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Aviation English Assessment and Training

Robert Fowler
Middle Tennessee State University

Elizabeth Mathews
Embry-Riddle Aeronautical University, MATHEWE1@erau.edu

Jena Lynch
Embry-Riddle Aeronautical University, lynchj12@erau.edu

Jennifer Roberts M.A.
Embry-Riddle Aeronautical University, roberj62@erau.edu

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Aviation English Assessment and Training

Robert Fowler
Middle Tennessee State University

Jennifer Roberts
Embry-Riddle Aeronautical University

Elizabeth Matthews
Embry-Riddle Aeronautical University

Jena Lynch
Embry-Riddle Aeronautical University

Due to a significant global increase in demand for air travel, there has been a corresponding increase in demand for ab initio flight training. Thousands of international flight students seek admission to collegiate aviation programs in the United States and Canada every year. These international flight students come to the United States and Canada because flight training is nonexistent in their native countries. In fact, flight training in most of these countries is impossible due to airspace restrictions and onerous regulations. If there is flight training available in these countries, the cost is usually prohibitive compared to the cost in the United States and Canada. The requirements and recommendations for international aeronautical communications is described in the International Civil Aviation Organization (ICAO) Annex 10, Volume II which establishes the English language as the de facto language of international aviation. The majority of these international flight students are non-native English speakers (NNES) which can make it difficult for them to succeed in an already challenging academic environment. Inadequate English language proficiency is also a significant safety issue. Unfortunately, there are very few aviation English assessment programs available to evaluate NNES flight students for aviation English proficiency. There are also very few aviation English training programs available for those who are unable to demonstrate proficiency. This research seeks to answer two questions: Does inadequate aviation English proficiency continue to be a flight safety issue? Has compliance with the ICAO Language Proficiency Requirements (LPRs) helped, or has it contributed to this problem?

The International Civil Aviation Organization (ICAO) is a special agency of the United Nations (UN) which is responsible for the management and development of international aviation. ICAO Annex 10, Volume II describes the requirements and recommendations for aeronautical communications and establishes the English language for radiotelephony and the use of standard ICAO phraseology in all situations for which it is specified (ICAO, 2001). The demand for air travel has increased significantly around the globe, which has led to an increase in demand for flight training. Many student pilots come to the United States from China, South Korea, Japan, and other countries where the demand for air travel is growing rapidly. Inadequate English language proficiency is a significant safety issue that causes delays in progress and could even prevent international student pilots from successfully completing their flight training. High quality aviation English evaluation and training programs are needed to assess the language proficiency of non-native English speaking (NNES) flight students, and subsequently provide language support for those who require it. Currently, there are very few quality aviation English evaluation and training programs available in the United States.

Purpose

The focus of this research is data from the National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) concerning the number of safety incident reports due to inadequate aviation English proficiency submitted between 2009 and 2019. Communication errors have been a contributing factor in many commercial aviation accidents including the worst aviation accident in history at Tenerife (Netherlands Aviation Safety Board [NASB], 1978). A quantitative analysis was done to determine whether the number of ASRS incident reports due to inadequate aviation English proficiency have decreased since the ICAO Language Proficiency Requirements became applicable in 2008.

Research Question

Did the number of ASRS incident reports due to inadequate aviation English decrease after the member states of ICAO implemented the Language Proficiency Requirements (LPRs) in 2008?

Hypotheses

Null Hypothesis: The number of reported aviation incidents due to inadequate aviation English proficiency did not decrease between June 2009 and June 2019.

Alternate Hypothesis: The number of reported aviation incidents due to inadequate aviation English proficiency decreased between June 2009 and June 2019.

The probability of making a Type I error or rejecting a true null hypothesis will be set at significance level .05 ($\alpha = .05$).

Literature Review

Aviation English and Safety

One of the probable causes for the worst aviation accident in history was due in part to inadequate English language proficiency (NASB, 1978). KLM Flight 4805 and Pan American Flight 1736 were two Boeing 747's that diverted to Los Rodeos Airport on the island of Tenerife when a bomb exploded at their destination at Gran Canaria Airport. Los Rodeos Airport and Gran Canaria Airport are both located in the Spanish Canary Islands off the coast of North Africa. Due to the large number of flights diverted to Los Rodeos Airport, the air traffic controllers were forced to park aircraft on the taxiway. When Gran Canaria reopened, both aircraft were cleared to taxi down the runway because the taxiway was blocked by other aircraft. KLM Flight 4805 was cleared to taxi first. Pan American Flight 1736 was cleared to taxi behind KLM Flight 4805 and leave the runway at the last exit before reaching the end. Due to a dense fog that had settled over the airport, visibility was limited, and voice communication on the ground control radio frequency was the only way to determine the position of each aircraft.

