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# Aviation English in a Bilingual Context

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With over one thousand fatalities attributed to language errors within the field of aviation, pilots' level of self-efficacy in English, the official language of aviation, relates directly to their level of comfort in the cockpit and ability to perform their flight duties safely. There are international standards that evaluate a pilot's ability to read, speak, write, and understand English before a pilot is permitted to test for his or her license. However, issues still arise and can be attributed to a pilot speaking limited English register of aviation English. This study investigates the use of English and Spanish in the applied context of aviation by researching bilingual cockpit interactions. Data pooled from a survey of pilots who speak Spanish as a native language were used to recognize patterns between language acquisition and proficiency within the cockpit as well as understand the frequency with which pilots hear their native language over the radio. The primary research question attempted to evaluate pilots' comfort level in professional aviation situations that involved the use of non-native language. Additional research questions investigated how bilingual pilots react linguistically to emergency situations and how this affects their abilities to perform flight duties. Understanding pilots´ in-flight experiences in relation to language proficiency may contribute to a proactive safety culture by providing recommendations that could help prevent future accidents.

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With the advent of global aviation and worldwide involvement in the rapidly expanding industry of aviation, effective collaboration necessitates standards be set in place that regulates the industry's operating procedures. As early as the Chicago Conference and the founding of the International Civil Aviation Organization (ICAO), English was determined to be utilized as the "de facto" language of aviation, and this has since been the standard upon which all further regulations have been built. Standard phraseology has been established, using the English language, that creates an Aviation English register, or language used for a specific purpose, and in this case, within a specific professional context. Each pilot is expected to learn to operate using this register for all radiotelephony communications, which can pose a challenge, especially for pilots who do not speak English as a native language. Although flying the aircraft itself is a pilot's first priority, when they are taught to "aviate, navigate, communicate," communication plays a critical role in safe operations and involves a human factor that can be trained and therefore has the potential for improvement to increase overall safety in aviation. Despite standards and requirements for compliance being set in place, communication continues to be a threat to aviation safety (Fowler et al., 2021).

## Purpose

This research focuses on pilots' levels of self-efficacy in the cockpit, in various flight scenarios, when asked to rate their comfort level using and performing in English, a language that, for the group under study, is not their native language. By evaluating differing levels of English proficiency and corresponding proficiencies in performing cockpit operations, this research analyzes different language decisions by pilots whose native language is not English. The research aims to provide information as to where potential latencies in pilot language training exist and aims to offer concrete suggestions to improve the current situation.

## Research Questions

1. *How does exposure to the English language influence pilots' levels of self-efficacy of Aviation English proficiency in the cockpit?*
2. *With what frequency are pilots exposed to their native language while performing aviation duties, and what effect does this have on their ability to perform their duties*
3. *What is the preferred language (the official aviation language, which is English or another language) for bilingual (or multilingual) pilots for processing a situation and performing their piloting tasks during an emergency, and how does this affect their ability to perform related tasks?*

## Literature Review

### Aviation English

ICAO's language standards divide English proficiency into six categories, with the requirement to test to at least a level 4. Having tested at this level of proficiency indicates that the individual should have a pronunciation that only sometimes interferes with understanding, has well-controlled grammar, with errors only occurring in unexpected situations, and has the vocabulary necessary to effectively communicate in the register required. These categories are based on linguistic aspects such as Pronunciation, Structure, Vocabulary, Fluency, Comprehension, and Interactions. The standard aviation phraseology that all of this is based on includes about 400 words (Friginal et al. 2020). Although understanding may be slower when situations occur outside of the standard phraseology, the pilot is expected to be proficient with the language in a way that has been determined not to interfere with flight safety. Even ICAO acknowledges, however, that "no set of standardized phraseologies can fully describe all possible circumstances and responses" (ICAO 2010).

