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„Aviation English, ESP and ELF: language-related factors of miscommunication in radiotelephony communication between pilots and air traffic controllers“

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List of abbreviations

ASRS ..... Aviation Safety Reporting System
ATC ..... Air Traffic Control, Air Traffic Controller
ATIS ..... Automatic Terminal Information Service
CEFR ..... Common European Framework of Reference
CPDLC ..... Controller-Pilot Data Link Communications
EAP ..... English for Academic Purposes
EBE ..... English for Business and Economics
ELF ..... English as a Lingua Franca
ENL ..... English as a Native Language
EOP ..... English for Occupational Purposes
ESP ..... English for Specific Purposes
ESS ..... English for Social Sciences
EST ..... English for Science and Technology
FAA ..... Federal Aviation Administration
FL ..... Flight Level
ICAO ..... International Civil Aviation Organization
ILS ..... Instrument Landing System
L1 ..... First Language
NASA ..... National Aeronautics and Space Administration
PTT ..... Push-To-Talk
SARP ..... Standards and Recommended Practices
TRACON ..... Terminal Approach Control
VHF ..... Very-High Frequency

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1. Introduction

The aviation industry has always been known for its strive towards maximum optimization in terms of operational safety. Especially when considering the influence of human error in fatal commercial aircraft accidents – an aspect which comprises about 70% of the factors contributing to such accidents (Allianz Global Corporate & Specialty 2014: 34) – it becomes evident that measures aimed at preventing airplane crashes need to take into consideration the human factor embedded in such a complex system. As radiotelephony communication between pilots and air traffic controllers (ATC) is a prime component of human interaction in aviation, a crucial issue requiring discussion is that of the problematics of miscommunication.[1]

This paper will focus on defective radiotelephony communication between pilots and air traffic controllers, with a special emphasis on miscommunication caused by language-related factors. The latter constraint allows for a clear delimitation of possible reasons for miscommunication, as it excludes factors such as the culture of the parties involved or technological aspects impeding communication.

Aviation English can be considered an instance of English for specific purposes (ESP) as well as a manifestation of English as a lingua franca (ELF). The characteristics of these two particular uses of the English language are discussed in chapter 2. Since aviation English has emerged as a language of its own due to its central role in the industry, its unique status necessitates a critical evaluation of structural and functional characteristics, which will be provided in sub-chapters 3.2 – 3.5. This also includes a discussion of characteristics which aviation English and ESP as well as aviation English and ELF have in common (sub-chapter 3.3), thus establishing a link to the linguistic aspects covered in chapter 2.[2]

Chapter 4 provides a review of the findings of research carried out so far on the issue of miscommunication in aviation English. What follows then is a discussion of a selection of fatal aviation accidents whose causal or contributory factor was determined to be miscommunication due to improper use of aviation English. These cases

[1] This paragraph was taken from Konrath (2017: 1).
[2] The reason for why I separately establish this link later on in the paper, rather than at the beginning, is to allow the reader to familiarize himself/herself with the most relevant features of aviation English first (I assume a readership with limited to no knowledge about aviation English).

should serve as a motivation for highlighting the need for clear and precise communication in the aviation industry.

The discussions from chapters 2 – 4 are expanded on by findings from an analysis of anonymous incident reports collected by the National Space Administration's (NASA) Aviation Safety Reporting System (ASRS). Patterns of recurring causal factors for language-related miscommunication are identified, which will serve as examples to stress the importance of a correct use of aviation English by aviation personnel. Chapter 6 discusses the findings with a focus on the importance of a standardized language system as well as the design of training courses for pilots and air traffic controllers. Even though there already exist many ideas and considerations pertaining to these aspects of aviation English, it is important to highlight the relevance of them in the context of language-related miscommunication.

