English Language Proficiency in Radiotelephony: A survey about its effect on the safety and efficiency of aviation

Proficiência em língua inglesa na radiotelefonia: uma pesquisa sobre seus efeitos na segurança e eficiência da aviação

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ABSTRACT

The purpose of this paper is to reveal and discuss evidence that the safety and efficiency of international aviation continues to be adversely impacted by poor English language proficiency over the radio. In 2011, all members of the International Civil Aviation Organisation (ICAO) were declared to be compliant with regards to the English language testing of all pilots and air traffic controllers (ATCOs). However, language experts have continued to raise concerns about the regulatory framework of Language Proficiency Requirements (LPRs) and about whether an international standard of English language proficiency has truly been established. This paper describes the analysis of responses given by pilots and ATCOs to a survey which addressed the nature and frequency of poor language proficiency that they experience during flights. The data show evidence that there continues to be a problem of language proficiency among pilots and ATCOs, that this problem is encountered relatively frequently and that some regions of the world are experiencing it more acutely than others.

Keywords: Aviation, Radiotelephony, English, Safety, Efficiency

RESUMO

A proposta deste artigo é revelar e discutir evidência de que a segurança e a eficiência da aviação internacional continuam a ser impactadas negativamente pela proficiência linguística do inglês radiotelefônico. Em 2011, todos os membros da Organização de Aviação Civil Internacional (OACI) foram impostos a se adequarem à avaliação linguística em inglês de pilotos e controladores de tráfego aéreo. Contudo, especialistas em linguística continuaram a levantar questões sobre o quadro regulatório dos Requerimentos de Proficiência Linguística, além de argumentarem se o padrão internacional de proficiência linguística em inglês estava realmente delineado. Este artigo descreve a análise das respostas fornecidas por pilotos e controladores por meio de um questionário que abordou a natureza e a frequência de problemas com proficiência linguística que vivenciam durante o voo. Os dados mostram evidência de que continua havendo um problema relacionado à falta de proficiência linguística entre pilotos e controladores de tráfego aéreo, que tal problema é relativamente frequente e que algumas regiões do mundo o estão vivendo mais intensamente do que outras.

Palavras-Chave: Aviação, Radiotelefonia, Inglês, Segurança de Voo, Eficiência.

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1. Introduction

Pilots' and air traffic controllers' (ATCOs') communication is primarily a safety issue where intelligible, direct, appropriate, non-ambiguous and concise language is required during routine and non-standard situations and incidents. In 2001, the International Civil Aviation Organisation (ICAO) decided that poor English language proficiency among pilots and ATCOs could be linked to 7 accidents that had resulted in more than 1500 passenger deaths. By 2011, a global system of English language proficiency requirements (LPRs) had been introduced into the licensing system of ICAO's member states' pilots and ATCOs. Crucially, ICAO has no authority to enforce LPRs, and as such their efforts have been restricted to forming the LPR holistic descriptors of Annex 1 Personnel Licensing (ICAO, 2011) and establishing the ICAO LPR Rating Scale. The descriptors within this scale can be used to rank pilots and ATCOs on 6 different areas of language proficiency: vocabulary, comprehension, interactions, fluency, grammar and pronunciation. The minimum level required for a pilot or ATCO to maintain operational status is a level 4 across all 6 of the linguistic areas. The lowest score in any one factor is considered to be the overall level of that pilot or ATCO. The ICAO Rating Scale is intended as a tool that reflects the language requirements of pilots and ATCOs as they communicate on the radio. This scale is only used to assess plain language proficiency. It is not used to assess standard phraseology which is currently considered as a separate qualification.

It is useful to explain the different aspects of radiotelephonic language. Radiotelephony (RTF) is a specific purpose communication between pilots and ATCOs that is designed to secure the safe and expeditious operation of aircraft. RTF is a "party line" in that all aircraft in the area can listen to each communication. However, only one transmission can broadcast at a time, and simultaneous transmissions will block each other with an unpleasant distortion sound. The majority of interactions required for the safe and expeditious operation of aircraft are highly predictable and routine. This type of communication can often (though not always) be adequately achieved using standardized phraseology (the ultra-specific, coded and constrained sub-language of radiotelephony). It is important to note that where standardized phraseology is insufficient ICAO regulations state that plain language may be used. This type of communication describes the spontaneous, creative and non-coded use of language – but language that is constrained to the professional context of radiotelephonic communication between pilots and air traffic controllers. Plain language may be distinguished from everyday language in that plain language must fulfill the maxims of intelligibility, directness, appropriacy, non-ambiguity and concision. It should be noted that while plain language will usually be required in non-standard events, its use may also be required even during reasonably standard interactions (ICAO, 2010).

