Analyzing the Threats of the Failure of Visual Awareness and Cognitive Bias During a Visual Approach for Commercial Operations

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Abstract
The purpose of this study is to conduct a detailed analysis of the limitation of visual awareness that flight crew experience while conducting visual approaches to an airport. Visual awareness is critical while conducting visual approaches and it is important to study the factors that can limit the capabilities of human beings to maintain visual awareness. This research will explore the limitations of visual awareness which special emphasis on change blindness, inattentional blindness, and visual masking. This study will also focus on forms of cognitive bias such as expectation and confirmation bias in the flight deck. Visual approaches expose pilots to a multitude of critical visual stimuli that require strong visual awareness for safe operations. This research will explore visual approaches in commercial operations around the world and conduct a detailed analysis of the Flight Safety Foundation accident database. This study investigated accidents that occurred during a visual approach for commercial operations. For accuracy and relevance to the purpose of the research, the data was further filtered to only include accidents that occurred due to human error that corresponded to visual awareness and cognitive bias. Factors such as alcohol impairment, equipment malfunction, incapacitation, and maintenance were not considered in the analysis. This allowed the researchers to analyze a small, yet relevant database to conduct a comprehension analysis of the factors and events that lead to the accidents. Each accident was analyzed individually and data was analyzed from the state aviation accident investigation report (National Transport Safety Board report).

Methodology
For the study, the aviation safety database of the Flight Safety Foundation was analyzed to study accidents in the period from 1998-2018 that occurred during a visual approach for commercial operations. For accuracy and relevance to the purpose of the research, the data was further filtered to only include accidents that occurred due to human error that corresponded to visual awareness and cognitive bias. Factors such as alcohol impairment, equipment malfunction, incapacitation, and maintenance were not considered in the analysis. This allowed the researchers to analyze a small, yet relevant database to conduct a comprehension analysis of the factors and events that lead to the accidents. Each accident was analyzed individually and data was analyzed from the state aviation accident investigation report (National Transport Safety Board report).

Introduction
Visual awareness is critical while conducting visual approaches and it is important to study the factors that can limit the capabilities of human beings to maintain visual awareness.

Key Concepts Overview
- Visual Awareness: The subjective sensation of seeing something (Wyart & Tallon-Baudry, 2008). Even though the retina of a human being might observe a stimulus, but might fail to perceive a salient visual stimuli.
- Cognitive Bias: Cognitive bias occurs when “human cognition reliably produces representations that are systematically distorted compared to some aspect of objective reality.” (Haslet, Nettle, & Murray, 2015) It can be described as a systematic error in thinking and judgment that affects the decision making of human beings.
- Confirmation Bias: “Seeking or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis in hand.” (Nickerson, 1998)
- Expectation Bias: An individual's behavior, decisions, or actions are influenced by the individual's expectations from an event or entity.
- Inattentional Blindness: A failure of visual awareness where people fail to notice salient objects while looking right at them.
- Change Blindness: The inability to detect changes to an object or scene.
- Visual Masking: The reduced visibility of one stimulus, called target, due to the presence of another stimulus, called mask.

Results
Quantitative Analysis
Accident Classification By Type of Operations

<table>
<thead>
<tr>
<th>Type of Operations</th>
<th>Frequency</th>
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<td>Cargo</td>
<td>1</td>
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<tr>
<td>Other</td>
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</table>

Qualitative Analysis
The following take-aways have been compiled by reviewing the reports from the state investigative agencies and the Flight Safety Foundation:
- Fatigue and situational awareness were analyzed to be leading causes of accidents due to human errors that related to visual awareness and cognitive biases.
- Loss of visual references on final led to accidents.
- Poor crew Resource Management practices described as a major risk.
- Lack of simulator training for visual approaches considered a factor in accidents.

Conclusion
The results from the Flight Safety Foundation data is quantified and a trend analysis is carried out. Fatigue and distractions inside the cockpit such as annunciation and alerts during high task saturation periods are analyzed to be major factors for incidents during visual approaches. Enhanced Crew Resource Management (CRM) procedures and varying Standard Operating Procedures(SOPs) for different Flight Duty Periods(FDPs) are some of the recommended practices that were analyzed in the study.

Acknowledgements
The researchers of this study would like to acknowledge the Flight Safety Foundation for the comprehensive database and insightful analysis. The researchers also acknowledge the aviation accident investigators around the world for their meticulous efforts into investigating aviation accidents and contributing towards making our skies safer. All the data in this study has been retrieved from the Flight Safety Foundation Aviation Safety database and state aviation accident investigation agency reports for each accident.

References