### Accidents Relating to Aviation English

There have been over 1,000 fatalities attributed to language errors within the field of aviation; this loss of life has at least partially been attributed to human factors caused in part by a lack of proficiency in English or by miscommunications due to cross-cultural communication breakdowns (Friginal et al., 2020). Accidents occurring that can be attributed, at least in part, to language issues necessitate the creation of additional standardized practices to mitigate the risk of complicating human communication factors in aviation. One accident that was affected by language barriers was that of Avianca Flight 052. This flight is considered to represent a lack of proficiency in Standard Aviation Phraseology. In this case, native-speaking Spanish crew members were coming in to land at JFK during a storm in 1990, where traffic was heavy because ATC was attempting to land planes as quickly as possible. The Avianca aircraft had minimum fuel and failed to convey this appropriately to ATC. They never declared an emergency as they should have but rather simply requested priority. When the plane had to go around, the plane was completely depleted of fuel and crashed, even though the crew members had communicated with each other, in Spanish, about the low fuel and were aware of the issue. The Captain in this situation seemed completely reliant on the First Officer's English communications, but even though the FO was communicating with ATC, he never actually conveyed how dire their condition really was (Friginal et al., 2020).

The Cali, Colombia accident, in 1995, which involved a Boeing 757 with a native English-speaking crew and a native Spanish-speaking controller resulted in the death of 160 people. Such accidents have prompted the need to evaluate how communication breakdowns contribute to unfortunate situations that can end in incidents or accidents. Although the most known cause of the accident was faulty navigation, unclear communication could possibly have prevented the severity of the situation. The ATC on duty at the time later reported that if the crew had been native Spanish speaking, he would have informed them that their transmissions regarding their navigation did not make sense. He admitted that his limited command of English prevented him from increasing the crew's situational awareness in a scenario where clear

communication could have saved their lives, along with the lives of the other people (Ladkin 1996). This situation reflects the usefulness of plain-language English, especially in emergency scenarios; the limited standard aviation phraseology that the ATC was trained in was not enough to communicate the situation the pilots were in or to understand why their navigational requests did not make sense (Friginal et al., 2020).

## Language Processing in Non-Native Speakers

There are many factors surrounding pilots' acquisition of their non-native language of English that can relate to proficiencies in the cockpit and must be taken into consideration when assessing a non-native English speaker's ability to respond to flight scenarios in English safely. The age for the onset of bilingualism and the context in which they learned the language each contribute as factors in this process. In order to improve training practices, it is also crucial to understand the intricacies of how non-native English speaking pilots process language while performing aviation tasks; this aids in understanding best practices in teaching and learning the aviation register, as well as any other necessary language, to contribute to a safer flight environment. By evaluating cockpit interaction, and cockpit conversations, of pilots who speak a native language other than English, conclusions can be drawn regarding a pilot's comfort level using their non-native language to perform tasks in different flight scenarios.

## Methodology

The research study was conducted in two stages, namely the primary stage and the secondary stage. During the primary stage, two research questions were addressed, while the secondary research stage explored an additional research question. After each survey was developed to address the respective research questions, they were distributed to various individuals to receive feedback and suggestions for improvement. The primary research survey tool was evaluated by several pilots, ranging from 3-10 years of experience in aviation. Since this survey was also distributed with the ability to complete the questions in Spanish, the Spanish version was edited and improved by a professor with a Ph.D. in Second Language Acquisition and Teaching, with a specialization in Spanish sociolinguistics, as well as a native Spanish speaker. This survey was distributed through a snowball method of recruitment, with the primary researcher contacting several pilots through various methods and asking that the survey be distributed to other pilots who fit the participant pool criteria.

The primary stage of the research focused on pilots who speak a native language other than English. For this study, it was the Spanish language. The research questions attempted to measure how pilots' levels of self-efficacy in the English language correlate to their overall proficiency in the cockpit. In addition, in order to understand more about the flight environment from a bilingual perspective, the research questions examined the frequency with which participants heard their native language in the cockpit. To that end, the following variables were studied: *pilots' English language proficiency in the cockpit* and *English language exposure*. The data collection instrument for the primary research consisted of a 44-question survey which utilizes both the Likert scale and other categorical responses. The survey instrument utilized six-point Likert scale questions to evaluate how comfortable pilots felt in different flight scenarios; these questions aimed to rate pilots' own levels of self-efficacy on their comfort level performing

tasks in their non-native language of English. Additional Likert-scale and categorical questions examined the frequency with which pilots were exposed to their native language over the radio and on the ground, as well as inquiring about experiences they have had flying with people who speak a native language that is different from their own. The study assumed pilots were already proficient in the Spanish language as native speakers; the survey questions focused on their overall experience with English. Out of the 44 questions that made up the first survey instrument, 12 questions were related to the demographics of the participants. These demographic questions directly assessed each participant's language experience as well as aviation background to allow for a comparison of language acquisition to presumed flight proficiency. Using this survey and the variables mentioned earlier, the research allowed for an examination of the relationship between English language exposure and Aviation English proficiency to evaluate plain-language English exposure's relation to Aviation language proficiency. In addition, questions addressed pilots' exposure to their native language while performing flight duties and their corresponding comfort level with performing flight tasks in English, and their language of choice compared to their flight proficiency. The survey was distributed to the participants through a link generated by the Qualtrics software; the participants were given an opportunity to respond between February 16, 2021, and March 28, 2021.

