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## 24 Linguistics in aviation

**Abstract:** Safety in aviation crucially depends on unambiguously clear und successful communication between air traffic controllers and pilots. Miscommunication is potentially fatal, and many accidents and incidents have been reported where faulty exchange of information played a contributory role. This paper examines some of the relevant issues and addresses the question of how linguistic expertise can be brought to bear on them.

### 1 English in aviation

Successful communication in aviation, especially between tower and cockpit, is of vital importance. If unsuccessful, dangerous situations may arise and lives may be at stake. In a globalised world, communication routinely happens in a multicultural and multilingual environment where participants from all over the world interact. The Chicago Convention in December 1944 saw the creation of the International Civil Aviation Organisation (ICAO) and the rise of English as the international language of aviation (ICAO, 2006). English has since become the globally used *lingua franca* in aviation. The bulk of worldwide communication in aviation today takes place between non-native speakers, and it is hardly surprising that problems of communication loom large in such a work environment.

What can happen in high-stakes aviation if communication breaks down has been amply documented. The worst accident in civil aviation happened in 1977 when two Boeing 747 collided on the runway at Los Rodeos airport in Tenerife (Barker, 2012; Philips, 1991). Many factors contributed to this fatal collision, in which almost 600 people lost their lives. Among these factors were poor visibility and unusual congestion at the airport, where many aeroplanes had been diverted in the wake of an attack on the airport near Las Palmas. Communication between the Spanish L1 controller in the tower, the Dutch L1 captain of the KLM airliner and the US English L1 captain of the Pan Am airliner was not only beset by technical difficulties (simultaneous transmissions were only partly intelligible), but also characterised by a lack of clarity in phraseology and difficulties in understanding the various accents involved. Thus, the phrase *we are at take-off* was intended to mean *in the process of taking off* but was understood as *being at take-off position, awaiting clearance*. Additionally, phonetic confusion arose with acoustically similar sibilants [f] and [s] in the expression *first exit/third exit*.

## 1.1 English phraseology

In the aftermath of this accident, measures were taken to refine phraseology in order to prevent ambiguities. Today there is a clearly defined set of phrases with unambiguous meanings which are to be used in all standard situations. How important such terminology is, was demonstrated by another widely discussed crash. On 25 January 1990, Avianca Flight 52 from Bogotá to JFK International Airport in New York was forced to hold over the airport for an hour and in the process used up its reserve fuel. The pilot notified ATC (air traffic control) that he wanted a “priority landing”, but the sense of urgency was lost since the correct (standard) terminology (“MAYDAY”, “PAN, PAN, PAN” and “EMERGENCY”) was not used. In addition to the problem of terminology, intercultural factors may have played a role in this particular accident as the Avianca pilot did not dare to challenge ATC and simply kept his holding position until he ran out of fuel (Attan, 2008).

Much later it was understood that while phraseology was a crucial help for standard situations, there were also many non-standard situations that could not be covered by a simple set of phrases and that required a working knowledge of the *lingua franca* of aviation – English. Thus, ICAO (2010) introduced a worldwide language proficiency test for pilots and air traffic controllers, which finally came into effect in 2011. Since that date, pilots and air traffic controllers who operate internationally have been under the obligation to demonstrate adequate command of English, indicated as level 4 on the ICAO rating scale (1–6). This test is high-stakes as failure to achieve level 4 entails the loss of licence and livelihood. It is therefore not surprising that efforts to standardise English language competence worldwide has been met with considerable resistance and has, in fact, not yet been achieved.

## 1.2 English testing requirements

What sets this English proficiency test apart from all other well-known English tests on the market is the fact that it is to be taken irrespective of L1, i. e. by native and non-native speakers alike. The reasoning behind this is that this test should demonstrate a person’s ability to communicate successfully through the medium of aeronautical English with a wide range of speakers across the globe. Successful communication, understood in these terms, does not simply mean being close enough to a native speaker model, but it also includes the ability to adapt one’s language to that of speakers with a lower degree of English ability.

## 2 Language use in aviation safety

The safety record of the aviation industry is formidable, and human factors, especially communication, constitute something of a last hurdle. Apart from the above-described Tenerife collision and the Avianca crash, there have been many other fatal accidents in the last few decades that have been blamed, at least in part, on communication problems. In the course of the investigation of these accidents, it often becomes clear that the investigators lack sufficient linguistic expertise to properly assess the fatal chain of events from a language point of view. Examining the evidence relating to a 2006 crash in Brazil, in which 154 people lost their lives, Mathews asks:

“Did language proficiency and language use play a contributory role in the 2006 collision of an Embraer Legacy 600 and a Boeing 737–800 over the Amazon rain forest? A linguistic analysis of the evidence provided in the accident investigation reports suggests that a number of subtle – but significant – language factors helped create an atmosphere in which a series of communication failures were allowed to develop” (Mathews, 2012). She concludes that too often linguistic factors contributing to accidents are ignored and escape the attention of the investigators since typically they “do not have the background training required to perceive any but the most blatant language errors.”

(Mathews, 2012).

### 2.1 Language training

What can (applied) linguistics offer to aviation to make it even safer and to reduce the number of accidents caused by problems in communication? First, there is a clear demand for linguistically trained accident investigators; second, in all national aviation bodies worldwide, there is a need for linguistically trained communication specialists who can assist in the training of national experts, language trainers and assessors, etc., as they will be aware of the particular language pitfalls faced by speakers of that speech community.