One of the catalysts for pursuing the specific goals of this paper, and the broader goals of the PhD thesis within which this paper is imbedded, is the response from ICAO to Garcia's submission to the 39th Assembly of ICAO (GARCIA, 2016). Her submission is discussed in the literature review. Empirical evidence to support a revision of the ICAO Rating Scale could be represented by a statistically significant correlation between poor English language proficiency and safety incidents. However, no such evidence exists because no such data are being collected by ICAO. It is quite possible that this type of data are currently not being sought after as it is extremely commercially sensitive. It would also require unprecedented cooperation between states. First, a valid aviation English test would need to be administered to a representative sample of the global population of aviators. Secondly, every safety incident investigation would need to include application of the same test to all of the aviators involved. In this way, a reliable correlation between poor English language proficiency and safety incidents might be established. In the absence of such data, researchers are constrained to collecting anecdotal evidence based on the opinions and insights provided by aviators and language experts. The data collected with this survey are an example of anecdotal evidence.

It is hoped that research such as this might provide ICAO with sufficient anecdotal evidence of poor English language proficiency in aeronautical communication that it might consider pursuing more robust empirical evidence as described above. This paper acts as an introductory study for establishing the direction and content of a PhD thesis. That thesis will (1) gather more data directly from the target domain of ATC to pilot communication, (2) organize those data into a new framework that might be used for future revision of the ICAO Rating Scale, and (3) apply the framework to a corpus analysis of flight transcripts.

This article reports upon a survey completed by 555 pilots and air traffic controllers from all over the world. The purpose of the data gathered for this article is to establish evidence of whether there remains, in the opinion of pilots and air traffic controllers, a safety hazard in the aviation industry in the form of insufficient English language ability among pilots and air traffic controllers. Participants were asked a variety of questions on the nature and extent of English language proficiency and its effects on the safety and efficiency of safe aeronautical operations.

2. Literature review

The nature of the aviation industry as a vastly complex cooperative endeavor between nations is significant complicating factor for establishing a consistent global standard of English proficiency. Campbell-Laird (2004) was early to state that hopes of a truly global standard of aviation English language proficiency testing would remain fractured while each civil aviation authority charted its own

course. Five years after Campbell-Laird's prescient insight, Moder and Halleck (2009) came out in agreement, noting that aviation language testing has been driven more by political horse trading than by best practice. Evidence of this was revealed the following year as Alderson (2010) conducted a comprehensive survey of the quality of aviation language testing in the industry. He found a considerable variation in quality of responses and surmised that this reflected a variation in the quality of the tests themselves, with many institutions demonstrating an equally low awareness of appropriate procedures for test development, maintenance and validation. As recently as 2019, the test construct continues be criticized for its lack of clear definition (PRADO, 2019). The current initiative of the International Civil Aviation English Association (ICAEA) to establish clear principles for aviation English testing is laudable but it remains to be seen whether civil aviation authorities will take up these methodologies. After all, if poor language proficiency is the reality among many pilots and ATCOs, would not accurate testing force national carriers and air service providers to confront the fact that many of their personnel should not actually be operating at all? Do the various global stakeholders actually want accurate language testing of aeronautical personnel?

Furthermore, the ICAO Rating Scale itself has come under scrutiny for not providing empirical evidence to validate their scale (VANMOERE et al, 2009; ALDERSON, 2009; EMERY, 2014). It has also been contested by aeronautical personnel on the basis that it does not prioritize aviation expertise enough (KIM; ELDER, 2015). Garcia (2015) has pointed out the apparent anomaly of the rating scale valuing non-verbal cues, idiomatic speech and complex grammatical speech. Kim and Elder (2015) and Garcia (2015) have demonstrated that both aeronautical personnel and experts on language have doubts as to the validity of the ICAO LPR Rating Scale.

In 2015, Garcia (2015) critiqued the ICAO Rating Scale on the basis that it did not sufficiently meet the specific requirements of aeronautical communication. Following this research, Garcia wrote a working paper submission to the 39th Assembly of ICAO in 2016 on behalf of the member state of Brazil (GARCIA, 2016). Garcia's recommendations included: (1) that Native English Speakers (NESs) should also be tested for communicative competence as NESs and Non Native English Speakers (NNESs) share the responsibility of successful communication, (2) that the ICAO Rating Scale descriptors need to be revised in order to reflect the target domain, and (3) that language proficiency assessment should also encompass standard phraseology. Unfortunately, ICAO decided that no new empirical evidence was available to justify revision of the scale.

One way to collect evidence for identifying a particular problem in a workplace is through surveying the people who are working in that environment. Validation of the content of this paper's questionnaire was accomplished by review of appropriate literature with the questions designed to

reveal data where previous studies had not (e.g.WILLIAMS 2016) or to augment previous research (e.g. PRINZO et al, 2008; FARRIS, 2007; TIEWTRAKUL AND FLETCHER, 2010). Although Malhotra (2006) describes questionnaire design as being as much an art as a science, he advises instrument designers to focus on defining the issue of each question. This advice is especially relevant in the context of surveying aviators who probably do not have a nuanced understanding of linguistics issues relevant to aviation. Krosnick and Presser (2010) make a variety of further recommendations about survey instrument design, including (1) using clear, simple questions with familiar syntax, (2) grouping questions around their related topics, and (3) offering ranking scales that are unambiguous and will be interpreted in a similar way by all respondents. They also recommend that simpler questions (for example demographic questions) should be included early in the questionnaire, with more complex questions at the end. Rattray and Jones (2007) note that including a logical, systematic and structured approach to instrument design will improve reliability and validity of data. All of these suggestions will impact a linguistics survey distributed to aviators. In particular, careful attention should be paid to avoiding academic linguistics terms, or if unavoidable, clearly defining them for the participants.