The secondary research went more in-depth to examine what bilingual pilots' preferred language is inside the cockpit and whether the language they choose to use affects their ability to perform flight tasks. To better understand the role of English proficiency in aviation accidents, the study examined how multilingual pilots react linguistically, especially in emergency or high-stress scenarios. The goal was to further evaluate the *pilot's level of comfort* in these scenarios and see how their *preferred language choice* affected their *ability to perform in the cockpit*. A survey was developed that took information learned from other Spanish-English research and investigated deeper into which language pilots think in and how this affects their self-efficacy when performing tasks in the cockpit. As such, this second stage of research sought to evaluate which is the preferred language of pilots when processing a situation and performing their piloting tasks during an emergency, as well as how the language they instinctively use affects their ability to perform. The intent was to evaluate whether pilots would prefer to use English, the official language of aviation, or their native language, in which they may feel more comfortable. The survey instrument consisted of 34 questions; 10 questions were demographic ones. Like the primary stage survey instrument, the participants were provided with a link to the survey. The survey was administered through the Qualtrics software; the participants were provided with a time window between July 26 and October 24, 2021, to complete the survey.

An interactive survey was developed that asked aviation students to respond to a pre-recorded Air Traffic Control audio prompt which simulated actual flight scenarios, then evaluate their linguistic processing and level of comfort responding to the scenario. Each of the ten scenarios represented different phases of flight as well as flight conditions. The audio prompts also established differing intensities, based upon whether the situation was a standard situation that happens regularly during flights or if the prompt was asking the student to respond to an irregularly occurring experience, such as a bird strike. Each of the prompts was recorded by a former Air Traffic Controller and utilized standard aviation phraseology. Below is a sample of the audio prompt which the participants were asked to listen to:

Air Traffic Control Audio: *November 123 Alpha Bravo Kennedy Tower. Wind 180 at 5, runway 22 left, cleared to land. Caution wake turbulence, 5 and a half miles in trail of a heavy Airbus A350.*

Participation was requested from aviation students that attend two different university flight departments, a public, mid-sized institution in the Midwest and a private university in the Southern United States. Participants were typically at the beginning of their aviation training and provided insight into how they establish a basis for developing their English skills inside the cockpit. These students represent a group that is at a critical level to benefit from strategic English language education. Demographic questions gauged where participants were in their flight training, as well as experiences they had with each language. Data for these surveys were based on pilots' own ratings of themselves. Similar to the primary research, the survey for the secondary research was evaluated and improved by a former Air Traffic Controller with over eight years of experience, who now works for the FAA. Survey questions were also reviewed by multiple pilots, ranging from 10-21 years of experience in the field. Since this research focused on collegiate flight program students, it was distributed through university emails and professors, requesting participation from flight students who met the criteria of speaking a native language other than English.

Analyzing data for the purpose of this research involved a focus on those who were least comfortable and assessing how their language acquisition or language processing differed from those who felt they were more comfortable. Based on the small data pool, this analysis focused on descriptive statistics and measures of frequency to determine the percentage of participants that responded similarly to each prompt. Analysis of the data involved the use of non-Parametrics statistical tests and comparisons of qualitative data based upon the self-efficacy and levels of experience of the respondents.

