Somato/oculogyral illusion in helicopter flying

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ABSTRACT

A Chetak helicopter, piloted by a 28 years old trainee aviator met with an accident in a rocky terrain. The aviator, having commenced a left descending turn with 8-10 degrees of bank, experienced pronounced yaw to right. Both pilot and co-pilot perceived it as a case of engine failure. The visual sense was so overwhelming that they failed to notice the jetpipe temperature and the presence of engine noise. Subsequent actions were taken by the co-pilot, a trained aviator with a total of 1483 flying hours. Helicopter crash landed with severe vertical impact. The pilot was unable to monitor or interpret instruments. The accident occurred due to misperception of the abnormal attitude of aircraft as an emergency due to single, yet visually predominant symptom (viz yaw to right). This misappropriation can be ascribed to an inadequate correspondence while simulating such an emergency during flying training. The paper discusses such issues as 'transfer surfaces' and 'realism' during flying training and simulation.

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KEY WORDS : Somato/oculogyral illusion, Helicopter crash, Flying training, Realistic simulation

Many a times, simulation of emergencies during flying training is not very realistic. This results into a degree of correspondence, between simulation and the situation simulated, less than one-to-one. In such situations, successful learning takes place indirectly i.e. through cues and selecting appropriate responses, a process called discrimination and use of previously learned skills in situations which are different from the situations wherein the skill was learned, a process called generalisation. Nevertheless, the skill acquired through training in such low realism simulations, which are instinctually incompatible is vulnerable to certain subtle breakdowns especially in a novice. This paper discusses a helicopter accident of Army Aviation. The accident was a direct consequence of a false perception of the abnormal attitude of aircraft as an emergency. This misperception can be ascribed

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to an inadequate correspondence of simulated emergency during flying training with realistic situation.

**Brief narrative**

A Chetak helicopter, piloted by a 28 years old trainee aviator (108 captain hours on helicopters; 0:45 captain hour experience in night flying) met with an accident in a rocky terrain at approximately 2000h in the month of May. The aviator, having commenced a left descending turn with 8-10 degrees of bank, experienced pronounced yaw to right. Both pilot and co-pilot perceived it as a case of engine failure. The visual sense was so overwhelming, that they failed to notice the JPT and ignored the presence of engine noise. Subsequent action were taken by the co-pilot, a trained aviator with a total of 1483 flying hours. Pilot was unable to monitor or possibly interpret the instruments which were all hazy to him. Helicopter crash landed with severe vertical impact inflicting fatal injuries to the co-pilot. No physical/physiological incapacitation or infirmity in the pilots or technical malfunction was identifiable in the causation of the accident.

**Discussion**

Training is the systematic modification of behaviour through instruction, practice, measurement and feedback. A realism is necessary to assure that training received in a simulated condition will transfer to operational environment. This concept is based upon a theory developed by an American psychologist, Edward L Thorndike [1]. His 'common elements theory' suggests that transfer will occur to the extent that a simulation and the situation simulated share common elements. A later theorist, Charles E Osgood [2], developed the concept of 'transfer surface' based upon an extension of the common element theory. Using Osgood's transfer surface, one could map an assumed relationship between elements of simulation and the actual condition being simulated. When there is one-to-one correspondence, according to Osgood, transfer of training will be positive and high. Less than one-to-one correspondence will yield decreasing transfer to the point that none will occur when the correspondence is zero.

In the absence of realism, transfer of training takes place through cues. Pilots depend upon cues to assess the status and condition of their aircraft, to initiate action, to guide their performance and to signal when an action should be altered or ended. The concept of cues and the distinction between a cue and stimulus are important aspects of simulation and flight training technology. A stimulus is a physical object or event that can activate a sense organ. The training task is to learn the meaning of such stimuli and to derive pertinent information from them, so that proper responses can be made. As these meanings are learned, stimuli become cues. In other words, a cue is a stimulus that has acquired meaning [3].

Interpreting cues and selecting appropriate responses involve a process called discrimination. Discriminations are not simple, easily learned processes. The more complex the skill, the larger is the number of moment-to moment discriminations that must be made. The principal difference between a novice and an expert pilot performing complex task is that the expert has learned to discriminate subtle stimulus differences, that a novice cannot. He/she can also translate subtle meanings of such stimuli in to equally subtle control movement or other responses [3].

Another concept important to the understanding of training is generalisation which refers to the use of previously learned skills in situations which are different from the situations in which the skill was learned [4].

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In the accident cited above, the following important points were observed:

(a) Following a left descending turn, the pilot perceived a sense of yaw to right. It is possible that the left descending turn was tighter than admitted by the pilot and accelerative force in the manoeuvre could have been well/marginally beyond the threshold of human perception. This perception of yaw to right could have been due to oculo/somatogyril illusion.

(b) Pilot's inability to monitor the instruments could be an accompaniment of oculo/somatogyril illusion.

(c) The accident occurred due to misperception of the abnormal attitude of the aircraft by the pilot and co-pilot, due to a single, yet visually pre-dominant, symptom of yaw to the right, as an emergency i.e., engine failure. This was because, during flying training, such an emergency is simulated by lowering the collective control column. This results in a loss of height and yaw to right. However, two other cardinal signs of the emergency viz fall in JPT and loss of engine noise can not be simulated because the engine is actually running. Loss of height and movement of yaw to right, alone are to be learnt as an indication of engine failure with a presumed fall in JPT and cessation of engine noise. Obviously, the correspondence between simulation and the situation simulated is less than one-to-one and the learning is through discrimination and generalisation which are liable to degenerate in a stressful situation, especially in a novice crew.

Conclusion:

The accident reiterates the significance of realism in simulation during flying training. Such a realism may be achievable in an advanced, motion based simulator. Statistics of occurrence of flying accidents due to inadequate realism in simulation during flying training, is not available to the authors. However, 'no power landing' are known to have been executed by the fixed wing pilots in Indian Air Force even when there was no engine malfunction. These instances share a common analogy with the sequence of events in the case presented above (ie an erroneous yet dominant cue was misinterpreted as an emergency even in the absence of corroborative evidences). The accident also underlines the need for a 'human factor' analysis of such simulations, during flying training, to evaluate its conformity to human instinct, degree of correspondence between the simulation and the situation simulated and their consequent efficacy in imparting flying skill.

References