3. Methodology

The key purpose of the data collected is to establish whether there is evidence of a problem of language proficiency among pilots and ATCOs around the world.

The research questions for this survey were:

1. What do aviators tell us about their experiences with aeronautical communication and how it impacts safety and efficiency in aviation?
2. What is the frequency, nature and significance of poor English language competence in aeronautical communication?

This quantitative survey was carried out from June 2019 until August 2020. A total of 954 responses were recorded via the online survey tool Qualtrics. 555 participants completed the survey in its entirety. Participants were all current or former commercial pilots and air traffic controllers. For the purposes of broad analysis, the survey inquired of the region(s) in which each respondent worked. These regions included North America, Latin America, Africa, Europe, the Commonwealth of Independent States, the Middle East, Asia and Oceania. Respondents were allowed to choose multiple regions to reflect the flight network within which they work.

The nationality of each participant was not requested as there is no necessary correlation between an individual's state and where they work, nor whether they speak English as a first language. Instead, the survey participants were asked which language they considered to be their "mother tongue". 176 respondents indicated English as their first language. A further 15 respondents chose "Other." The remaining responses indicated a range of 45 other languages as a first language.

The survey consisted of 21 questions (see Appendix) that primarily looked at the participants' opinions of the extent, implications and nature of language proficiency problems they encounter during aviation operations. Moreover, the survey touched on certain aspects of the current regulatory environment for English language requirements both locally and globally. This paper focuses on the results of 14 of those questions.

A short, forced-choice questionnaire methodology allowed for the recruitment of a high number of participants from a wide range of national backgrounds, reflecting the international diversity of pilots and air traffic controllers. The instrument was designed with reference to the development processes of other surveys conducted in the aviation industry, see for example Scarpellini & Bowen (2001) and Ison (2011). Content was derived from a review of relevant literature and examination of previous surveys in the aviation sector. The questionnaire underwent a multi-step analysis consisting of aviation content review and survey technique review.

Early decisions about the design of this survey included addressing the topic of the survey early in the questionnaire, grouping questions of the same topic together and proceeding from general to specific questions (KROSNICK; PRESSER, 2010). Considering the large-scale target for participants, closed questions were chosen. Open format questions will follow in a later-stage of the research design of the PhD. "Don't know" options were not included to avoid the phenomenon of "satisficing" where participants inadvertently provide convenient responses to avoid the effort of reflecting on their answers (KROSNICK; PRESSER, 2010). Attention was paid to wording of questions given that aviators were not expected to be familiar with applied linguistics. Information regarding the ICAO rating scale and language in radiotelephony was included early in the questionnaire to avoid error as a result of misunderstanding of particular concepts such as standard phraseology, plain language and general language.

Evaluation of the instrument was secured from linguistics professors at the University of Canterbury, a human factors specialist at Emirates airline as well as a commercial pilot with ATC software expertise. A trial of the instrument was conducted in early July 2019 by three pilots. The required time for each pilot to complete their questionnaire was recorded and feedback sought as to the structure and content of the instrument. In all three cases participants needed less than 15 minutes.

Changes as a result of feedback included defining acronyms such as "NES" (native English speaker) throughout the survey rather than only at the start, and to remind participants of the order of the ICAO Rating Scale 1 (low) to 6 (high).

4. Results

This section of the paper presents the results of the survey. Participants were asked whether they believe that the safety and efficiency of aviation is adversely affected by poor English language proficiency. They were then asked which regions they believe are most adversely affected and the frequency with which they encountered poor English language proficiency on the radio. This section continues with a report on the types of poor language proficiency identified by participants and a discussion of how the survey data corroborate previous research. Finally, data are presented about participants' opinions on whether sufficient resources are allocated to the issue of English language proficiency and whether they believe that tests from different parts of the world are directly comparable to each other.

The regions where the sample population worked are unlikely to be a proportional representation of the where the world's population of aviators work. Respondents were allowed to choose as many regions as they needed, to reflect the different parts of the world that they worked in. The results are presented in Figure 1.