## Results

### Demographic Analysis

Twenty-three (n=23) participants gave their consent to participate in the primary part of the research study. Participants for initial research included pilots from several countries, including Chile, Colombia, Costa Rica, Ecuador, France, Mexico, and the United States, with several from Puerto Rico. Their exposure to English, the number of years they have spoken English relative to their age, as well as their purpose and methods for learning the language all varied between participants. 48% of the participants had aviation experience in the airlines, but the pilots ranged from types of aviation such as the military, general aviation, flight instructors, cargo transport, passenger charters, or others. While a larger number of participants were skewed to a lower end of flight hours and years of experience, there were several with over 10,000 flight hours, and 50+ years of experience, with many in the middle of these two extremes as well. The average age of the participants was 40 years. Regarding the reliability of the survey scale items, a Cronbach's alpha ($\alpha$) value of 0.7 or higher was selected for this study. The SPSS software was used to determine the reliability of the scale items. The reliability was found to be ($\alpha = 0.67$ for 4 items) for language proficiency and ($\alpha = 0.97$ for 2 items) for language exposure. For the second stage of the research, nine (n=9) participants agreed to participate in the study. For the questions

that tested the ability of the participants in processing the given flight situations, the Cronbach's alpha ($\alpha$) value was found to be 0.897. Participants were all attending collegiate flight programs and therefore represented a population at a low level of overall aviation experience. These flight students represented student pilots, private pilots, commercial pilots, and several with an instrument rating. They had between 64 and 210 flight hours logged and had been pilots for between 1 and 5 years. The students had spoken English for between 7-19 years, with 44.5% of the respondents having seven years of experience with English. Participants spoke native languages of Korean, Mandarin Chinese, and 44.5% of the participants spoke Spanish natively.

**Research Question One**: *How does exposure to the English language influence pilots' levels of self-efficacy of Aviation English proficiency in the cockpit?*

Gauging how English exposure influenced pilots' levels of self-efficacy in the cockpit was done through a comparison of those whose responses indicated they were less comfortable to those who were reportedly more comfortable with their use of English in the cockpit. 17% of the respondents indicated that they had experienced a situation in which they were less situationally aware due to a lack of language proficiency. Of this percentage, 94% of their responses were ranked moderately comfortable or lower. 75% of these participants preferred Spanish in the cockpit, and they were much less likely to use English outside of the workplace. 13% of the total respondents indicated that they *never* use English outside of the workplace, and 48% of participants had little to no experience with English outside of aviation. In addition, pilots also tended to rate their ability to speak Aviation English higher than their ability to speak English in general. The one-sample Wilcoxon Signed Rank Test (significance level of 0.5) indicated that pilots were at least moderately comfortable using (both hearing and speaking) English while in the cockpit. Also, pilots indicated being most comfortable using English while they were in the cruise stage of the flight, followed by the taxiing stage. On the other hand, about 50% of the pilots preferred to use the Spanish language while in the cockpit, assuming this was caused by the pairing of the staff at their respective jobs, still about 30% of them indicated feeling less comfortable communicating with their peers while in the cockpit. This points to the possibility that when pilots are required to utilize English outside of the aviation register, such as during the circumstances of the Cali, Colombia accident, limited English proficiency can decrease situational awareness and ability to respond appropriately.

17% of the participants indicated having experienced a lack of situational awareness due to their own language proficiency; 52% of the participants also indicated a lack of situational awareness due to someone else's language proficiency. Pilots who responded that they had experienced this lack of proficiency due to language were more likely to indicate that they were less comfortable overall with English, heard Spanish over the radio more frequently, had learned English specifically to become a pilot, and used English less outside of the workspace. One of the respondents who indicated they had been less situationally aware because of language responded that they spoke English a little but that they spoke Aviation English Very Well. This disconnect in the way pilots rate themselves and their own English proficiency is indicative of the types of discrepancies that future training procedures need to take into consideration to best teach English to future pilots. When asked if there was ever a time they did not speak up because they felt they could not say what they needed to in English, 35% responded yes. These situations

represent critical moments in which accidents or incidents could occur because of a pilot's language experience, not necessarily even related to their actual ability to fly the aircraft.

**Research Question Two**: *With what frequency are pilots exposed to their native language while performing aviation duties and what effect does this have on their ability to perform their duties?*

Of the pilots surveyed, 96% reported *always, often,* or *sometimes* hearing their native language over the radio. According to the participants, checklists and placards are mostly provided in English, but 48% still preferred to use Spanish in the cockpit. Operational wise, 42% of the participants indicated hearing Spanish over the radio the most in high traffic zones; also, 88% of the participants indicated hearing Spanish over the radio in the regions of South America, Central America, and Spain. This indicates the extent to which a locally used language plays in aviation operations. Only 39% of pilots surveyed responded that their flight lessons were conducted completely in English, and 56% had flight lessons conducted, at least partially, in Spanish. Most of the participants also indicated speaking Spanish for most of their livelihood; on the other hand, the participants indicated speaking English for significantly less time during their lifetime. This is also supported by other findings in the study in which 60% of them indicated speaking the English language with their family sometimes or not at all; similarly, 47% of the participants responded that they used the English language at their workplace only sometimes or not at all.

**Research Question Three**: *What is the preferred language (the official aviation language, which is English or another language) for bilingual (or multilingual) pilots for processing a situation and performing their piloting tasks during an emergency, and how does this affect their ability to perform related tasks?*

When participants indicated that language processing of a given scenario occurred in English, they were more likely to feel comfortable responding to the prompt and communicating as expected to ATC. 90% of the responses indicated that participants were internally processing in English, while only 10% indicated that they were processed in a native language. Although infrequent, when participants internally processed in their native language, they reportedly felt less comfortable overall, indicative of hesitations that can occur during in-flight language breakdowns. While participants indicated that it was rare for them to process scenarios in their native language, when they did so, they indicated a tendency to experience difficulty in formulating a response and thereafter performing a given task. When responding to emergency or high-stress scenarios given by ATC, they were more likely to feel less comfortable overall. Responses indicated stuttering, difficulty with vocabulary, feeling the need to repeat a response, or other levels of discomfort when performing the given task.

## Conclusions

Lack of proficiency in the register of aviation still exists and is negatively contributing to latencies within the safety culture of aviation. Considering linguistics in aviation accident evaluations represents a relatively recent area of research, and although standards of language exist, improvements in training practices and the standards themselves are still necessary in order

to contribute to a greater safety culture overall. Acquiring language from a source outside of aviation, or having experience with English outside the workplace, may greatly contribute to overall comprehension and mastery of the Aviation English standard phraseology. Having a higher level of presumed language proficiency directly correlates to comfort levels inside of the cockpit and performing flight duties.

## Recommendations

Participants who struggled with responding indicated common themes of lack of understanding of Aviation English instructions and a lack of vocabulary to provide appropriate and correct responses. These indications display a lack of both Aviation English proficiency and plain language English proficiency. Flight programs should not limit their flight training to just standardized English and ensure the student is being exposed to the English language outside of just the standardized phraseology. Students who responded that they had experienced a situation in which they didn't speak up because they felt they couldn't convey what they needed to in English also tended to have a lower experience with English overall or had flight lessons conducted in their native language.

At a collegiate level, admission into flight programs can base language comprehension solely on the university English tests rather than a flight department's own assessment. While such exams assess a student's ability to perform in English at an academic level, aviation inherently requires more immediate and distinct responses, especially during flight or when communicating with Air Traffic Controllers. Assessing a student's proficiency in Aviation English specifically before they begin the program could save time, frustration, and money, all critical components of a student's potential for future success in the industry. Incorporating English assessments throughout the training could allow students to feel supported throughout their time in the program, as well as ensure they are not falling behind for reasons that relate to language proficiency rather than their flying ability.

## Limitations

This research was intentionally limited by narrowing the data pool, as well as by only focusing on pilots rather than other aviation personnel, such as air traffic controllers, who are also required to use English. Rather than focusing on their actual flying ability, information was only gathered based on pilot self-assessment of communication skills. As each case is unique in regard to communication, a larger data pool is needed to provide more accurate results and suggestions going forward. While primary research attempted to permeate the field of Aviation English into the Spanish language, each language has its own nuances and should be studied as well. Secondary research was limited to students in two flight programs in the US, which could be expanded to more collegiate programs as well. Comparing the results of secondary research to those of seasoned pilots would aid in discovering where in the flight training process most language errors are occurring. This would shed light on how they could be prevented from developing and affecting professional aviation environments and lead to a more proactive safety culture throughout the industry. With everyone's language acquisition and aviation experience being unique, follow-up interviews could be a very useful tool to provide concrete examples of what has been most effective as well as aspects that need improvement in relation to English

training procedures and standards in the field of aviation. The researchers hope to improve the study, moving forward by both revising the study design and utilizing more robust data analyses techniques in the future; this will create more definitive results that could affirm the correlations presented here.

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