The accident investigation determined that the Captain of KLM Flight 4805 erroneously thought that Pan American Flight 1736 had exited the runway and misinterpreted a clearance received from the air traffic controller to be a clearance to take-off. The First Officer on KLM Flight 4805 repeated the clearance and stated "we are now at take-off" which is not standard phraseology. The air traffic controller had not issued a clearance to take-off and did not understand that KLM Flight 4805 had begun its take-off roll while Pan American Flight 1736 was still taxiing down the runway. Approximately 8 seconds before impact, the Pan American crew saw KLM Flight 4805 and attempted to accelerate off the runway, but it was too late. The two aircraft collided causing a total of 583 fatalities (NASB, 1978).

As a result of the investigation, the Netherlands Aviation Safety Board (NASB) made three recommendations. First, they recommended placing a greater emphasis on the importance of exact compliance with instructions and clearances. Second, the use of standard, concise, and unequivocal aeronautical language was recommended. Finally, they recommended the avoidance of the word "TAKE-OFF" in any air traffic control clearance that is not explicitly a take-off clearance (NASB, 1978). This accident clearly demonstrates the importance of clear and accurate communication to the safety of flight.

The communication error that contributed to this tragedy was only one link in a long chain of errors leading up to the accident, including fatigue and the pressure to complete the flight before the crews' duty time expired. However, the fact remains that a simple miscommunication was a critical factor in the accident. The flight crew involved in the Tenerife accident were all highly experienced airline pilots. KLM 4805 Captain Jacob Van Zanten had 11,700 hours of total flight time with 1,545 hours on the Boeing 747 (NASB, 1978). If experienced pilots with thousands of flight hours can make serious communication errors, pilots who have very little flight experience, and who must communicate using English as a second or foreign language could be even more likely to make serious communication errors. While aviation accidents due to inadequate English language proficiency are relatively rare, the

consequences can be catastrophic, as illustrated by the following mid-air collision between two small training aircraft in Canada.

On March 17, 2017, two Cessna 152 training aircraft were involved in a fatal mid-air collision at an altitude of 1,500 feet mean sea level (MSL) just 1.7 nautical miles east southeast of the Montreal St. Hubert Airport (CYHU) where both aircraft were based. The aircraft were operated by a flight school located at CYHU. Cessna C-GPNP was being flown by a private pilot completing commercial pilot training and returning to CYHU from a solo flight to a local practice area. Cessna C-FGOI was being flown by a student pilot who was departing from CYHU on a solo flight to a local practice area (Transportation Safety Board of Canada, 2018).

The private pilot flying C-GPNP had 135.8 total flying hours at the time of the accident. The student pilot flying C-FGOI only had 39.5 total flying hours. Both were international students whose first language was neither English nor French. The English language proficiency of both pilots had been assessed at ICAO Operational Level 4 which is the minimum level recommended by the ICAO Language Proficiency Requirements (LPRs). Cessna C-GPNP had experienced radio communication problems caused by a defect in the push-to-talk switch. The pilot could hear air traffic control (ATC) transmissions, but the pilot's transmissions could only be heard by ATC intermittently (Transportation Safety Board of Canada, 2018).

When the student pilot was cleared to take-off from CYHU, ATC instructed him to turn left eastbound and maintain an altitude "not above 1,100 feet." The readback of the ATC instructions by the student pilot was correct. At the same time, the private pilot was returning to CYHU from the southeast at 2,000 feet and five nautical miles from the airport. During the flight back to CYHU, the private pilot descended to 1,800 feet, and the student pilot climbed to 1,100 feet as instructed by ATC. When the two aircraft reached a separation distance of 1.8 nautical miles, the air traffic controller issued a traffic advisory to the private pilot flying Cessna C-GPNP to look for Cessna C-FGOI, and then repeated the traffic advisory after the private pilot failed to acknowledge the transmission. By this time, the two aircraft were only 1.3 nautical miles apart. At a separation distance of .5 nautical miles, the air traffic controller made one more attempt to contact the private pilot. Contrary to ATC instructions, the student pilot had climbed above 1,100 feet while the private pilot was still at 1,800 feet. When the private pilot flying Cessna C-GPNP realized that ATC could not hear his radio transmissions, he began to troubleshoot the technical problem which caused him to descend below 1,800 feet. The airplanes collided at 1,500 feet resulting in the death of one of the pilots (Transportation Safety Board of Canada, 2018).

The Transport Safety Board of Canada could not determine why the student pilot of C-FGOI climbed above the altitude restriction of 1,100 feet. However, the report indicated that student pilots were not required by Canadian Aviation Regulations at that time to demonstrate English language proficiency before being authorized for solo flights. As a result, there was a high risk of miscommunication of critical flight information by student pilots with minimal English language proficiency. Due to this finding, the safety action taken included publication of a civil aviation safety alert (CASA) that required flight training units ensure that student pilots have been evaluated at an operational level of language proficiency prior to the first solo flight (Transportation Safety Board of Canada, 2018).