Figure 1. Regions of the world where the respondents work.
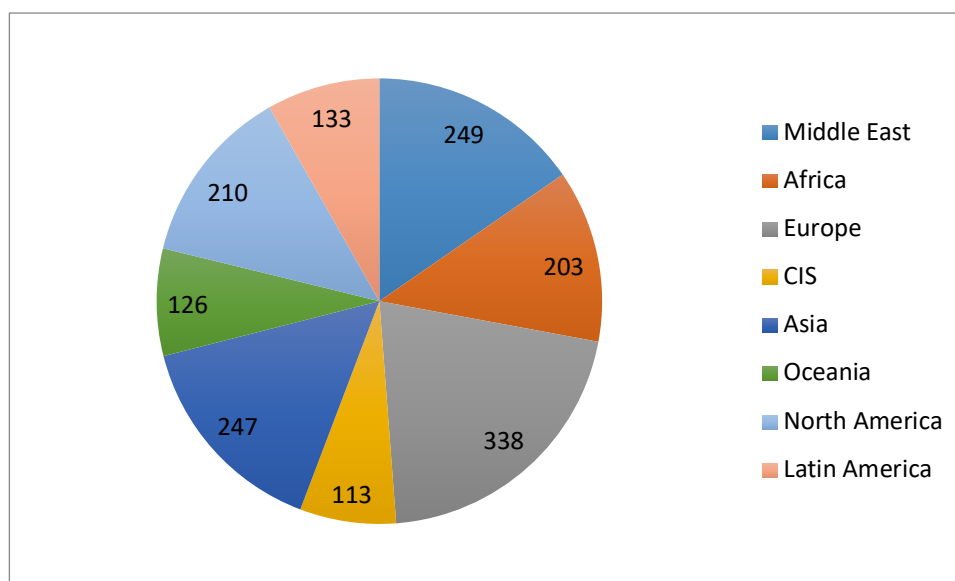
72% of all respondents at least somewhat agree that poor English language proficiency impacts the efficiency of operations in their network. Furthermore, 39% agree or strongly agree. Results with regards efficiency are presented in Table 1.

Table 1. The global effect of low English language proficiency on efficiency of flight networks.

Due to the cascading effects of slight delays, low language proficiency among pilots and/or ATCOs causes a loss of efficiency to the aviation network I work in.						
Strongly agree	Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Disagree	Strongly disagree
63	154	183	39	34	62	20
Total responses: 555						

The negative effect of poor English language proficiency is perceived to be more significant on safety than efficiency. 84% of all respondents at least somewhat agree that safety is compromised by low English language proficiency present in their flight network. Moreover, 64% agree or strongly agree. Results with regards safety are presented in Table 2.

Table 2. The global effect of low English language proficiency on safety of flight networks.

Low language proficiency has a negative impact on the safety of the aviation network I work in.						
Strongly agree	Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Disagree	Strongly disagree
169	186	109	17	16	29	29
Total responses: 555						

Safety and efficiency might be considered to be the two most pressing concerns for the aviation industry. This research reveals clear evidence that, despite the international system of ICAO language proficiency requirements established since 2011, aviators continue to express concern that both safety and efficiency are currently compromised by poor English language proficiency.

Having addressed the effect of poor English proficiency on the safety and efficiency of aviation, the survey then asked which part or parts of the world were considered to have the most serious problems with English communication on the radio. Asia was most commonly identified. The results are presented in Figure 2.

Figure 2. Regions where poor English language proficiency are considered to be most problematic.
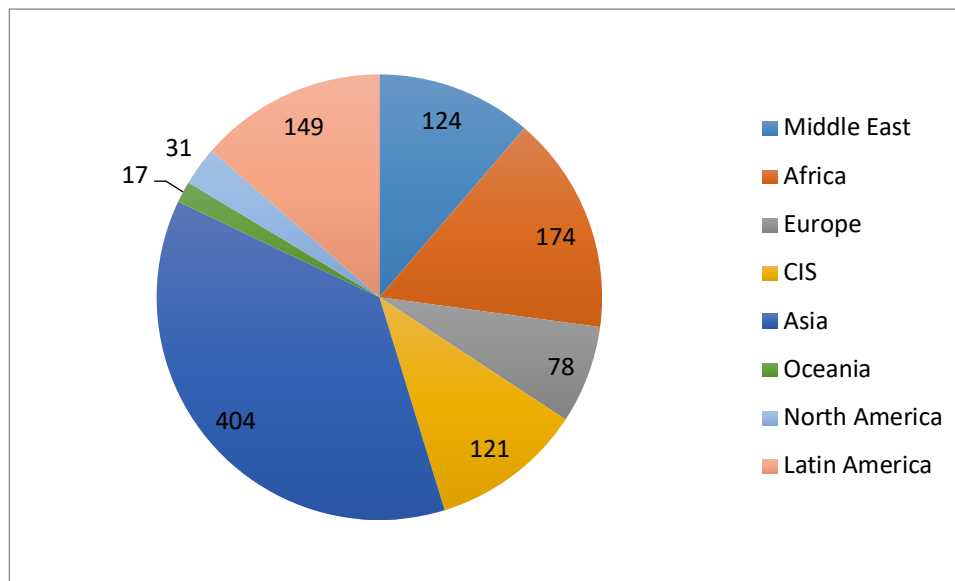
These data reveal evidence that there continues to be a significant problem of poor English language proficiency in aeronautical communication – especially among those regions outside of North America, Europe and Oceania. It is notable that Asia is most often singled out. Given that Asia (and particularly China) is forecast to experience the most industry growth in the foreseeable future (BOEING, 2020), these results indicate that the development of quality English language testing and training will be of most benefit to this region.

Having identified that there is evidence of continuing problems of English language proficiency in several areas of the world, the survey also examined the frequency that aviators are encountering the problem. Participants were asked what percentage of their routine and non-routine flights they heard other aviators speaking on the frequency who they believed did not have the minimum standard of English required. For the purposes of this survey, non-routine flights were defined as those flights where the aviator faced an unexpected situation that required the use of plain language. The demarcation between routine and non-routine flights sought to establish whether the unique pressure of communicating during non-routine (unexpected, infrequent or unusual) situations might exacerbate communication problems.

