Case Report

Trans-Cockpit Authority Gradient in Flying Training: A Case Report

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ABSTRACT

Crew pairing in a dual seat cockpit is an important factor in aviation, more so in military aviation, when it concerns both ab-initio and continuty training. Personality of the instructor pilot can at times overwhelm the responses of the pupil pilot and therefore disrupt cockpit resource management, so crucial in safe flying. This may lead to decrement of both situational awareness and airmanship during an emergency situation. This Trans-cockpit Authority Gradient, if not properly maintained, can at times be the cause of an avoidable aircraft accident. This case report explains a situation wherein an improper crew pairing led to breakdown in communication and coordination between the pilot and the co-pilot during an aircraft emergency leading to unpleasant consequences. The need of the hour is to introduce crew resource management training in Indian Air Force in a formal way so as to reduce accidents attributed by such failures.

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Flying training is the systematic modification of behaviour through instruction, practice, measurement and feedback. Its purpose is to teach the pupil to perform tasks not previously possible or to a level of skill / proficiency previously unattainable, both in the situation of ab-initio and continuity-training. Flying training also includes efficient management of control of all those resources that go into the making of such schedules. Modern aviators are required to combine physical, cognitive, team building, and communication skills, while simultaneously monitoring, managing, and updating a dynamic situation in a relatively hostile environment. Communication of factual information is but one aspect of the human-human interface (SHEL model) in a trainer cockpit composition (1, 2, 3). Their efforts must be smoothly coordinated in order to achieve safe and efficient operation of task. The instructor, who normally leads the team, must achieve satisfactory working relationship with his pupil pilot. It should neither be an over-bearing, dictatorial approach nor one in whch command function is obscured.

This variable to be optimized has been termed as 'Trans-cockpit Authority Gradient (TAG)'. It holds importance in areas of flying training where the student pilot's abilities could go unnoticed and result into an error ridden event especially during emergencies in air (4, 5).

With some groups, this TAG is quite naturally established but, in some where it is not established, appropriate training in social skills and related management techniques must be developed. However, in all multi-seat cockpit aircraft accidents, TAG is an important factor and needs to be identified by the investigating team enquiring into the cause of the accident. It must be remembered that breakdown of airmanship is most often caused by failure of integration, and not by any lack of skill or proficiency.

A Case Report

An aircraft accident of a fighter trainer aircraft is described to identify crew coordination and communication.

(a) A dual-check was planned for the benefit of an under - trainee (U/T) Operational pilot, who rejoined from leave after two months. The instructor was operating from the rear cockpit and the U/T Operational pilot from the front cockpit.

(b) Problems started right from taxy of the aircraft to the line-up, where the U/T Operational pilot misread the safe distance between two aircrafts that had a potential for a ground incident. During lineup, the

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crew decided for a dry take-off (in which the throttle is fixed short of max throttle position prior to wheels up) and commenced a take-off after clearance from the Air Traffic Controller (ATC). During take-off, the U/T Operational pilot misread the Jet pipe temperature (JPT) gauge on three occasions and was corrected by the instructor.

(c) Immediately on commencing a turn towards sector, the instructor heard an unusual noise from the engine and noticed the master blinker and fire-warning lights glow. He asked the pupil to confirm the JPT, which was reported as 'off the clock'. Having sensed trouble, the instructor immediately reacted and ordered the pupil to switch off the throttle (HP cock), his tenor of speech was raised.

(d) He simultaneously transmitted *'Engine on fire, Engine flameout, Ejecting'* to the ATC. The fire extinguisher was operated next and fire-warning light went off. At this stage their height was 800 m AGL.

(e) The engine was re-lit and the warning light reappeared. The HP cock was again selected to off position and having spent nearly 55 seconds after transmission of emergency, decided to eject. At that time their height was 500 m AGL.

(f) The instructor initiated ejection and failed in two attempts. When the height was 350 m AGL, the U/T initiated ejection. The ejection was however uneventful.

Discussion

During the course of investigation, certain shortcomings emerged that had a bearing on the aspect of group interaction.

(a) A proper brief and Gen test of the U/T Operational pilot was not carried out.

(b) The responses of the pupil pilot right from the beginning was tentative and lacked confidence. He also exhibited loss of situational awareness. It showed his level of preparedness for this flight.

