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Go-Around Noncompliance During Unstabilized Approaches and Landings in Commercial Aviation: A Human Factors Analysis

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GO-AROUND NONCOMPLIANCE DURING UNSTABILIZED APPROACHES AND LANDINGS IN COMMERCIAL AVIATION: A HUMAN FACTORS ANALYSIS

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Informed by findings and recommendations from the Flight Safety Foundation's Approach and Landing Accident Reduction Task Force, we examined and analyzed Aviation Safety Reporting System (ASRS) incident report data from unstabilized approach and landing events. The aim of this study was to investigate the human factors reported as contributing to operational incidents of unstabilized approaches and landings in United States-based commercial aviation. Results showed the unstabilized approaches were significantly less likely to be responded to with go-around compliance. Binomial logistic regression analysis revealed descriptive differences in the associations of the ASRS-coded human factors with the likelihood of unstabilized approaches being continued to landing rather than go-around compliance. Content analysis of flight crew incident report narratives may allow for identification of other contributory human factors not explicitly coded by ASRS, such as decision making. Results from such investigations have the potential to inform effective go-around compliance training designs.

Although U. S. commercial aviation has long been classified as the safest mode of passenger transportation, safety remains a primary focus in NextGen airspace developments. Approximately 65 percent of commercial aviation accidents occur during the approach and landing phases of flight (FSF, 2017; International Air Transportation Association [IATA], 2016). According to the Flight Safety Foundation study, 83 percent of those approach and landing accidents were avoidable if flight crews had intervened on their unstabilized approaches and initiated a go-around. Thus, following proper operational procedures of initiating a go-around in response to an unstabilized approach could potentially avoid 54 percent of commercial aviation accidents. However, despite commercial aviation industry go-around policies, it is estimated that only approximately 3 to 5 percent of unstabilized approaches are met with go-around policy compliance (FSF, 2017).

Unstabilized approaches and landings are persistent and pervasive risks to commercial aviation safety, and they have been identified as a top current safety threat. Echoing the earlier recommendations by the National Transportation Safety Board, the Flight Safety Foundation's Approach and Landing Accident Reduction (FSF ALAR) Task Force called for increased efforts improving flight crew training in order to promote go-around compliance. The ALAR Task Force concluded that go-around policies and procedures have not been sufficient for ensuring aviation safety during approaches and landings (FSF, 2017). Deficiencies in flight crew training for the appropriate operational decision making during unstabilized approaches and landings were identified. According to the ALAR Task Force findings, improvements to flight crew training for go-around compliance need to be informed by the lessons learned from the review and analysis of operational events and incidents of unstabilized approaches and landings (FSF, 2017). To date, there have been no documented efforts reviewing and analyzing operational incidents of unstabilized approaches and landings in commercial aviation toward the end of understanding the psychology of go-around noncompliance and improving effective commercial pilot training for go-around execution.

At the onset of the descent phase of flight, commercial flight crews aim to continuously manage the aircraft configuration of speed and attitude for a stabilized approach to a safe landing. Although occupying less than 14 percent of total commercial flight time, more than half of all fatal accidents in worldwide commercial aviation operations occur during the approach and landing phases of flight (Boeing, 2017). Unstabilized approaches are the primary risk factor in approach and landing accidents, and nearly 97 percent of unstabilized approaches are voluntarily continued to landing (FSF, 2017) in conditions that unnecessarily jeopardize commercial aviation safety. In other words, flight crew continuation of an unstabilized approach was the causal factor, and attributable to human factors. Despite go-around policies and procedural training designed to mitigate needless risks to aviation safety, the tendency for highly trained flight crews to continue with an unstabilized approach persists.