These accidents clearly demonstrate how miscommunications due to inadequate aviation English language proficiency can be catastrophic. It is therefore important to understand the prevalence of incidents due to problems with English language proficiency. Baugh and Stolzer (2018) sought to determine if there is a relationship between inadequate aviation English and safety in General Aviation (GA) and specifically in GA flight training. The authors hoped to better understand this relationship to improve the effectiveness of GA safety management systems (SMS). The number of near miss reports submitted to the Aviation Safety Reporting System (ASRS) that involved student pilots was analyzed. While the number of reports suggested that incidents due to inadequate English language proficiency are underreported, the number of near miss reports (NMAC) is evidence that the potential severity of these incidents is extremely high (Baugh and Stolzer, 2018).

ICAO Language Proficiency Requirements

The International Civil Aviation Organization (ICAO) was formed in 1944 at the "Chicago Convention" to promote international civil aviation. Today, 192 member states work together in ICAO to advance the development and ensure the safety of international civil aviation. ICAO standards and recommended practices are published in 19 Annexes to the ICAO Convention. One of these standards requires pilots and air traffic controllers who work on international flights to demonstrate the ability to speak and understand the English language.

The origin of what are commonly referred to as the ICAO Language Proficiency Requirements (LPRs) is ICAO Assembly Resolution A32-16, proposed by India to ICAO in 1998 partly in response to a midair collision over India but also to address a few commercial aviation accidents in which inadequate English language proficiency in radiotelephony communications was determined to be a factor (Friginal, Matthews, & Roberts, 2019). The LPRs include a rating scale that establishes minimum speaking and listening proficiency for pilots and air traffic controllers who operate along international air routes at "Operational Level 4" on the six-band ICAO rating scale. The ICAO LPRs, in fact, only address the English language proficiency required for effective radiotelephony communications, and do not address reading proficiency, nor the English language needs of flight students, flight instructors, or aviation ground personnel (Friginal et al., 2019). Reading proficiency, important because most aircraft operating manuals, checklists, and maintenance manuals are written in the English language, had not been widely identified by accident investigators as a contributing factor in accident investigations at the time of the adoption of the LPRs.

Article 42 of the ICAO Convention requires that standards relating to licensing requirements must be implemented within five years of their adoption by ICAO: the standards were adopted in 2003 and became applicable in 2008. However, the effort required to ensure that personnel achieve ICAO Operational Level 4 is significant, and many member states found it difficult to fully comply by 2008. Partially as a result, the formal applicability date for compliance was extended by three years to March 5, 2011 (Friginal et al., 2019). Even after the 2011 extended deadline, and still today, a number of Member States continue to report difficulties in achieving full compliance. An additional challenge to the aviation industry is that language testing and language training are by and large unregulated industry sectors. Because

there is no accreditation process for language testing and training programs or instructors, the quality of available programs is inconsistent (Werfelman, 2007).

ICAO LPRs Compliance Methods

Every ICAO member state has implemented its own language proficiency guidance and procedures since it is the responsibility of each member state to implement ICAO standards into their national regulations and to monitor compliance with the LPRs. Inevitably, global levels of compliance with the ICAO LPRs has been inconsistent. In the United States, the Federal Aviation Administration (2016) issued an Advisory Circular, AC 60-28b, to provide guidance and procedures on compliance with the "Aviation English Language Standards" (AELS). In Canada, Advisory Circular, AC 401-009 was published by Transport Canada (2018) on "The Conduct of Aviation Language Proficiency Demonstrations."

ICAO LPRs Compliance by Transport Canada

Transport Canada Advisory Circular, AC 401-009, begins with an introduction which states the following: "This Advisory Circular describes the acceptable means of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend or permit deviations from regulatory requirements, nor does it establish minimum standards" (Transport Canada, 2018, p. 3) The next section describes the purpose of the document as follows: "The purpose of this document is to provide guidance regarding the conduct of formal and informal aviation language proficiency demonstrations" (Transport Canada, 2018, p. 3).

Under Transport Canada (2018) definitions, a formal aviation language proficiency demonstration is defined as:

> a demonstration of language proficiency conducted by persons authorized to do so under Section 7.1(3) of this AC to confirm the expert proficiency level of candidates that meet the requirements of Section 6.0(2) of this AC. Language Assessor means a person who has entered into a Memorandum of Understanding with Transport Canada to provide Page 4)

The Advisory Circular goes on to say that Transport Canada (2018) is responsible to:

> implement, maintain, and oversee the program, appoint enough Language Assessors to ensure a timely delivery of service, ensure that all persons authorized to conduct informal and formal language proficiency demonstrations have received training appropriate to the requirements of their functions and maintain and provide to stakeholders a list of Language Assessors. (p. 4)

Transport Canada Advisory Circular AC 401-009 clearly requires that language proficiency assessments be performed by Language Assessors who are qualified to do language assessments. Language Assessors must be approved and hold a Memorandum of Understanding with Transport Canada and receive specialized training to perform this role (Transport Canada, 2018).