(c) The instructor was impulsive and over-reactive, guided by inadequate parameters (failed to monitor the engine overheat light) in the lead up to the diagnosis of the emergency and was generally guided by a sequence of events with a high degree of expectancy. He failed to comprehensively take over the controls, though he had intended to do so.

(d) In event of this emergency, the instructor got himself worked up to the extent of cognitive fatigue that exhibited in repeated failed attempts to initiate a successful ejection, though the ejection seat was fully serviceable. He failed to sequentially 'first squeeze and then pull' the ejection handle.

(e) The U/T Operational pilot was conspicuous by his non-participation in events during the emergency and did not contribute anything that could have improved the instructor's situational awareness. In fact, he used a non-standard term 'off-the clock' (meaning overheated engine) to describe the JPT that led the instructor to interpret the situation as engine flameout.

(f) There was inadequate communication and co-ordination between both the crew and the overall 'team situational awareness' was depleted. The probable reasons may have been incorrect judgment, breakdown in adequate group interaction and incompatible crew pairing.

Profile of the pilots It is quite evident that experience and behavioral style of the pilots had an important role in the resultant crew performance.

(a) **Instructor**: He was a fairly experienced pilot with about 1200 hrs of experience on type. Additionally, he was a qualified flying instructor and a fighter strike leader. Presently, he was the Squadron flight commander, in-charge of all flying operations. Analysis of various evidences, viz., interviews by the court, flying documents, clothing card, CVR, etc., indicated him as emotional, impulsive over reactive and 'heedless for rules'.

(b) **U/T Operational pilot**: An inexperienced pilot with about 400 hrs of total flying experience which includes 51 hrs on type. His present appointment in the Squadron was of a U/T Operational Pilot. His progress record in flying showed a regular decline indicating him as a slow learner and average

in flying proficiency. He had averaged about 3 hrs of flying per month since getting posted in his present appointment. Analysis of various evidences indicated that he was under - confident, unassertive and passive.

Pilot Judgement The court-of-inquiry observed that, in the event of an unusual noise, the instructor arrived at the diagnosis of engine flameout without confirming the engine-overheat light and his decision to elect 'HP-cock off' in this situation was considered incorrect. His decision was probably driven more by his prior experience in this aircraft. Judgment is the mental process that is used in decision-making. This process comprises of an eight-step model starting from problem discovery, problem diagnosis, alternative generation, risk analysis, background problem, decision and action. Some of the human abilities required for a good judgment include perception, creativity, mental fortitude, discipline, leadership and social skills. It can be inferred that good judgment can be cultivated and developed. The key factor here is attitude. Flying training and experience develops an attitude towards risk taking in aviation. It may at times cultivate hazardous attitudes, a cause of irrational behaviour that must be detected and corrected in time before they control the decision making process. Some indications for such attitudes are tentative pilot, scud running, loss of situational awareness, casual neglect for flight planning, over-confidence and so on (6).

More often, incorrect judgment is reinforced because it does not result into a bad outcome. When a poor decision is made and nothing happens, it distorts our perception of the decision and makes us regard the poor decision not so bad. A tendency to cultivate such a hazardous attitude rises as we think that because nothing happened before, nothing will happen this time. Many times in the course of flying training, small errors of omission and commission are condoned and adequate efforts are not made to rectify them. Such aviators are more likely to fit the 'accident profile'. This profile involves pilots with flying experience of 300 to 800 hours during which time their 'confidence levels' exceeds their 'ability levels'.

Team Work The U/T Operational pilot after having read the JPT as 'off the clock', neither reported nor was asked to report the JPT thereafter that could have probably affected the instuctor's situational awareness. Development of a multi-piloted aircraft has no doubt reduced the individual workload but the system of redundancy has failed too often because either the Captains have not heeded the warnings of the sub-ordinate members or the crew members who possessed adequate information, had for some reason, not provided it. In a group performance situation, a number of interpersonal factors are relevent to crew effectiveness. The personality required for a single pilot aircraft may at times lead to selection of pilots who communicate less than an average person, an essential requirement for a well performing group. This aspect has great impact in areas of flying training and invariably affects the performance/learning abilities of student pilots. It is well known that teamwork among operational personnel depends on positive relationships. At times, losing temper, swearing or shouting at the student training. It adversely affects this relationship, specifically when flying with a similar instructor. The team needs to appreciate how timing, phrasing, intonation and non-verbal aspects of communication influence group dynamics.TheU/T Operational pilot may have been overwhelmed by the tenor of transmission from the instructor in the wake of the emergency. Ironically, data on pilot selection that is an important input factor for effective flying training, is predominantly related with military flying but, most of the published data on aspects of teamwork failure in aviation relates to civil aviation (6, 7, 8).