There have been various terms employed for the communicative interaction between pilots and air traffic controllers: "ATC communication" (Morrow, Lee & Rodvold 1993; Tajima 2004), "controller-pilot communication" (Morrow, Lee & Rodvold 1993), "tower communications" (Ragan 1997), "pilot-ATC discourse" (Howard 2008), and "radiotelephony communication" (Kim & Elder 2009). Although these terms rightly suggest an interaction between a controller and a pilot, the picture becomes blurred when using similar terms such as "aviation communication", "aviator discourse" or "aviation dialogue" (Howard 2008) to describe the same process, as these might, for instance, also refer to intra-cockpit communication among the crew or to the communication between the cockpit crew and ground personnel on the apron. To avoid such inconsistencies, the terms "radiotelephony communication" and "ATC communication" will be used interchangeably throughout the rest of the paper.

Similarly, the language used for this specific type of communication has been denoted differently by scholars: "control tower language", "air language" and a "sublanguage" of the English language (Frick & Sumby 1952), "Airspeak" (Sullivan & Girginer 2002: 399; Campbell-Laird 2004), "aviation English" (Campbell-Laird 2004; Tajima 2004; Tiewtrakul & Fletcher 2010), and "ATC-English" (Breul 2013: 74). In contrast to Campbell-Laird's and Tajima's definition of "aviation English", Wang (2008: 152) makes a distinction between "aviation English" and "radiotelephony English": according to him, the latter specifically pertains to radiotelephony communication between pilots and air traffic controllers, whereas the former encompasses the use of

English in settings outside of pilot-controller interaction and thus represents an overarching term for the language generally used in aviation (i.e. including stakeholders such as technicians, managers, or dispatchers). While Wang singles out pilots and air traffic controllers from other language user groups within the international aviation community, there are also other users who engage in radiotelephony communication, such as local firefighters at an airport. If such groups utilize the same language system as the one used in ATC communication, why are they not identified as users of radiotelephony English? And if their language system differs, what would its designation be, given that communication also occurs via radio? Moreover, there is the risk that radiotelephony English might be confused with the language in domains other than aviation, in which interlocutors communicate via radiotelephony in the English language (e.g. seafaring, military, police). With these considerations in mind, and due to the increased occurrence of "aviation English" in the literature, this term appears to be most suitable to be used in the context of ATC communication and will thus be used in this paper.[3]

Finally, whenever there is a mention of *the pilot*, it is the pilot communicating with the corresponding air traffic controller that is being referred to. This is obvious in cases where the aircraft is usually flown by one pilot only, but with commercial aircraft (and these will represent the majority of cases in this paper), the cockpit crew consists of at least two people, with one pilot being designated as the 'pilot flying' while it is the 'pilot not flying' that is, among other tasks, responsible for ATC communication.

2. Linguistic considerations

2.1. English for Specific Purposes (ESP)

2.1.1. Historical development

The beginnings of ESP can be traced back to the mid-1900s. After World War I, English and French were on a par in terms of linguistic relevance, but this situation changed

[3] This paragraph was taken from Konrath (2017: 1–2) with some modifications.

with the end of World War II, which saw the need for an international language materialize, and thus

> led to the emergence of a new generation of learners who needed to use English in specific settings, e.g. businessmen to run their businesses, doctors to keep up with recent developments in medicine, students to read their textbooks and international journals only available in English, to name but a few groups. (Lesiak-Bielawska 2015: 2)

English courses were thus "tailored to learners' specific needs" (Lesiak-Bielawska 2015: 2). What emerged from this was the goal-directedness that is typical of ESP, which means that "students study English not because they are interested in the English language (or English-language culture) as such but because they need English for study or work purposes" (Robinson 1996: 2).

English for Science and Technology (EST) constitutes one of the first instances of ESP, and it gave rise to the discipline of register analysis in the 1960s, as the research in the field of ESP at that time focused on "English for Science and Technology (EST) in academic settings" (Lesiak-Bielawska 2015: 3). As a result of register analysis, EST has been identified to

> [use] the same structures as any other kind of English but with a different distribution. There may be a tendency for more passives and more complex nominal groups to occur, while there are few occurrences of question-tag forms. (Kennedy & Bolitho 1984: 19)

The above quote reflects how register analysis is considered to be a quantitative approach: Its interest lies in "the frequency of feature x or y" (Robinson 1996: 24), thus facilitating the comparison of texts in terms of their linguistic features. Even though this approach allows for the identification of certain characteristics among different registers on the sentence level, its "extreme concentration on form […] offered little explanation about why and how the sentences were formed and combined as they were" (González Ramírez 2015: 380). This problem was tackled with the second phase of development in ESP, which is that of discourse analysis.