AC 401-009 states that any candidate who demonstrates a language proficiency at the ICAO Expert Level 6 according to the ICAO Language Proficiency Rating Scale will not require a language assessment. Any candidate who is assessed at ICAO Operational Level 4 (minimum proficiency) must be reassessed every 5 years. Anyone unable to demonstrate Level 4 is disqualified for a Canadian pilot or air traffic controller license. The Advisory Circular also differentiates between a formal and informal assessment. Candidates who demonstrate Expert Level 6 language proficiency (e.g. native English or French speakers) do not require a formal assessment. Flight instructors are required to determine whether a student's language proficiency is at the Operational level before allowing the student to conduct any radio communications. When an Operational level of language proficiency is in doubt, AC 401-009 recommends a formal language proficiency demonstration (Transport Canada, 2018).

Informal language proficiency demonstrations may be conducted by trained and qualified Civil Aviation Safety Inspectors and Pilot Examiners (PE's) who are authorized to conduct informal language proficiency demonstrations during the knowledge examination of a check ride. If the candidate cannot demonstrate an Expert level of language proficiency, the PE must advise the candidate that a formal language assessment by a Language Assessor is required and report the result to Transport Canada (Transport Canada, 2018).

Language Assessors are required to complete training before they can conduct a formal language assessment. They must become familiar with the AC and listen to rated speech samples that were developed by ICAO. Applications for the Language Assessor Memorandum of Understanding are reviewed by Transport Canada for approval on a case-by-case basis. Language Assessors must undergo initial training and recurrent training as well as scheduled and special monitoring events (Transport Canada, 2018).

A strength of the Transport Canada AC 401-009 is the requirement for a formal language assessment by a trained and qualified Language Assessor for any candidate who is unable to meet the Expert level of language proficiency. However, it is important to note that there is no requirement for any advanced training in linguistics to be a formal Language Assessor in AC 401-009. ICAO recommends at least two raters to perform language proficiency assessments: one should be a language specialist while the other rater should be an aviation operational specialist (Friginal et al., 2019). AC 401-009 does not include this requirement.

ICAO LPRs Compliance by the Federal Aviation Administration

Federal Aviation Administration (2017) Advisory Circular 60-28B states the following:

This advisory circular introduces the Federal Aviation Administration (FAA) Aviation English Language Standard (AELS) and provides guidance to applicants, airmen, training organizations, Designated Examiners (DE), and flight and ground instructors on how to determine that an applicant for an FAA certificate or a person holding an FAA certificate meets the FAA AELS. AELS will be evaluated before acceptance of a student pilot application or issuance of a student solo endorsement, recommendation or examination of an applicant for an FAA pilot certificate or additional aircraft rating, and whenever an

individual is tested or checked as required by the Administrator under Title 14 of the Code of Federal Regulations (14 CFR). (p. 1)

The AC goes on to state that the United States is a member nation of the International Civil Aviation Organization (ICAO) and has agreed to comply with the ICAO Language Proficiency Requirements (LPRs). All applicants for an FAA certificate must demonstrate ICAO Operational Level 4 English language proficiency. The definitions section of AC 60-28B refers to ICAO Doc 9835 which is the *Manual on the Implementation of ICAO Language Proficiency Requirements* and the attachment in ICAO Annex 1 Personnel Licensing. ICAO Language Proficiency Operational Level 4 is defined as the AELS minimum to receive the "English Proficient" certificate endorsement. AC 60-28B also defines an FAA AELS Evaluator to be "any individual who is authorized to conduct certification, training, testing or checking, or to issue an endorsement required by the regulations" (FAA, 2017, p. 3).

The AC lists FAA personnel, Designated Examiners (DE's), flight and ground instructors, Training Center Evaluators (TCE), check FE's/check pilots, training facilities and flight schools as persons and organizations responsible for continuously monitoring AELS. Unlike Transport Canada AC 401-009, there is absolutely no requirement for any special training. Instead, the AC section 6.2 recommends developing multiple plans of action to make sure the evaluation does not become predictable and refers the reader to the ICAO language proficiency website to listen to audio of the different ICAO English language levels. Section 4.1 notes that the AELS requires a minimum Operational Level 4 on the ICAO Language Proficiency Rating Scale and then describes what the evaluator should look for regarding pronunciation, structure, vocabulary, fluency, comprehension, and interactions. These descriptions are taken directly from the ICAO Language Proficiency Rating Scale. In addition, the reader is referred to Appendix A which simply gives guidance to an evaluator on how to conduct an evaluation for the AELS. According to FAA (2017) Section A.2.3. of Appendix A states the following:

> Based upon the applicant's aviation experience, training, and/or FAA certificate held (or the certificate applied for), the evaluator may ask questions specific to the certificate application. For example, have the applicant/airman listen to the evaluator read an ATC clearance or instructions, an Airplane Flight Manual (AFM)/Pilot's Operating Handbook (POH), or weather report, etc., then ask the applicant to explain the material. The evaluator can determine if the applicant understands in English what they heard and read and if they can effectively communicate in English in a discernible and understandable manner. (p. A-2)

The AC then explains that this will determine the applicant's ability to communicate with ATC, pilots and others who are involved in the preparation and operation of the aircraft (FAA, 2017).