During investigation into a DC 8 air crash in 1978, the National Transportation Safety Board (NTSB) noted, *"the safety board believes that this accident exemplifies a recurring problem - a breakdown of cockpit management and teamwork during a situation involving malfunction of aircraft systems in flight. To combat this, responsibilities must be divided amongst members of the flight crew while the malfunction is being resolved..... Admittedly, the stature of a captain and his management style may exert subtle pressure on his crew to conform to his way of thinking. It may hinder interaction and adequate monitoring and force other crew member to*

yield his right to express an opinion". In another air crash of a B 737 in 1982, the NTSB reported the cause of the accident to the *co-pilot's lack of assertiveness and possibly a general hesitancy among subordinates to question superiors forcefully* (6).

Maintenance of a healthy group norm is very important in effective crew performance. Input factors for a suitable group performance are, personality characteristics on attitudes related to leaderships and cockpit role structure. Two leadership profiles are identified that are more pertinent to effective group function, 'task oriented' that is primarily concerned with performance and, 'group oriented' that is primarily concerned with feelings and needs of the group members. The ideal orientation for flight crew in most situations is a *strong* combination of both. Extremes of each type discourage effective communication. It has been observed that *'low-task, high-group'* oriented pilots (as in case of the instructor) are quite effective in routine situations but not as effective in high demands. The instructor's response during this emergency may have manifested this observation. On the other hand, *'high-task, low-group'* oriented pilots are quite effective in high demands but not as effective in day-to-day operations. The performance of the sub-ordinate members largely depends on the Captain's leadership style. If the characteristic of the Captain is insensitive and intimidating, the sub-ordinate crew hesitates to speak up and shows reluctance to question superiors or assume control even in potentially dangerous situations (6, 7, 8, 9). The trainee, despite being an operational pilot, was found to have been non-participating in the events that unfolded throughout except in the end when preservation of life mattered, and he offered to initiate ejection after a couple of failed attempts by the instructor. Knowledge and expectations cultivated from their prior experiences can also significantly facilitate or inhibit the function of the group.

Leadership behaviour One of the important functions of an effective leader is to develop a team concept within his group, i.e., to develop a feeling or motivation to accomplish team goals over and above individual goals. Personality and attitude are factors that control this outcome. Where personality traits cannot be modified, attitudes are highly modifiable. As discussed above, it is a strong combination of both task-orientation and group-orientation (assertive behavior) that is most desirable. This is shown in the leadership grid (Fig 1) that places various behavioral styles in perspective. In this accident, the instructor was in 'violate their own rights' whereas the pupil was in the 'do not contribute' area of the grid, both behaviour styles being incompatible.

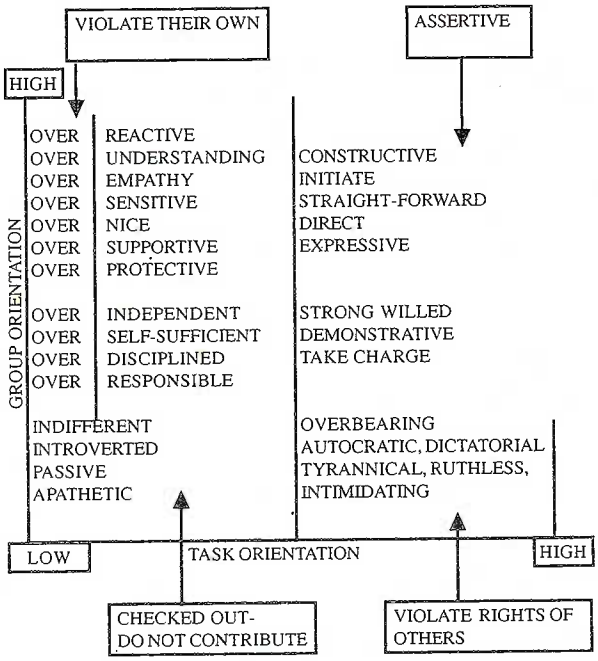

Fig 1: Leadership Grid

Trans-cockpit Authority Gradient (TAG) Communication and co-ordination of the crewmembers in a multi-piloted aircraft cockpit plays a very important role in establishing a healthy group norm. The manner in which the instructors exert authority on the cockpit activities, greatly influences the flow and coherency of cockpit communication. A steep gradient is produced when an over-bearing or dictatorial instructor is paired with a fairly inexperienced pupil. An inverse steep gradient is formed when the instructor allows the command function to be obscured, more so in military aviation where the ranks and roles are well defined; espeially when the co-pilot/other crew/passengers happen to be senior to the captain. A flat gradient is produced when both the crew with equal proficiency are paired together. In this, if one makes a mistake, the other may be slower to point it out and therefore does not wish to cause offence,

