Relationship between situation awareness and experience during conditions of equipment failure and poor visibility

Maria Natalia Russi-Vigoya, PhD, AHFP and Patrick Patterson, PhD, CPE

Abstract

Situation awareness (SA) is not required to make good decisions, but when pilots are fully aware of a situation, SA tends to have a positive impact on their decisions. Furthermore, research has also shown that hours of experience flying (HEF) play an important role in aviation safety. Records show that certified private pilots who have more HEF have fewer accidents than those having less. This research aims to identify whether there is a relationship between HEF and SA under unexpected flight conditions of equipment failure and poor visibility. The results showed that less HEF was associated with higher SA only during the no failure conditions. There were no statistically significant relationships showing that SA and HEF correlated under any combination of failure and visibility conditions. Better understanding of SA and flying experience could potentially improve decision making under unexpected conditions.

Introduction

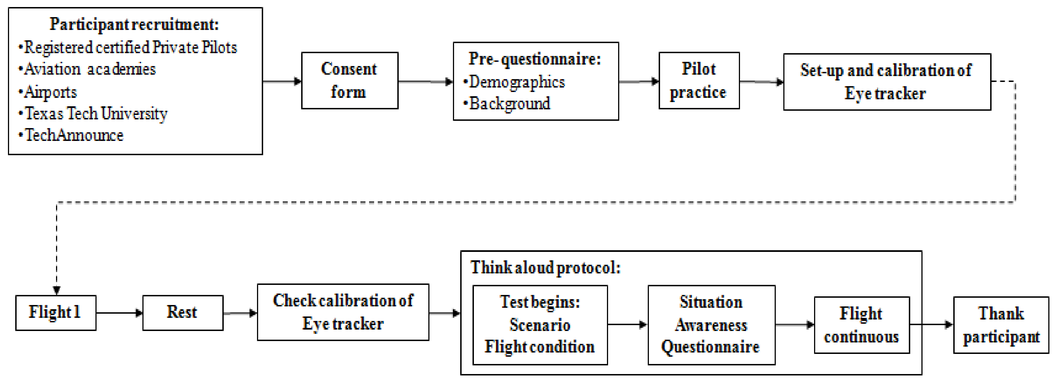
- Poor visibility and equipment failure are abnormal conditions for VFR pilots. However, they are still vulnerable to these conditions
- SA plays an important role in the decision-making process [1, 2]
- There is still a need to understand pilot SA when faced with unexpected conditions [3, 4]
- Pilots with more HEF have fewer flight incidents [4]
- More experienced pilots develop better memory storage, facilitating the categorization of events by gathering cues from the environment [2, 6]
- Novice pilots tend to either overlook or over sample information because they need to think through the information provided [6]
- Pilots with less experience can build SA by maneuvering the aircraft [7]
- Too much information can diminish SA, especially in pilots with little experience [7]
- More experience with a system can lead to a better understanding of changes within the system, stating that more experienced people tend to recognize unusual situations fast [8]

Purpose

Investigated the relationship between SA and HEF during abnormal conditions of visibility and equipment failure

Methods

Procedure



Apparatus

Flight simulator:
1) Airspeed indicator; (2) attitude indicator; (3) altimeter; (4) vertical speed indicator; (5) directional gyro; (6) turn indicator; (7) outside view; (8) compass; (9) GPS; (1b) backup airspeed indicator; (2b) backup attitude indicator; (3b) backup altimeter; and (9b) backup GPS. (10) Playseat, (11) joystick, (12) throttle, and (13) rubber pedals

Participants

30 male non-instruments certified private pilots from different ages (M = 49.13 years old; SD = 12.63)

Variables

Situation awareness (SA):

- SA is defined as "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" [1]
- SA was measured using the SAGAT technique (Situation Awareness Global Assessment Technique)

Hours of experience flying (HEF):

- Participants reported their HEF on a pre-questionnaire

N = 30	Failure		
Weather	None	Directional Gyro (DG)	Altimeter
Clear visibility	(n = 5)	(n = 5)	(n = 5)
Poor visibility	(n = 5)	(n = 5)	(n = 5)

Results

Conditions	Correlation
All (n=30)	- 0.100
Clear visibility (n=15)	- 0.069
Poor visibility (n=15)	- 0.062
No failure (n=10)	**- 0.751***
Altimeter failure (n=10)	- 0.028
DG failure (n=10)	0.409
Combined clear visibility and no failure (n=5)	- 0.418
Combined clear visibility and altimeter failure (n=5)	- 0.539
Combined clear visibility and DG failure (n=5)	0.728
Combined poor visibility and no failure (n=5)	0.382
Combined poor visibility and altimeter failure (n=5)	0.231
Combined poor visibility and DG failure (n=5)	0.330

* Significant

Discussion and Conclusions

- This research provides a better understanding of the relationship between SA and HFE in private pilot decision making when facing unexpected conditions in a glass cockpit situation
- Even though more experienced pilots have less accidents during abnormal conditions, this does not mean that more experienced pilots are more aware of the status of the aircraft
- HEF and SA were not related under conditions of poor visibility and equipment failure
- HEF and SA were only related when there were no failures, regardless of the visibility condition

References

[1] Endsley, M. R. (1988). Situation Awareness Global Assessment Technique (SAGAT). In proceedings of the National Aerospace and Electronics Conference (NAECON) (pp.789-795). New York: IEEE.
[2] Endsley, M. R. (1995). Measurement of situation awareness in dynamic systems. Human Factors, 37(1), 65-84.
[3] National Transportation Safety Board [NTSB]. (2010). Safety study: Introduction of glass cockpit avionics into light aircraft (NTSB Publication No. SS-10/01).
[4] National Transportation Safety Board [NTSB]. (2012). Review of U.S Civil aviation accidents, Calendar year 2010. (Annual Review NTSB/ARA-12/01). Retrieved from http://www.ntsb.gov/doclib/reports/2012/ARA1201.pdf
[5] Hunter, D. R., Martinussen, M., Wiggins, M., & O'Hare, D. (2011). Situation and personal characteristics associated with adverse weather encounters by pilots. Accident Analysis and Prevention, 43(2011), 176-186.
[6] Endsley, M. R. (2013). Chapter 5: Situation Awareness. In Lee, J. D., Kirlik, A., & Dainoff, M. L. (Eds.), The oxford handbook of cognitive engineering (pp.88-108). New York: Oxford University Press.
[7] Endsley, M. R. (2001). Designing for situation awareness in complex system. Proceedings of the second international workshop on symbiosis of humans, aircrafts and environment, Kyoto, Japan.
[8] Kahneman, D. (2011). Thinking, fast and slow. New York: Farrar, Straus and Giroux.

Full list of references upon request