The most significant difference between Transport Canada AC 401-009 and FAA AC 60-28B is the qualifications required to evaluate candidates for language proficiency. Transport Canada does not require Language Assessors to have any special linguistic knowledge or training, and there is no requirement for two evaluators as recommended by ICAO. However,

Transport Canada does require Language Assessors to receive special training and approval to perform language assessments. The FAA requires no special training or approval. The typical flight instructor, check airmen, and Designated Examiner (DE) does not have the specialized knowledge, experience and training required to assess an applicant for English language proficiency. As a result, many candidates for an FAA certificate may receive the endorsement for English Proficiency without a thorough and appropriate assessment.

Another weakness in both approaches is the absence of any guidance for applicants who are assessed below ICAO Operational Level 4. Transport Canada AC 401-009 advises applicants that they must wait 90 days before they can be reassessed (Transport Canada, 2018). FAA AC 60-28B states that an applicant or airman who does not meet the FAA AELS must be referred to the local Flight Standards District Office (FSDO) for evaluation. A certificated airman who is unable to meet the FAA AELS, may be required to undergo a reexamination under Title 49 of the United States Code of Federal Regulations. This is otherwise known as a 709 ride. If an airman is unable to meet the FAA AELS, AC 60-28B states that only the FSDO and appropriately rated aviation safety inspectors or the FAA policy division is authorized to override the original decision. Unlike Transport Canada AC 401-009, the FAA AC 60-28B does not give the applicant a time limit on reexamination. Notably, neither Advisory Circular gives any guidance about training in aviation English after an applicant is assessed below ICAO Operational Level 4 (FAA, 2017).

Methods

This research employs an ex post facto quantitative approach to data extracted from the Aviation Safety Reporting System. A quantitative analysis was performed on this data to determine the number of ASRS reports due to inadequate aviation English proficiency from 2009 to 2019. A linear regression was performed on the data to determine whether the number of reports submitted has decreased since the ICAO LPRs were implemented in 2008.

The Aviation Safety Reporting System (ASRS) is a voluntary reporting system designed to collect aviation incident reports from pilots, air traffic controllers and any other aviation personnel. Highly experienced ASRS staff collect, analyze, and respond to thousands of reports submitted every year. Millions of safety reports have been submitted since the start of the ASRS in 1975.

Limitations of Data

The safety reports submitted to the ASRS are voluntary. As a result, many incidents may not be reported in the system and coding of these reports may contain inaccuracies. Also, there is no specific category in the ASRS database for incidents due to inadequate English language proficiency. Therefore, it was necessary to conduct a search for the words *English* and *accent* in the narratives and synopses to identify incident reports due to inadequate English language proficiency. Unfortunately, many language related incident reports may not include these specific words. As a result, language related incidents may be underreported.

Results

Data for this research was limited to reports submitted between June 2009 and June 2019. A total of 50,885 reports were submitted during this period (Table 1). Unfortunately, the ASRS does not include a report category for language-related incidents. Therefore, a search of the database was performed looking for the words *English, misunderstanding, foreign, communications, language,* and *accent*, resulting in 3,513 reports. However, many of these incident reports were not related to problems with the English language. To determine which were English language incidents, searches were performed using just one word at a time. Searches for the words *foreign, communications, misunderstanding,* and *language* resulted in very few reports. Searching for the words *English and accent* returned 312 valid reports. After analyzing these reports, 247 were found to be incidents related to English language problems.

Table 1 shows a breakdown of these reports. From June 2009 to June 2019, the mean number of total reports due to English language issues was 24.7 and the standard deviation was 6.86 as shown in Table 2. Figure 2 is a scatterplot of the total number of reports per year with a trendline which shows a slight upward trend of the total number of reports from 2009 to 2019.