In response to the pervasiveness of go-around noncompliance, the FSF ALAR Task Force conducted an extensive study of the psychology of go-around noncompliance as part of the FSF Go-Around Safety Initiative of 2011 (FSF, 2017). The results of the study revealed that there were differences between commercial pilots who had continued an unstabilized approach to landing and commercial pilots who executed a go-around in response to an unstabilized approach. It was found that a pilot's ability to correctly perceive and assess risk during unstabilized approaches was directly affected by the pilot's situational awareness competencies (FSF, 2017). Pilots who executed a go-around scored higher across all nine factors of situational awareness compared to pilots who landed during unstabilized approaches. As for human factors associated with go-around noncompliance, there were also differences (FSF, 2017). Compared to pilots who executed a go-around, it was revealed that pilots who landed during unstabilized approaches experienced greater influence of human factors associated with a perceived pressure to land, lack of crew support for a go-around, discomfort in being challenged or challenging others, and inhibitions about calling for a go-around due to a perceived authority imbalance in the flight deck (FSF, 2017). Further, the ALAR Task Force interpreted from the results a concerning risk to the commercial aviation culture. Commercial pilots who do not comply with go-around policies and procedures appear to have normalized an attitude of go-around noncompliance (FSF, 2017).

The ALAR Task Force recommendations included the need to understand the psychology of go-around noncompliance, and the lessons learned need to be applied to commercial pilot training programs. Go-around training needs to incorporate lessons learned from operational incidents in order to appropriately reflect typical and atypical go-around execution risk scenarios, and training scenarios should involve realistic simulation (FSF, 2017). The assumption is that training in a wide range of typical and atypical operational conditions may facilitate increased awareness of the risks inherent in those conditions that pose risk to stabilized approaches and warrant execution of a go-around. According to the ALAR Task Force, realistic training scenarios are needed for validation of recommended strategies for improved go-around compliance training (FSF, 2017). In sum, understanding the attitudes and conditions of noncompliance with go-around policies begins with understanding the characteristics of unstabilized approach and landing incidents.

The purpose of this study was to investigate human factors identified and coded as contributing to reported operational incidents of unstabilized approaches and landings in commercial aviation. Understanding the attitudes and conditions of flight crew noncompliance with go-around policies and procedures begins with understanding characteristics of unstabilized approach and landing incidents. Thus, the aims of this study were three-fold: (1) identify the human factors that are coded in Aviation Safety Reporting System (ASRS) reports as contributing to aviation incidents of unstabilized approaches; (2) assess to what extent, if any, the ASRS-coded human factors are associated with unstabilized approaches reported in the ASRS database; and, (3) determine if there was a relationship of the human factors in the likelihood that the reported incident was an unstabilized approach continued to landing versus go-around. This study had the potential of identifying human factors associated with and contributing to reported incidents of flight crew go-around noncompliance during unstabilized approaches and landings and informing effective go-around compliance training designs.

Method

The reports of interest in this study were from commercial passenger air carriers operating under Federal Aviation Regulations Part 121. A study sample pool of incident reports was gathered from the ASRS online reporting system database using the following criteria:

- Date of incident: 01 January 2012 to 31 December 2016
- Federal aviation regulations: Part 121
- Reporting organization: air carrier
- Reporter function: captain, first officer, pilot flying, pilot not flying
- Phase of flight: initial approach, final approach, landing
- Event type: unstabilized approach
- Contributing factors: human factors

The database query output resulted in a return of 444 reports meeting this initial study sample criteria. Following exclusions (e.g., incomplete fields, sole human factor was “other/unknown”), a final study sample of 95 reports was randomly selected, based on an *a priori* power analysis to achieve .95 statistical power in detecting a medium sized effect.

The ALAR Task Force report was consulted for the “situational awareness constructs” and “key psychosocial factors” that were assessed as part of the prior FSF 2017 study, since the ALAR Task Force report was informing this current study. The ALAR Task Force situational awareness constructs and key psychosocial factors were carefully mapped to the ASRS-coded human factors (see Figure 1). Taking this informed approach, eight ASRS human factors were identified for the current study: communication breakdown, confusion, fatigue, human-machine interface, situational awareness, time pressure, training/qualifications, and workload. Since these ASRS-coded human factors map to the constructs and factors identified by the ALAR Task Force, these eight human factors were identified as IVs for this current study.

Given that the overall goal of this study was to inform aviation training designs, the remaining four human factors were reviewed for reconsideration as an IV in the current study. Of those remaining human factors, distraction was identified for inclusion. It was assumed that training designs can impose distractions, and distractions have been found to influence overall flight crew performance (Barnes & Monan, 1990; Foyle et al., 2005; Strayer & Cooper, 2015). This resulted in a total of nine human factors used for this current study.