Unlike register analysis, discourse analysis (which became prominent in the 1970s) focuses on the function of language: "[T]he relationships between EST grammar or lexicon and the authors' rhetorical purposes in texts were central, a connection that continues to be the focus of much of the ESP discourse analysis" (Johns 2013: 7). Regarding the language used in scientific discourse, Lackstrom, Selinker and Trimble

offer an interesting linguistic example of how the choice of tense influences a core idea's degree of generality:

> A plant to convert cellulose of pine sawdust into fermentable sugar and that into ethyl alcohol failed because a sawmill couldn't sell as much lumber as plans called for, and thereby curtailed the alcohol plant's raw material supply.
>
> […]
>
> Plants to convert cellulose of pine sawdust into fermentable sugar and that into ethyl alcohol have failed because sawmills haven't been able to sell as much lumber as plans have called for, and thereby have curtailed the alcohol plant's raw material supply.
>
> […]
>
> Plants to convert cellulose of pine sawdust into fermentable sugar and that into ethyl alcohol fail because sawmills can't sell as much lumber as plans call for, and thereby curtail the alcohol plants' raw material supply. (Lackstrom, Selinker & Trimble 1988: 65)

What is important about the choice of tense is not the time at which the failure of the plants' conversion occurred, but the degree of generality the author wants to convey. In other words, whether the author chooses to use the present tense, the present perfect tense, or the past tense depends on the number of plant failures he/she is certain to have happened, and probably will happen in the future. By using the present tense, he/she signals that there are many cases of plant failures he/she knows about, and that the information provided can be regarded as being generally true. The use of the present perfect tense shows that there are fewer cases of plant failures the author is aware of. Lastly, by using the past tense (together with the singular form of the plant and the sawmill in question, as opposed to the plural form in the other two sentences), the reader gathers that the author only knows about one case of plant failure, and thus cannot draw conclusions about future instances of such failures (Lackstrom, Selinker & Trimble 1988: 65). While the context of this example is that of academics rather than aviation, it nonetheless shows how different forms of a language can lead to different functions being realized. With regard to aviation English, this aspect will be referred to again in sub-chapter 3.3.

2.1.2. Characteristics

One of ESP's most salient features is its use of a specialized vocabulary. When thinking about the previously-mentioned varieties of ESP, it becomes clear that, for example, when using the word *sentence*, a lawyer will be talking about something completely different than a professor of linguistics. Widdowson differentiates between 'mastery language' and 'mystery language':

> The English used for business, management, marketing, banking and so on, with all their legal and financial intricacies, is […] a *mastery language* for the insiders who practise these occupations, and it is the purpose of professional courses to instruct people in such mastery. However, it is *a mystery language* for outsiders, like me […]. [T]his mastery is not the same as general proficiency in English, which is why we need ESP. (Widdowson 1998: 11–12)

Therefore, for someone to successfully navigate through a domain of ESP, he/she first needs to acquire specialist knowledge from that domain (Schneider 2013: 48). This specialist knowledge comprises factual knowledge and knowledge about the kind of language that is used in the domain. The vocabulary, as an example, is thereby found to be consisting of "semi-technical words which often change their 'normal' meaning when put into a specialized context" (Kennedy & Bolitho 1984: 19). With regard to aviation English, this means that aviation personnel need to acquire specialist knowledge (comprised of knowledge about the physics of flying, meteorology, instruments, to name a few, and knowledge about the language used for radiotelephony communication) in order to safely operate in the aviation domain. It is not least because of the highly specialized vocabulary of aviation English that this code has to be learned as if it were a new language in order for pilots and air traffic controllers to be able to communicate with each other.