Table 1
ASRS Incident Reports (June 2009-June 2019)

Year	Part 121			Part 91			Part 135			No Entry			Total		
	Not ESL	ESL	Total	Not ESL	ESL	Total	Not ESL	ESL	Total	Not ESL	ESL	Total	Not ESL	ESL	Total
2009	2242	10	2252	816	5	821	115	0	115	211	0	211	3384	15	3399
2010	3542	11	3553	1176	5	1181	193	1	194	565	8	573	5476	25	5501
2011	3479	18	3497	1333	6	1339	202	1	203	599	8	607	5613	33	5646
2012	3085	11	3096	1394	8	1402	219	0	219	334	4	338	5032	23	5055
2013	2833	15	2848	1168	6	1174	190	1	191	259	2	261	4450	24	4474
2014	2757	18	2775	1233	7	1240	199	1	200	358	4	362	4547	30	4577
2015	3520	19	3539	1573	7	1580	309	2	311	539	2	541	5941	30	5971
2016	3125	6	3131	1593	5	1598	307	0	307	371	1	372	5396	12	5408
2017	3009	17	3026	1542	6	1548	254	1	255	385	0	385	5190	24	5214
2018	3463	20	3483	1416	6	1422	269	1	270	461	4	465	5609	31	5640
Totals	**31055**	**145**	**31200**	**13244**	**61**	**13305**	**2257**	**8**	**2265**	**4082**	**33**	**4115**	**50638**	**247**	**50885**

Note. **ESL** = Incidents due to language issues. **Not ESL** = Incidents not due to language issues. **No Entry** = Federal Aviation Regulation was not entered in database.
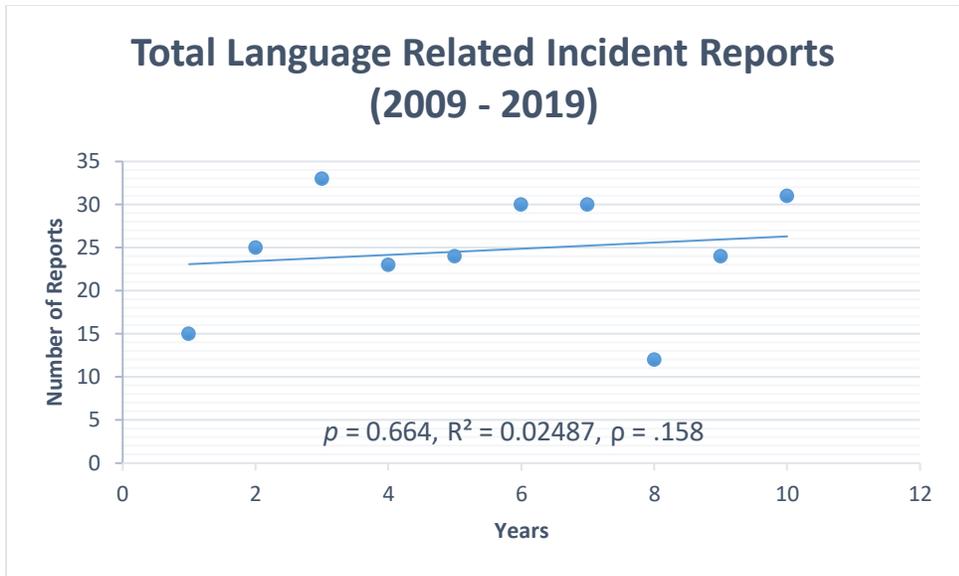
Figure 1. Total Language Related Incident Reports (2009-2019).

Table 2
Summary Statistics

Part	Incident Type	N	Min	Max	Mean	SD
91	Non-Language	10	816	1593	1324.4	237.56
	Language Related	10	5	8	6.1	.9944
	Total	10	821	1598	1330.5	237.88
121	Non-Language	10	2242	3542	3105.5	419.14
	Language Related	10	6	20	14.5	4.696
	Total	10	2252	3553	3120.0	420.70
135	Non-Language	10	115	309	225.7	59.76
	Language Related	10	0	2	.8	.6324
	Total	10	115	311	226.5	59.98
No Entry	Non-Language	10	211	599	408.2	129.95
	Language Related	10	0	8	3.3	2.907
	Total	10	211	607	411.5	132.03
Totals	Non-Language	10	3384	5941	5063.8	755.06
	Language Related	10	12	33	24.7	6.864
	Total	10	3399	5971	5088.5	758.39

A linear regression was done on the total number of language related incidents reported to the ASRS between June 2009 and June 2019 as shown in Figure 1. A simple linear regression was found to be statistically insignificant, $F(1, 8) = .204$, $p = .664$ with an R^2 of .025. Additionally, the scatterplot showed a weak relationship between the year and ASRS reports, and this was confirmed by Pearson's correlation test, $\rho = .158$. Therefore, we fail to reject the null hypothesis. The number of reported aviation incidents due to inadequate aviation English proficiency did not decrease between June 2009 and June 2019. This analysis suggests that the

number of ASRS reports due to inadequate aviation English proficiency is still a threat to aviation safety despite the implementation of the ICAO LPRs in 2008. The largest number of reports in Table 1 were submitted by Part 121 scheduled air carriers with a total of 145 reports. The mean number of reports submitted by Part 121 air carriers was 14.5 with a standard deviation of 4.696 as shown in Table 2.