The average response to this question was that poor English language proficiency was experienced on 29.5% of routine flights. During non-routine flights the average was slightly higher at 31.8%. When these data were filtered to include only those aviators working in regions outside of North America, Europe and Oceania, the rates climbed to 32.5% for routine flights and 35.5% of non-routine flights. Furthermore, when considering only the responses of aviators who work in Asia the frequency

rose to 34.5% of routine flights and 36.7% of non-routine flights. This information is presented in Table 3.

Table 3. Comparison of percentage of routine and non-routine flights where poor language proficiency is encountered.

Average percentage of routine and non-routine flights where poor language proficiency is encountered					
Global		Regions outside of North America, Europe and Oceania		Asia	
Routine flights	Non-routine flights	Routine flights	Non-routine flights	Routine flights	Non-routine flights
29.5%	31.8%	32.5%	35.5%	34.5%	36.7%

It appears that non-routine situations correlate with an increased perception of poor English language proficiency. Moreover, this correlation intensifies in regions outside of North America, Europe and Oceania, and in Asia in particular.

Of course, not all flights are of equal duration so another way to ask this question is the number of times poor English language proficiency is encountered for every 8 hours of flight (the typical duty time for a single pilot or ATCO). The results of this question are tabulated in Table 4.

Table 4. Frequency of language proficiency problems encountered for every 8 hours of flight.

For every 8 hours you spend on the flight deck (pilots) or on duty (ATCOs), how often do you observe other pilots or ATCOs on the radio who you believe have language proficiency below the target of ICAO 4?						
	0	1-3	4-6	7-9	10+	Total
Overall	70 (12.6%)	325 (58.6%)	108 (19.4%)	18 (3.0%)	34 (6.0%)	555 (100%)

87.4% of all respondents report encountering poor English language proficiency on the radio at least 1-3 times for every 8 hours they are on duty. These data can also usefully be filtered for responses from those aviators who work in regions outside of North America, Europe and Oceania. 89.5% of these respondents report at least 1-3 instances of language proficiency impacting communication. When considering only those aviators who work in Asia that number increases to 93.4%. Furthermore, the percentage of aviators who report 10+ instances of poor English language proficiency are significantly higher from those who work in Asia (9.2%) compared to all regions of the world (6.0%).

The results at this stage of the survey show a consistent pattern: poor language proficiency continues to be a problem for aviators, it is a problem that is encountered reasonably frequently and some regions of the world experience this more often than others. The next part of the survey will examine what types of poor English language proficiency aviators are reporting.

There are 6 skills included in the ICAO Rating Scale: comprehension, fluency, structure, pronunciation, vocabulary and interactions. The participants were asked what type or types of poor language proficiency they observed on the radio. Participants chose from negative descriptors that represented each of the 6 skills from the ICAO Rating Scale. These descriptors are correlated to the ICAO Rating Scale in table 5 below.

Table 5. Correlation of ICAO Rating Scale skills to the survey descriptors.

ICAO Rating Scale Skill	Survey Descriptor
Comprehension	Lack of understanding of radio calls
Vocabulary	Poor vocabulary choices that lead to difficulty in being understood
Structure	Poor grammatical choices that lead to difficulty in being understood
Pronunciation	Poor pronunciation that leads to difficulty in being understood
Fluency	Inappropriate pausing and use of fillers, e.g. "um, ah, er" that leads to difficulty in being understood
Interactions	Inappropriate management of the speaker/listener relationship, e.g. checking for understanding, clarification etc.

Language proficiency problems are often the result of various contributing factors. Therefore, participants were allowed multiple selections. The results are presented in Figure 3.