Students of linguistics receive a good grounding in the major areas of phonetics/phonology, syntax/morphology and semantics/pragmatics. Let us exemplify this with reference to phonetics/phonology. An understanding of articulatory and acoustic phonetics helps to appreciate what the potential difficulties are in interlingual contact. An understanding of the phones of English compared to those of other languages and how they pattern (phonemes, allophones) in these languages is essential if one wishes to address communication problems. To take a local (Swiss) example, the initial sibilant in English [sʌn] ‘sun’ and that of the corresponding Swiss German [sʊnə] are more or less identical and in contrast to

that of Standard German where we have sibilant voicing. The function of these sounds is, however, very different in these three varieties, and it is only in English where we find a phonemic contrast between voiced and voiceless (zoo vs sue). An understanding of such distinctions in sibilants/fricatives helps linguists to pinpoint areas of misunderstanding in such words as choose/Jews/juice from a (Swiss) German point of view. In addition to phonetic and phonemic patterns, an understanding of phonotactic constraints, stress pattern and intonation is also vital.

## 2.2 Assessing English proficiency

ICAO (2010) has introduced six criteria to assess proficiency of plain English, one of which is pronunciation (more below). This is fundamental as the ability to understand what the interlocutor is saying is key in being able to assess other criteria. A particular point of contention concerns the choice of acceptable dialect. There are many different established varieties of English, many of which are not easily mutually intelligible. ICAO states that “*Proficient speakers shall use a dialect or accent which is intelligible to the aeronautical community.* A first and natural response to this holistic descriptor is to inquire which dialects or accents would be considered intelligible. One answer is to consider how this issue has traditionally been handled among native-speaker controller populations. In the United Kingdom, for instance, a great variety of regional dialects and differences exist. Air traffic control applicants and trainees are informally screened for use of a dialect appropriate to the international aviation context” (ICAO, 2010: 46).

## 3 Linguistic understanding in aviation

While there is no universally accepted institution or organisation that establishes the norms of internationally acceptable pronunciation of English, it is nevertheless true that there is tacit international agreement on what constitutes such norms. These norms have been established on the basis of non-linguistic factors, such as economic clout or tradition, and are recognised by the international aviation community. Models of “ideal pronunciation” do of course exist, such as Standard American English or British RP (Received Pronunciation), and it is with reference to these models that other varieties of dialects of English are evaluated; additionally, non-native varieties of English are assessed on the basis of their deviations from these norms.

Attempts have been made to determine and highlight those features of English phonetics/phonology which must be maintained by non-native speakers of English in order to guarantee mutual intelligibility. The most comprehensive account to date can be found in Jenkins (2005). As quoted in the ICAO (2010) manual, these features include:

- a) long/short vowel length distinctions (e. g. hit/heat);
- b) the correct placing of nuclear stress (e. g. radar);
- c) the marking of tone boundaries (i. e. significant changes in voice pitch or the direction of intonation which identify new components of a message); and
- d) the avoidance of simplification or reduction of some consonant clusters (e. g. the cluster “st fl” linking the two words of “test flight” may be reduced in rapid speech to “tes’ flight”). (ICAO, 2010: 26).

To clarify the distinction between essential and non-essential features of pronunciation, consider an example involving English plosives: aspiration in syllable-initial, bilabial plosives is crucial as otherwise the phonemic contrast with voiced bilabials gets blurred (pin vs bin). However, the same aspiration is irrelevant after [s-] as in this position the phonemic contrast has been neutralised [spin] or [sp<sup>h</sup>in]. Among other things, phonetically/phonologically educated linguists can apply their knowledge in the fields of test development or training of aviation test assessors. At the ZHAW, students in the aviation degree programme attend classes of aeronautical English for two years and are introduced to the basics of phonetics/phonology. The students are confronted with a range of speech samples from around the world and are made to analyse phonetic and phonological peculiarities of speakers with different L1s. They therefore become acquainted with the problems that exist in a key area of aviation communication, and they can later, depending on their field of work, put this knowledge to good use.

In addition to pronunciation, ICAO (2010) has established the following criteria to assess language ability:

1. vocabulary
2. structure
3. fluency
4. comprehension
5. interaction

The information above with reference to phonetics/phonology applies equally to these areas. Aviation personnel working in areas where linguistic expertise matters profit considerably from a thorough grounding in the relevant areas of the discipline.

## 4 Conclusion

I will finish this short foray into the common ground shared by aviators and linguists with a comment on ambiguity. Lexical and syntactic ambiguities are a pervasive feature of English and natural languages in general. In view of the fact that there is simply no time in fast-developing situations to ask back and clear up resulting confusions, every effort must be made in the cockpit and in the tower to avoid language that can be interpreted in different ways. Of particular concern here are syntactic ambiguities, the result of structural differences, where the different semantic interpretations stem from different underlying phrase structures. Two examples may suffice for the purposes of illustration:

*flying planes can be dangerous (Chomsky, 1965)*

The ambiguity here lies in the fact that *planes* can be interpreted either as part of the subject *flying planes* or as object of the gerund *flying*. This results in two completely different interpretations.

*I didn't go to the party because Sue was there (author's example)*

The ambiguity here is due to two different interpretations of the negation. The scope of the negation is either the whole sentence (I went to the party for a reason that had nothing to do with Sue), or it is just the verb (the reason I didn't go to the party was that Sue was there).

Aviation personnel involved in test development, assessment and training of ATC and pilots need to be aware of such structural ambiguities in English, and this applies to all the other areas that could not be discussed within the confines of this short article. The recognition in aviation of the potentially beneficial contribution applied linguistics can make to the safety record of the industry will be a welcome development.

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