Part 91 operators submitted a total of 61 reports as shown in Table 1. The mean number of reports submitted by Part 91 operators was 6.1 with a standard deviation of .9944 as shown in Table 2. To determine the number of ASRS incident reports involving Part 91 training flights, a search was performed on the Part 91 incident reports to determine the number that were submitted with a mission of "training." This search yielded 21 incident reports out of the 61 total incident reports filed between June 2009 and June 2019 that were related to inadequate aviation English language proficiency during a training flight. Therefore, 34% of the Part 91 incident reports were related to a flight training incident. This relatively small number of incident reports supports the conclusion of Baugh & Stolzer (2018) that incidents related to English language proficiency are underreported. However, the potential severity of these incidents is extremely high considering that seven of the 21 training incidents (33%) resulted in a near miss (NMAC event category).

Conclusions

The data from the ASRS demonstrates that the number of reported incidents due to inadequate English language proficiency did not decrease after the ICAO LPR's were strengthened in 2003 and continue to threaten aviation safety. While the number of reports from Part 91 operators is relatively small compared to the number of reports from Part 121 operators, the number of near miss reports from Part 91 operators demonstrates the potential high cost of these incidents.

It is not just commercial air carriers that are endangered by this problem. The fatal midair collision between two Canadian training aircraft flown by international flight students who were nonnative English speakers (NNES) was partly due to communication issues (Transport Canada, 2018). In the United States, an estimated 40,000 international student pilots train every year, and many are NNES (FAA, 2019; Hoffman, 2020), creating the possibility of a similar event occurring in the future. The Canadian accident and the disaster at Tenerife show that pilots of all experience levels have been involved in accidents that were due to communication issues. Therefore, it is imperative that candidates for pilot certificates be properly assessed for English language proficiency, and that those who do not meet the proficiency requirements receive specialized training in aviation English courses informed by best practices in language teaching. Unfortunately, the language testing and training industry is not well regulated, which has led to inconsistency in aviation English assessment and training.

It is the responsibility of each member state to develop tests and procedures to comply with the ICAO LPRs. ICAO provided guidance in ICAO Document 9835, *Manual on the Implementation of the ICAO Language Proficiency Requirements* and held a series of workshops and seminars (Friginal et al., 2019). For example, Document 9835 recommends that member states form groups of qualified and experienced language raters; however, it is not the mission

nor the mandate of ICAO to produce a standard language test. For many reasons, including the lack of standardized language testing, compliance has been inconsistent and uneven (Friginal et al., 2019).

While Canadian and the U.S. regulations are clearly intended to comply with ICAO LPRs, the guidance and procedures outlined in AC 401-009 and AC 60-28B do not consistently follow the recommendations in ICAO Document 9835. Strengthening and clarifying assessment procedures, in accordance with ICAO Document 9835, will improve member states' ability to fully comply with the ICAO LPRs, and better ensure that language-related disasters are not repeated.

Recommendations

The results of this research clearly demonstrate that safety incidents due to inadequate aviation English proficiency continue to threaten aviation safety. ICAO recognized this and made recommendations to strengthen language proficiency requirements and improve aviation safety as a result. More than a decade after ICAO strengthened the language proficiency requirements, incidents and accidents due to inadequate English language proficiency continue to occur. While incidents due to inadequate aviation English proficiency appear to be underreported, data from the ASRS demonstrate the high potential cost of these incidents. Due to ICAO's reliance on each member state to comply with the LPRs and ICAO's limited resources, compliance with the ICAO LPRs has been inconsistent and ineffective as shown by the examples in this report.

To develop and implement solutions to the issue of language proficiency in flight training, academically well-qualified English as a second language (ESL) specialists and aviation experts must collaborate to design and implement assessment programs to evaluate international flight students for aviation English proficiency and aviation English training curricula to help those who are unable to demonstrate proficiency. These programs should be designed to closely follow ICAO recommendations for aviation English assessment and training.

As mentioned in a previous section, the FAA's AELS is one current measure in place to reduce the likelihood of English proficiency as a safety hazard. Lynch and Porcellato (2020) articulate the challenges facing the Designated Examiners, instructor pilots, and flight training institutions in assessing and monitoring flight students' English proficiency; namely that these persons responsible for compliance with the FAA AELS might have no training in language assessment, and they receive minimal guidance from the FAA on how to conduct and rate these high-stakes, safety-critical assessments. One solution to the challenge facing flight training programs is to screen NNES candidates before they begin flight training.

Many university-based flight training programs rely on university entrance requirements such as TOEFL or IELTS results to screen candidates for English proficiency (Campbell-Laird, 2006). While there appears to be some overlap in the academic skills needed to attend a U.S. university and those needed to pursue flight training, there are critical differences. Lynch and Porcellato (2020) highlight the mismatch between the nuanced skills likely needed for flight training and the composite scores of popular tests like TOEFL and IELTS. These scores include

flight training-irrelevant language skills, such as academic writing, which may mask areas of weakness in oral skills. In other words, students may meet academic English proficiency requirements but still lack critical language skills needed for effective flight training. Put simply, flight training is a unique linguistic environment, and a tailored English proficiency test is required for more valid results.