generally described as mutual complacency. In all these situations, the inferential elements of communication may be inappropriate and overall communication impaired, an important causal factor for an error. An optimum gradient needs to be established to ensure that the operational integrity of cockpit dialogue is in no way compromised (1,4,5). In some, it is naturally established but in some it can be overcome by training on certain social skills and management techniques. It must be reiterated that TAG is factor of attitudes and leadership behaviour and not that of ranks and positions. It's about how the captain leads his team resulting in a meaningful and effective response from the crewmembers, collectively, to a given situation. Considering the behavioural styles of the instructor and the student pilot, the gradient can be presumed to be steep that led to inadequate co-ordination between both of them.

The aspect of TAG assumes greater importance in military aviation, as even in single seat operations, the pilot is a member of a team. It may include member of a formation, the controller or even the supervisors. Training aviators for this involves even more complexities. Under these circumstances, the TAG established is far more variable and unpreditable. Therefore, there exists a need to introduce formal training to aviators on this aspect, early in their careers. A small survey carried out on operational military pilots at the Flying Instructors School indicated that it was the behavioural and leadership style of the captain that held the key in deciding the gradient in flying training. The student pilot has no say in the matter and does things as told. A feedback from the instructors of the same school indicated that 'weeding out' rate was very low in Indian Air Force and that permitted accident-prone pilots into operational flying. They echoed frequent active interaction of aviation psychologist/physiologist with pilots and other crew at all flying training establishments in IAF. Incidentally, none indicated the desire for any formal training to improve this aspect.

CRM Training Inadequate communication has played a major role in causation of all human error accidents. In order to enhance operational efficiency and flight safety by improving coordination between crewmembers and judicious use of available resources, crew/cockpit resource management (CRM) training assumes great importance. Though some of the major airlines and other air forces have included this aspect in thier flying training schedules, the Indian Air Force is conspicuous by its absence. CRM training essentially addresses issues like communication among crew members, dealing and coping with stress, modification of attitude/behaviour, conflict resolution, offering critique, leadership and assertiveness, building up of team concept, delegation of tasks, true appraisal of a situation and decision making. Response effectiveness (5, 7, 9) was reported positive, in that, attitude and behaviour improved with training and Pettitt (5) reported reduction in sense of urgency and response rigidity. It must be remembered that a formal and structured training schedule on CRM techniques improves the chances of teams establishing the optimum TAG under varied circumstances, especially in military aviation, where one may not be in a position to select his own crew.

Conclusion

Modern aviation has evolved from a meaning of basic stick and rudder competence, to something much broader - a complex mix of human, machine, and environmental elements. Operational errors and aviation accidents, roughly 80% of which still involve human error, are frequently blamed on 'poor airmanship'. Aircraft accidents, espeially in military operations, are on a rise and the major causative factor remains human error. Most of the times it is failure of group interaction as a result of inappropriate TAG that is the cause of the accident. Ironically, very few reports identify this as a factor. Identification of attitudinal profiles and establishing the optimum authority gradient in aviators is of paramount importance, particularly in flying training. The concept of reinforcement of CRM techniques in flying training has proved its reliability and validity by various airline organiations and air forces. In military aviation, tailormade crew pairing is an untenable possiblity. The definite role of a formal and structured CRM training in reducing the number of flying accidents attributed to human error must fast be realized and implemented. There also is a need to monitor aspects of CRM deficiencies at flying training establishments by trained aviation psychologists/ physiologists closely and intervene wherever necessary. A proper feedback structure must be developed to avoid

chances of any personal bias. This would ensure cultivating healthy group interaction norms by pilots quite early in their flying career. Finally, there exists a need to develop and publish a data bank on all issues involving human error accidents in military operations, specifically factors involving cockpit resource management failure, to suggest further developments in this area.

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