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Figure 3. Types of poor language proficiency encountered on the radio.
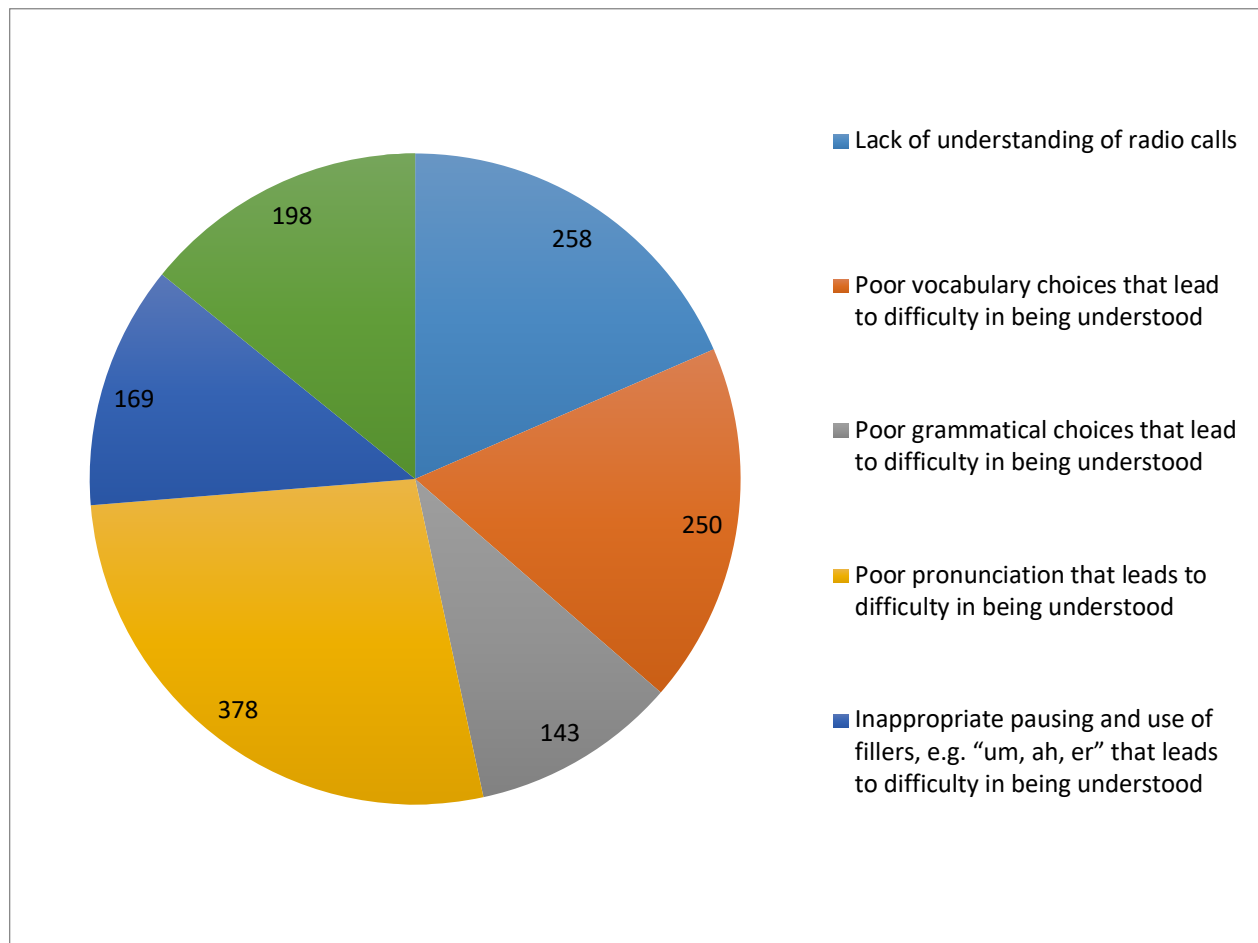
The most common language proficiency problem identified by the respondents is poor pronunciation. This is perhaps no surprise, given the technical constraints of the medium of communication. For example, poor microphone technique, signal static and external noises are non-language proficiency issues that can directly exacerbate pronunciation deficiencies. Furthermore, prosody (intonation and rhythm) has been consistently identified by multiple aviation English researchers as being a key factor in miscommunication in aeronautical communication (BARSHI; FARRIS, 2013; ESTIVAL; MOLESWORTH, 2011; PHILPS, 1991; TRIPPE; BAESE-BERK, 2019).

The next most frequently cited types of problems are poor comprehension skills and poor vocabulary choices. With regards to the participants identifying poor comprehension of interactions on the radio, the survey did not specify whether the aviator was involved in this type of interaction. As radiotelephony is a "party line" where all aviators in the area are listening to each interaction, the participants who identify poor comprehension as a problem may or may not have been involved in each exchange. In those cases where the aviator is involved, it is entirely possible that they do not fully understand their own passive and active roles in the lack of comprehension from their audience.

Successful aviation communication is a shared interaction with responsibility lying both upon interlocutor and audience (KIM; ELDER, 2009). Therefore, poor comprehension may not only come about as a result of inadequate proficiency from the listener. For example, a lack of accommodation skills from highly proficient speakers should also be considered a contributing deficiency. Furthermore, intercultural miscommunication from either interlocutor or the audience can lead to inadequate comprehension outcomes (MONTEIRO, 2012). Neither of these factors should be considered solely as a poor English language proficiency issue.

Poor vocabulary choices are, on the other hand, fairly obvious indicators of inadequate language proficiency. It is estimated that only 400 vocabulary items are required for mastery of the tightly constrained, codified and predictable sub-language of Standard Phraseology (ICAO, 2010). However, the requirements of plain language are represented by a far broader set of functions and topics, where spontaneous, creative and non-coded use of the language is essential (ICAO, 2010). This language capacity can only be served by an equally broad mastery of a wide array of vocabulary items.

Respondents focused less attention on grammar as an identified language proficiency difficulty. In fact, this was the least frequently identified language proficiency problem. These data may be affected by aviators' perceptions of what should be considered "language proficiency" on the radio. Although 62% of respondents indicated they were at least reasonably familiar with the ICAO Rating Scale, 64% incorrectly indicated that its purpose was to measure proficiency of standard phraseology. In fact, it is used solely for the purpose of measuring "plain language." It is possible that aviators do not necessarily see a clear functional or operational demarcation between standard phraseology and plain language. Furthermore, aviators tend to assess language proficiency through the lens of technical knowledge, perhaps because they are not equipped to assess language criteria (KNOCH, 2014).