At least one university-based flight training program has begun developing aviation English proficiency screening tools for this purpose. These assessments help to identify incoming students whose English proficiency is sufficient to begin flight training and those who need additional aviation English instruction prior to flight training. Ongoing research and development of screening tools should incorporate guidance from ICAO Document 9835, as well as research findings from aviation English scholars about the linguistic domain of flight training such as that conducted by Bieswanger, Prado, and Roberts (2020) and the forthcoming work of Udell, Schneider, and Kim (2020). Such research will help identify salient linguistic tasks and features of English proficiency required for flight training, particularly in U.S. university-based programs. The flight training industry will benefit from well-designed screening tools that can offer a first line of support for incoming NNES flight training candidates in their pursuit of safe and efficient training.

Demonstration of an English language proficiency level which is inadequate for the linguistic demands of ab initio flight training should not mean a student pilot cannot pursue flight training. However, to maintain operational safety, it is recommended that the student does not begin practical flight training until achieving the required English language proficiency level. Language acquisition takes considerable time and is dependent on several internal and external variables. It is impossible to predict the exact amount of time which will be required to reach the appropriate level. Research indicates it may take between 200-400 hours of aviation English training to achieve results (Mathews, 2008), and in some cases even more time may be required.

Importantly, due to the uniqueness of the flight training domain, the training provided should be designed specifically for the flight training context (Friginal et al., 2019). Student pilots need to communicate with many people in many contexts, including air traffic controllers, flight instructors, classmates, and FAA examiners. They use English in learning environments like classrooms and simulators, and in real, high-stakes operational environments like airports and flight decks. In addition to listening and speaking skills, student pilots require reading proficiency to comprehend information-dense technical texts such as the FAA's 500-page *Pilot's Handbook of Aeronautical Knowledge* (FAA, 2016). Student pilots must also communicate in both formal and informal assessment settings during oral and written examinations. This domain description demonstrates some of the key differences between flight training and professional pilot domains. As the ICAO Language Proficiency Requirements were developed for the professional pilot and air traffic controller domain, this description also highlights the challenges of applying the ICAO LPRs to the evaluation of student pilots who will use English in the ab initio flight training domain.

A quality aviation English course for flight training, purposefully built for that distinct context, must also be taught by an academically well-qualified instructor. ICAO Document 9835 recommends that the instructor have master's degree credentials in the field of Teaching English

as a Second Language (TESOL) or Applied Linguistics. To ensure operational accuracy, it is also recommended that instructors work with aviation subject matter experts during course design and implementation.

ICAO also recommends that a training course follow a Content-Based Language Teaching approach: Students learn aviation content relevant to flight training while also developing the English language skills needed in flight training. For example, in a landing gear module, students could learn foundational knowledge about landing gear, including a case study about a landing gear incident, and practice associated language tasks such as *reporting an incident*. The curriculum may also introduce students to routine phraseology, providing the opportunity to develop familiarization through role play scenarios in a low-stakes, safe classroom environment. Students have reported these types of practice environments to be particularly beneficial before having to participate in radiotelephony communications with air traffic controllers while also flying an aircraft.

Along with aviation English proficiency screening, an English course designed for flight students will move the flight training industry towards a more systematic and principled approach at addressing the issue of English language proficiency. The assessment and training course strategically work together as an advantageous and productive part of a student pilot's flight training journey, increasing efficiency, and improving operational safety. With these proactive interventions, students can enter the high-stakes, expensive, and heavily procedural process of flight training prepared, resulting in overall smoother operations for flight training organizations.

The authors recommend that ICAO member states revise their compliance procedures with the ICAO LPRs to include assessment programs that closely follow ICAO guidance such as the Aviation English proficiency screening tool described in this report. In addition, well designed aviation English training programs should be included to help improve proficiency. Relying solely on aviation experts without specialized training in language testing or training to evaluate applicants for language proficiency may lead to pilots, air traffic controllers, and other aviation professionals in the system who are unable to understand and communicate critical information to ensure the safety of flight.

The available data about incidents due to inadequate aviation English proficiency is very limited. To improve data collection for future research, the authors recommend inclusion of a category in the ASRS for language related incidents. In addition, aviation accident investigators should be trained to identify accidents in which language issues were a factor. One tool developed to promote a more consistent and standardized system of identifying and considering possible language factors is the *Language as a Factor in Aviation Accidents and Serious Incidents: A Handbook for Accident Investigators* (Mathews, Brickhouse, Carson, & Valdes, 2019). While developed for accident investigators, it contains useful guidance for the reporting of language issues, including a checklist to identify possible language environments and a taxonomy to promote the use of standardized terminology in reports.

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