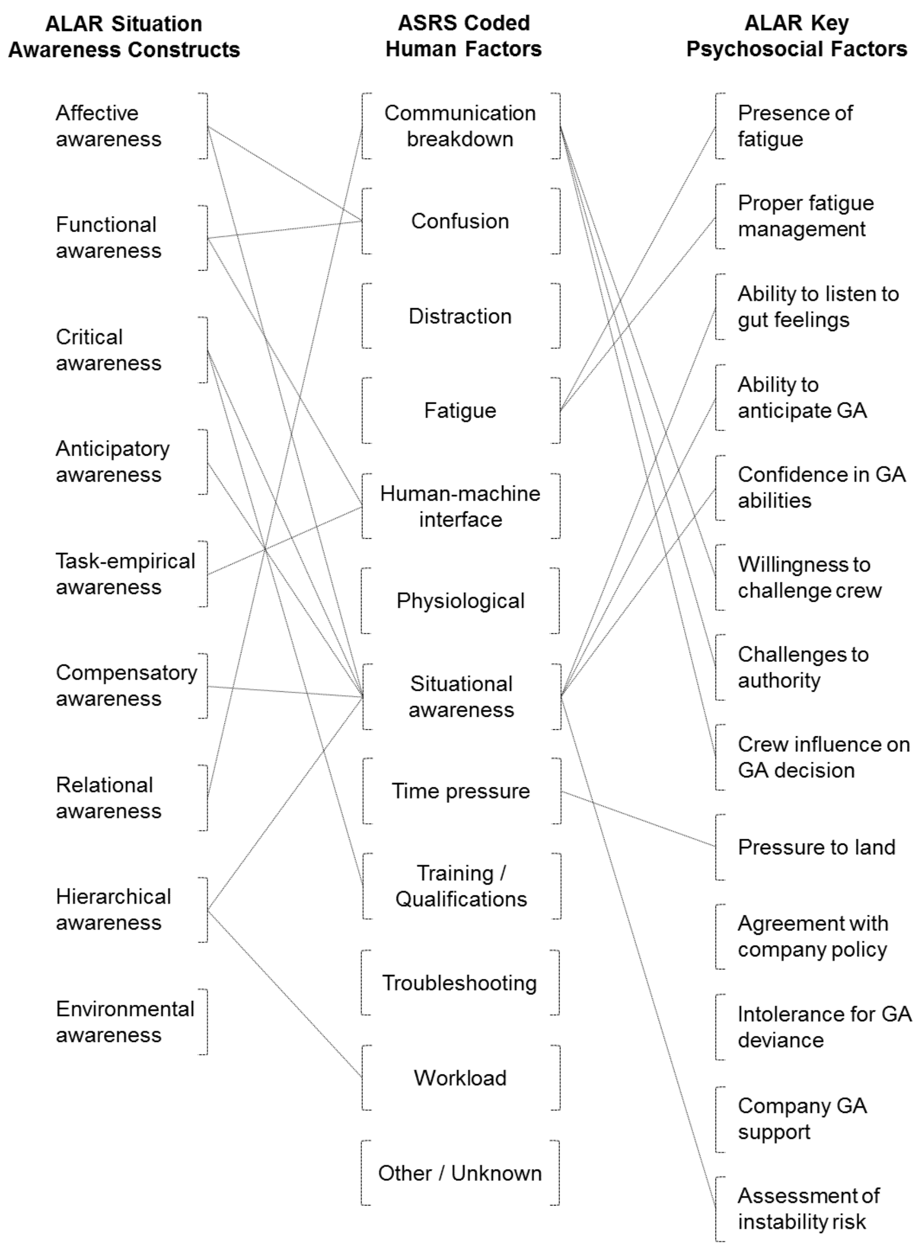

Figure 1. Diagram mapping the ALAR Task Force "situational awareness constructs" and "psychosocial factors" to the ASRS-coded human factors. Each line indicates a mapping from the situational construct or psychosocial factor to the human factor.