The second least identified issue is that of "inappropriate pauses" (correlated to "fluency" on the ICAO Rating Scale). Aeronautical communication requires turn management between interlocutor and audience. When one party is speaking, the other must wait until he/she is certain that it is his/her turn to speak. When more than one party tries to communicate on the same frequency at the same time, the effect is an unpleasant distortion sound that usually corrupts both broadcasts. Previous research has indicated that "filled pauses" such as those described in the survey ("um, ah, er…") may in fact act as a means to alert the listener's attention, or as a technique to "hold the floor" (PRADO, 2019). Prado (2019) also noted that since such "filled pauses" seem to indicate a strategy for dealing with a particular problem then a language proficiency deficit may not be the only reason for fluency disorder. Therefore, the data show some corroboration of Prado's theory, as respondents often did not consider it a significant factor when compared to other types of language proficiency problems.

So far, the data have shown evidence that aviators frequently encounter poor English language proficiency on the frequency, that the issue is exacerbated slightly when communicating during non-routine situations and that some regions of the world experience more problems than others. Furthermore, the primary language proficiency inadequacy that affects aeronautical communication has been identified as pronunciation, with (in descending order of importance) comprehension and vocabulary as significant contributing factors. Having established indications of the nature and frequency of poor English language proficiency in aeronautical communication, the survey also explores potential regulatory causes of the current situation.

On the subject of whether sufficient local resources are currently focused on English language proficiency, the participants tend to agree that this is the case. 52% of respondents at least somewhat agree that their local authority is committing enough resources to LPRs, where 34% at least somewhat disagree. When it comes to ICAO attention to LPRs there is less consensus on whether enough is being done. Only 36% of respondents at least somewhat agree that ICAO is deploying adequate resources to the issue and 41% at least somewhat disagree. These data do not clearly identify the causes of language proficiency problems in terms of resources allocated either at a national or ICAO level. However, respondents to this survey generally agree that there is an ongoing issue of global testing consistency. When asked whether one aviation English test from one country could be reliably compared to another country's, 63% of participants at least somewhat disagreed that aviation English test results could be reliably compared from one country to another. This corroborates Alderson's (2010) conclusion that the industry cannot trust the global system of testing to produce accurate, reliable or consistent results.

Overall, a majority of pilots and air traffic controllers surveyed indicate that poor English language proficiency continues to have a negative influence on both the efficiency and safety of the network within which they work. They believe that some regions of the world, in particular Asia, are more adversely affected than others. They see pronunciation as the leading issue of the poor English language proficiency problem, with significant contributions from poor comprehension and vocabulary choices. Finally, this research has not revealed a significant concern among participants about the amount of resources currently allocated to supporting aviators' English language proficiency. However, the majority of respondents are not confident in the reliability of tests from different parts of the world.

5. Limitations

The target population were professionals with sufficient experience of aeronautical communication. Two roles were identified: pilots and ATCOs with international experience. Furthermore, those retired professionals who had held the above roles for at least 10 years were also

included. The survey collected responses from 555 aviators that fulfilled the above described requirements. Although information about the global population of pilots is technically available, after ICAO Data Plus[3] was approached, it was found the proposed costs were prohibitive even with their discount for researchers. It was therefore not possible to confirm whether the participants represent a proportional sample of the target population.

Another limitation of collecting a representative sample of the target population is that they were all contacted through a popular professional networking website: LinkedIn. However, this platform is generally unavailable to Chinese aviators and, therefore, very few pilots or ATCOs from this significantly important country completed the survey. Furthermore, the effect of contacting all respondents through LinkedIn may have had the effect of filtering out potential participants who do not have sufficient English language proficiency to make use of that website. The survey itself requires each respondent to have sufficient reading comprehension skills to be able to engage with its content. Those with weak reading ability may have exited the survey without completing all of the questions. It is possible that these factors have produced a skewed sample population.

Conclusions

Empirical evidence of poor English language proficiency contributing to safety incidents could be defined as a statistically significant correlation between lower language proficiency aviators and their involvement in safety incidents. These data, therefore, should not be described as an empirical confirmation of poor language proficiency contributing to unsafe situations in aviation. However, there is clear evidence that many pilots and ATCOs believe that it does make such a contribution. This prima facie evidence reinforces the results of other research that has attempted to make a clear connection between language proficiency and safety. Prinzo et al. (2008), for instance, established a clear connection between language proficiency and communication problems. Other studies conducted by Farris (2007) and Tiewtrakul and Fletcher (2010) also found a correlation between language proficiency and the severity and frequency of misunderstandings. The data from this survey serve to draw a connection between previous research (of Prinzo et al., Farris and Tiewtrakul and Fletcher) and safety issues.

