Pilot Cognitive Functioning During Extended, Extreme In-flight Emergencies

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Purpose

• To develop a detailed, holistic understanding of professional PICs’ experiences of an extended, extreme in-flight emergency, which were successfully overcome.
Focus

• Cognitive processes in general, and risk assessment, problem solving, and decision making specifically.
Methodology

• Qualitative.

• Guided interview.

• Precisely defined analysis.
Decision-making Strategies

• Codified
• Associative
• Analytic
Participant Demographics

• Operational experience ranged from very low to very high.
• All currently active in professional aviation.
• Single engine piston to multiengine heavy commercial turbojet/turbofan aircraft.
• Emergencies = two each military, corporate, commercial, and private operations.
Results

• Eight emergencies resulted in the employment of over 40 definitively identifiable cognitive processes, both simple and complex.

• Cognitive processing occurred in four generally discernible stages with definable characteristics.
Results

• Four stages composed of variations in three characteristics of the emergency:

  1. Pilot’s state of physiological/emotional arousal.
  2. Rate of evolution of the emergency.
  3. Understanding of immediate operational needs/impacts of the emergency.
Results

• 1st stage:
  - Short duration (seconds to 1 or 2 minutes)
  - Rapid, shallow, narrow, codified cognition

1. Significantly elevated state of arousal.
2. Explosively/rapidly evolving emergency.
3. Understanding the nature of the emergency; making the aircraft safe.
Results

• 2nd stage:
  - Moderate duration (several minutes)
  - Slower, broader, deeper, associative cognition

1. Moderately excited state of arousal.
2. Moderately evolving emergency.
3. Troubleshooting of the emergency, restoring/stabilizing the aircraft.
Results

• 3rd stage:
  - Moderate/long duration (minutes to hours)
  - Slower, broader, deeper, analytic cognition

1. Lower (still elevated) state of arousal.
2. Stabilized evolution of the emergency.
Results

• 4th stage:

  - Moderate duration (minutes to hour)
  - Slower, broader, deeper, analytic cognition

1. Stabilized to normal state of arousal.
2. Stabilized evolution of the emergency.
3. Executing plan of action; maintaining vigilance.
Results

• Fours stages intermix based upon characteristics of the emergency at any point in time.

• Despite differing circumstances, all the pilots studied similarly employed cognitive phases methodically, logically, and in an organized and generally disciplined manner.
Results

- A very complex web of both simple and complex cognitive processes were required.
- Decision-making was the principle higher order cognitive process employed; all other cognitive processes (simple and complex) supported the principle of decision-making.
Results

• The overall process of overcoming these emergencies was, to an extent, error-tolerant.

• The ability to prioritize and compartmentalize actions proved beneficial, possibly critical.
Results

• There was an observable level of arousal that proved beneficial that appeared to have both upper and lower bounds.

• The pilot’s ability to supplement his own knowledge with knowledge from outside the cockpit proved highly beneficial.
Results

• All forms of memory were involved.

• Both bottom-up and top-down processing were involved.

• Greater levels of experience and training proved very beneficial.
Results

• Codified, heuristic, and analytic decision models were employed autonomously based upon efficiency.

• Multiple forms of risk assessment (risk homeostasis, zero risk theory, threat avoidance model) were employed autonomously.
Discussion of the Results

• Provides insight as to where to focus attention for future research in order to most efficiently and effectively improve pilot cognitive functioning.
Discussion of the Results

• Error-tolerant nature provides optimism that the ultimate desired results are realistically achievable across a relatively wide spectrum of pilots.
Discussion of the Results

• Provide insight into possible immediate actions to be taken to improve pilot abilities in overcoming these emergencies.
Thank You