Results

A binomial logistic regression was used to test the associations and relationships of ASRS-coded human factors on the likelihood that the reported event was an unstabilized approach continued to landing versus go-around. Preliminary chi-square test analysis of the study sample revealed statistically significant differences in the outcome of reported unstabilized approaches ($\chi^2(1) = 6.58$, $p = .01$, $w = .26$), with more than 63% of the reported unstabilized approaches continued to landing and less than 37% responded to with go-around compliance. Nine of the twelve ASRS-coded human factors were used as the independent variables in the logistic regression: communication breakdown, confusion, distraction, fatigue, human-machine interface, situational awareness, time pressure, training/qualifications, and workload. The dependent variable was the reported unstabilized approach event outcome, either *continued to landing* or *go-around*. The model explained between 7.9% and 10.7% of the variance in event outcome, depending on the method used in calculating the explained variance (Cox & Snell R^2 or Naglekerke R^2, respectively). The model sensitivity was 88.3%, specificity was 31.4%, positive predictive value was 68.8%, and negative predictive value was 61.1%. However, the logistic regression model was not statistically significant ($\chi^2(9) = 7.78$, $p = .56$).

Although there were associations of the ASRS-coded human factors with reported unstabilized approaches, the relationships of these associations were not statistically significant. Three human factors – communication breakdown, confusion, and time pressure – were associated with decreased odds of the report being one of an unstabilized approach continued to landing when the human factor was coded as contributing to the event outcome (see Table 1). The remaining six human factors – distraction, fatigue, human-machine interface, situational awareness, training/qualifications, and workload – were associated with increased odds of the report being one of an unstabilized approach continued to landing when the human factor was coded as contributing to the event outcome.

Table 1.
Logistic Regression Predicting Likelihood of Unstabilized Approach to Landing Report

Variable entered at Step 1	*B*	SE	Wald χ^2	*df*	*p*	OR	95% CI for OR Lower	95% CI for OR Upper
Communication breakdown	-.210	.561	.140	1	.709	.811	.270	2.435
Confusion	-.650	.562	1.337	1	.248	.522	.173	1.571
Distraction	.092	.520	.031	1	.860	1.096	.396	3.036
Fatigue	.076	.700	.012	1	.913	1.079	.274	4.257
Human-machine interface	.191	.573	.111	1	.739	1.210	.394	3.722
Situational awareness	1.067	.571	3.487	1	.062	2.906	.949	8.906
Time pressure	-.275	.721	.145	1	.703	.760	.185	3.124
Training/qualifications	.227	.559	.165	1	.684	1.255	.420	3.754
Workload	.541	.520	1.084	1	.298	1.718	.620	4.757
Constant	-.264	1.033	.065	1	.798	.768		

Note. $\alpha = .05$. OR = Odds Ratio.

Using the Wald χ^2 test to determine the statistical significance of the contribution for each human factor to the model, the results indicate that none of the human factors added significantly to the model (all *p*s > .06). Although situational awareness was expected to improve the fit of the model as indicated during the baseline analysis, it did not result in a statistically significant contribution to the model when added (Wald $\chi^2(1) = 3.49$, $p = .06$, OR = 2.91, 95% CI [.95, 8.91]). This result suggests that when situational awareness is coded as a contributing factor, the reported event is 2.91 times more likely to be an unstabilized approach continued to landing than when the factor is not coded as contributing.

Discussion

This study was an analysis of human factors identified as contributing factors in unsafe acts and attitudes, operational errors, and flight crew behaviors during unstabilized approaches in commercial aviation incidents reported to ASRS. The primary aim was to assess if there was an association of the human factors with reported unstabilized approaches, such that the relationship of the human factors influenced the likelihood that the reported event was an unstabilized approach continued to landing versus go-around compliance. The results revealed that there is a statistically significant difference in the outcome of reported unstabilized approaches, in which it is more likely the unstabilized approach will be continued to landing. The influence of decrements in flight crew situational awareness approached the threshold of being a significant contribution to the likelihood that the reported unstabilized approach was continued to landing. However, results from the binomial logistic regression of this study do not support a claim of the outcome likelihood being influenced by the contribution of any sole or combination of human factors. A recommendation is to analyze associations of the different combinations of human factors coded by ASRS as contributing to reported unstabilized approaches. It may be that certain combinations of human factors are associated with an increased likelihood in the outcome of unstabilized approaches. Human factors may indeed have an influence on the likelihood of unstabilized approaches continued to landing rather than go-around compliance, and these human factors may be interacting with other non-human contributing factors. Analyses of these other contributing factors, human factors, and other flight characteristics is warranted.

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