Communication problems are a normal occurrence on the radio and most of the time they do not lead to serious incidents. However, it seems the majority of pilots and ATCOs who completed this survey would agree that the communication problems stemming from poor language proficiency are of a

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[3] ICAO Data Plus is an online tool that presents the air transport statistic data collected from its 192 Member States.

sufficiently serious nature as to undermine safety. Furthermore, all of those studies support the findings of the UK CAA from research conducted by Clark (2017) where 20% of safety incidents reported to the UK CAA were either as a result of or exacerbated by poor language proficiency. Clark's research essentially examined the opinions of pilots and ATCOs in the form of their safety incident reports. The data revealed by this survey further reinforces her findings by showing that for every 8 hours of duty, the large majority of participants reported at least 1-3 incidences of poor language proficiency on the radio. A significant minority reported 4 or more incidences. It seems that pilots and ATCOs are routinely encountering poor language proficiency and according to Clark, this is translating into very real safety incidents.

Given that the aviation sector is an extremely price sensitive industry, it is somewhat of a positive result that the survey respondents do not uniformly correlate language proficiency problems with a lack of resources either at a regional or ICAO level. The inference could be made that other factors are at play. Inconsistent testing practices from one country to another could be driven by a lack of language test/writing expertise, a potentially invalid Rating Scale (upon which all aviation English tests must be based) and/or a lack of intent from national regulators. All of these issues could have a significant effect on the consistency of English language proficiency standards around the world. However, they do not necessarily reflect a deficit of resources allocated. It may not be a case of how much resources are focused on English language issues, but instead a case of how those resources are organized. For example, such awareness raising initiatives as ICAEA's test design guidelines (TDGs) outreach training for national regulators and other industry partners to establish criteria for the design and recognition of valid and effective ICAO LPR tests. These TDGs may improve consistency of proficiency standards from one country to another by providing a common framework to analyze, evaluate and select LPR tests.

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The **E** specialist

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Appendix. 14 Survey Instrument Questions

1. Which area(s) of the world do you work in as a pilot or ATCO? (Tick as many as appropriate)

2. What is your first language?

3. This is the ICAO rating scale. On a scale of 1 (low) to 7 (high), how familiar are you with this ICAO rating scale?

1	2	3	4	5	6	7
I have never seen this before	I've seen this before, but I don't know what it is	I am somewhat aware of this	I know what this is, but I don't know much about it	I am reasonably familiar	I am very familiar	I am an expert

4. What is this scale used to measure? (choose one)

☐ Proficiency of ICAO standard phraseology (as described in Manual of Radiotelephony 9432)

☐ Plain language

☐ I don't know what this scale is used to measure.

5. During **routine** situations, ICAO standard phraseology is usually considered sufficient for effective communication. However, in some routine situations, pilots and air traffic controllers also use "plain language" (defined as any <u>effective and efficient</u> use of language that is not considered to be standard phraseology).

   During **routine** situations, how often do you encounter pilots or ATCOs on the frequency who you believe have language proficiency below the minimum of ICAO 4?

6. During **non-routine** situations, it can be possible that ICAO standard phraseology is not sufficient for effective communication. In these cases it can become necessary to use "plain language" in addition to, or instead of, ICAO standard phraseology.

During **non-routine** situations, where ICAO standard phraseology is not sufficient for effective communication, how often do you encounter pilots or ATCOs on the frequency who you believe have language proficiency below the minimum of ICAO 4?

7. For every 8 hours you spend on duty, how often do you observe other pilots or ATCOs who you believe have language proficiency below the target of ICAO 4?

0	1-3	4-6	7-9	10+ instances

8. What type of low proficiency do you notice? (Tick one or more)

Lack of understanding of radio calls

Poor vocabulary choices that lead to difficulty in being understood

Poor grammatical choices that lead to difficulty in being understood

Poor pronunciation that leads to difficulty in being understood

Inappropriate pausing and use of fillers, e.g. "um, ah, er" that leads to difficulty in being understood

Inappropriate management of the speaker/listener relationship, e.g. checking for understanding, clarification etc.

I don't ever encounter low English language proficiency from pilots or ATCOs on the frequency

9. In which part of the world do you encounter low English language proficiency (ICAO 3 or below) from pilots or ATCOs on the frequency? (Tick as many as needed)

North America

Latin America

Europe

Africa

Middle East

CIS

Asia

Oceania

I don't ever encounter low English language proficiency from pilots or ATCOs on the frequency

10. Consider the following statement and the degree to which you agree or disagree with it:

Due to the cascading effects of slight delays, low language proficiency among pilots and/or ATCOs causes a loss of efficiency to the aviation network I work in.

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree

11. Consider the following statement and the degree to which you agree or disagree with it:

Low language proficiency has a negative impact on the safety of the aviation network I work in.

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree

12. Consider the following statement and the degree to which you agree or disagree with it:

ICAO currently puts sufficient resources and attention to the issue of low language proficiency among pilots and ATCOs.

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree

13. Consider the following statement and the degree to which you agree or disagree with it:

The Civil Aviation Authority from which my license is issued, currently puts sufficient resources and attention to the issue of low language proficiency among pilots and ATCOs.

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree

14. Consider the following statement and the degree to which you agree or disagree with it:

When comparing the results of language testing for pilots and air traffic controllers from different countries around the world, those results are consistent and directly comparable to each other (e.g. an ICAO 5 earned in one country, would reliably be considered an ICAO 5 in another country).

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree