develop thinking dispositions such as open-mindedness, and attitudes of acceptance, nuanciation, relativization, rationality, and individualization. The results of the study suggest that this training has beneficial effects (a) on flight performance of cadets who had more difficulties during flights than other cadets, and (b) on stress management of all cadets who attended the training (Fornette et al., 2012).
training for the management of complex and unforeseen situations

The concept of mindfulness

Mindfulness refers to a state of consciousness in which an individual directs their whole attention on their present experience, internal and external, with an accepting state of mind, i.e., avoiding as much as possible reacting to the experience or judging its contents (Brown & Ryan, 2003). Mindfulness is a state of mind that can be developed with training. It seems particularly relevant in complex and unforeseen situations. Indeed, in such situations where multiple sources of uncertainty exist, including uncertainties concerning the relevant analysis framework, an open state of mind is undeniably advantageous (Dane, 2011). In the context of high-reliability organizations, Weick and Sutcliffe (2006) estimate that mindfulness is useful for managing unexpected situations because it encourages individuals to (a) keep in touch with deviating elements, (b) not distort reality to make it conform to available concepts, and (c) identify automatic reactions and associations.

Mindfulness training programs

Used initially for stress reduction or chronic pain management in patients, mindfulness training programs have progressively been adopted by healthy individuals (Grossman, Niemann, Schmidt, & Walach, 2004). Numerous studies indicate beneficial effects on cognitive functions (e.g., attentional capacities, cognitive flexibility) and emotions (e.g., mental health, emotional balance). Mindfulness trainings are now offered in professional environments. They have been shown to have beneficial impacts on several areas of work performance, such as learning, safety culture, conflict resolution, creativity, and decision-making (Passmore, 2009).

More recent studies have introduced and evaluated mindfulness training in risky environments, particularly, in military environments. For example, Jha, Stanley, Kiyonaga, Wong, and Gelfand (2010) proposed a new training program (the Mindfulness-based Mind Fitness Training) for improving operational effectiveness and building resilience to stressors in a high-stress military pre-deployment context. The evaluation of this training showed beneficial effects: (a) increases in working-memory capacity and positive affect, and (b) decreases in negative affect and perceived stress (Jha et al., 2010; Stanley, Schaldach, Kiyonaga, & Jha, 2011). However, these positive impacts were observed only for military participants with high mindfulness-training practice time. In Norway, Anders Meland has carried out studies to test the effects, and the transferability, of mindfulness training in military pilots. Preliminary results of a first study in a military F-16 fighter squadron indicate that 12-month mindfulness training is sufficient to further develop concentration and arousal regulation in individuals who already score high on such skills (Meland, Fonne, & Pensgaard, 2012). This training may also be used to protect against future functional and relational impairments that are often associated with high-stress contexts. However, it can have negative effects for participants who lack sufficient motivation to perform the training. On the basis of these preliminary results, a shorter (3-month), more targeted mindfulness training was developed and new studies evaluating its effects on cognitive function and stress among another sample of military pilots are ongoing.
Conclusion

Considering the ever-increasing constraints, demands, and changes that pilots are faced with, it seems especially important to help them improve their ability to cope with complex and unforeseen situations. New training approaches based on mindfulness or on thinking dispositions emphasize the importance for operators to be “present” in the situation, while at the same time developing attitudes of openness and acceptance toward unfolding events. In this way, an ability to see what is really present, independently of, or beyond, what is made salient by pilots’ expertise can be acquired. Bottom-up processes used by operators allow them to answer the question: “What aspects of the situation should I be processing and controlling?”. As a result, they become more likely to effectively “structure” and manage unforeseen and complex situations. By contrast, traditional training programs focus on reinforcing top-down processes by providing cognitive schemas that help pilots to control the thought processes that they use to manage situations. These traditional training programs seek primarily to reinforce cognitive control, whereas the new training approaches promote a “let-go” attitude. These new approaches belong to the category of “general skill training” programs. Indeed, once acquired, attitudes of openness and acceptance can be applied in all situations. The experts who met at the “Air transport pilots facing the unexpected” colloquium mentioned above recommended that the development of “general adaptation skill” trainings must be made a priority over the development of trainings focused on task management.

Even though the new training approaches described above seem very promising, to date, few studies have investigated the effects of such trainings on the management of unforeseen and complex situations in risky environments such as aeronautics. Additional studies are needed to better understand how these trainings operate, and also, how they can be better adapted to pilots. Providing pilots with trainings that are adapted to the specificities of their profession is a key step toward motivating them to practice the techniques that are taught to them in such training programs; without practice, such trainings cannot be effective (Jha et al., 2010). If future studies confirm the preliminary results obtained thus far, new training approaches that seek to foster an open state of mind could be an efficient and necessary complement to trainings centered on the control of thought processes, to improve the ability of pilots to manage complex and unforeseen situations.

References

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