A second characteristic of ESP is its preference for certain grammatical structures to occur over others, depending on the function which the language is to perform in a given domain (cf. example on page 5). While register analysis offers the tools to analyze language in terms of its functions, they also come at a cost, as Allen and Widdowson (1988: 74–75) point out:

> People who talk about 'scientific English' usually give the impression that it can be characterized in formal terms as revealing a high frequency of linguistic forms like the passive and the universal tense in association with

> a specialist vocabulary. But to characterize it in this way is to treat scientific discourse merely as exemplification of the language system, and does little or nothing to indicate what kind of communication it is.

Not only does a focus on form prevent insight into what is actually achieved through the use of language, but it also disregards the fact that contextual and pragmatic knowledge is required for the understanding of texts (Widdowson 1998: 4–7; Hyland 2007: 398). Widdowson's (1998: 4) example of how a syntactically and semantically comprehensible text nevertheless can fail to make sense aptly serves to illustrate the need for said knowledge:

> In homes, a haunted apparatus sleeps,
> that snores when you pick it up.
> If the ghost cries, they carry it
> to their lips and soothe it to sleep
> with sounds. And yet, they wake it up
> deliberately, by tickling with a finger.
>
> (from Craig Raine: *A Martian Sends a Postcard Home*)

The reader, even if he/she happens to be a native speaker of English, will most likely not be able to solve the riddle because there is "no convergence on shared knowledge, no common frame of reference" (Widdowson 1998: 5) – after all, the text represents a Martian's description of a thing it has encountered on Earth.[4] This essentially reflects a "central tenet" of ESP in that "professional communities possess their own distinguishing discoursal practices, genres, and communicative conventions, which arise from different ways of carrying out their work and of seeing the world" (Hyland 2007: 399). The aviation community is no exception, as it also possesses its own discoursal practices shaped by standards and regulations found in aviation English. This will be elaborated on in sub-chapter 3.2.3.

Finally, with ESP having developed as a branch of teaching English as a foreign language, it centers around the needs of the language learner. Curricula and syllabi are therefore shaped based on a needs analysis of the learners. In the case of aviation English, the learners are pilot and air traffic controller trainees, and the learner-centeredness of ESP courses implies the aim that "the language produced should be 'good enough for the job', not necessarily native-speaker-like" (Robinson 1996: 32), an as-

[4] The Martian is describing a telephone.

pect that will be discussed in more detail in sub-chapter 6.2. After all, it is communicative success, rather than native-like competence, that non-native speakers of English utilizing ESP are striving for. This mindset is not only typical of ESP, but also of English as a lingua franca, as will be shown in sub-chapter 2.2.3.

2.2. English as a Lingua Franca (ELF)

2.2.1. Historical development

Considering that, in today's time, no language compares to English in terms of its use as a lingua franca (Seidlhofer 2001: 133), the question may arise whether other languages had incorporated a similar role earlier in history.

English developed as a lingua franca during the era of colonization, starting in the late 16th century (Jenkins, Cogo & Dewey 2011: 281). Examples of other languages that had served or still serve this function are Sanskrit, Greek, Latin, Arabic and Portuguese (Ostler 2005, referred to in Jenkins, Cogo & Dewey 2011: 281; Abdullah & Chaudhary 2012: 128). Taking Latin as an example, the extensive use of the language, especially during the Renaissance, led to speakers, readers and writers of Latin being spread across Europe. With such a wide-spread use, the language served as a universal means of communication for various parts of society, such as science, commerce, and religion. Even today, long after its decline as a lingua franca, traces of Latin can be found in the vocabulary of the English language (e.g. *video*, *democracy, in medias res*), which shows how far-reaching the influence of the language had been and still continues to be.

How does a lingua franca develop? On the one hand, languages are constantly changing, one reason for these changes being that, in accordance with Grice's (1975) co-operative principle, the successful conveyance of a message usually deserves highest priority. This may be even more important than compliance with the standard (as will be discussed in sub-chapter 2.2.3), which is why certain deviations from the norm can occur. On the other hand, languages (or varieties thereof) can develop artificially, or on a planned basis (Samarin 1987: 372; Brosch 2015: 74), one well-known example of such a language being Esperanto. Its community of roughly 2 million speakers make

it the most widely spoken constructed language in the world, and as such, the language could have the potential to be regarded as an international artificial language one day.

Regarding the development of ELF in particular, it was after the two world wars that English gained more and more importance in areas such as economy, science, and culture. International relationships also increasingly relied on English as the language that facilitated transnational and transcultural communication – the language had already gained substantial popularity, which is why it was only natural for it to gradually become an international language. Globalization certainly had its share of this phenomenon, too:

> What is unprecedented and new about ELF is the extent of its use as both the cause and consequence of the unprecedented and new socio-economic, political, and technological developments in the world that go under the name of globalization. (Seidlhofer 2011: 92)

With globalization being a key factor in international aviation, this development also had a strong influence on the way through which an international language for aviation emerged, as will be discussed in sub-chapter 3.1.

2.2.2. Characteristics

There exists a variety of definitions of ELF, a selection of which is presented in the following:

> "a 'contact language' between persons who share neither a common native tongue nor a common (national) culture, and for whom English is the chosen foreign language of communication" (Firth 1996: 240)

> "a language used by people who share neither a native tongue nor a common culture, and for whom ELF is often the default means of communication" (House 2012: 173)

> "any use of English among speakers of different first languages for whom English is the communicative medium of choice, and often the only option" (Seidlhofer 2011: 7)

What becomes apparent from this selection of definitions is that while the first one suggests that there is no native speaker of English involved, the last two do not exclude the possibility of native speakers partaking in ELF communication. The latter understanding of ELF might imply that, given their advantage in utilizing the language, a native speaker "will in most cases easily outperform an L2-speaker" (Brosch 2015: 77). While this may be true with regard to linguistic competence, it is particularly the communicative ability and strategies of the speakers that have an influence on whether ELF communication is successful or not. The impact of ELF communication is especially important to consider in the context of international aviation, since radiotelephony communication is characteristic of interactions between native and non-native speakers of English. The differences between native and non-native speakers, as well as the consequences of this distinction for aviation English, are therefore discussed in the next sub-chapter as well as sub-chapter 3.3.

Since it is non-native speakers of English who are the most numerous interactants in ELF communications, it cannot be expected that the communication will feature a nearly flawless and accurate form of language. [5] In fact, accuracy and the imitation of native-like English are not what speakers of ELF aim for – rather, "the central concerns for this domain are efficiency, relevance and economy in language learning and language use" (Seidlhofer 2001: 141). Thus, it happens that the formal characteristics of ELF can sometimes be quite different from English as a native language (ENL). With the aim of contributing to a description of ELF and thus to a better understanding of the language variety, ELF research has focused on identifying features at different levels of language (Seidlhofer 2004). The levels most relevant to the discussion of aviation English in this paper, from an ELF point of view, are phonology and pragmatics, which are discussed in the following paragraphs. [6]

With regard to phonology, Jenkins (2000), in her work *The Phonology of English as an International Language*, identified key phonological characteristics necessary for intelligible communication and subsumed these features under the term 'Lingua

[5] It is important to point out that, even if only L1 speakers are involved, communication is never flawless and completely accurate (Pitzl 2015: 119) – miscommunication can therefore occur regardless of the linguistic skill set of the speakers.

[6] It is worth pointing out that the focus of ELF research lies on the spoken rather than the written form of communication, "for it is in the immediacy of interaction and the co-construction of spoken discourse that variation from the familiar standard norms becomes most apparent" (Seidlhofer 2004: 223).

Franca Core'. The features that have thus been identified are the following (Jenkins 2000: 136–159):

- All consonants except for /θ/, /ð/ and [ɬ] (dark 'l')
- Aspiration following /p/, /t/, and /k/ when occurring in word-initial position (in order to distinguish them phonetically from /b/, /d/, and /g/)
- Shortening of vowels in front of fortis consonants, and lengthening of vowels in front of lenis consonants (in order to avoid confusions between pairs such as *mat* and *mad*, in which the /æ/ sound of the latter is lengthened)
- No simplification of initial consonant clusters (e.g. *product* may not become ['pɒdʌkt]), whereas medial and final consonant clusters may be simplified as long as these simplifications are in line with rules that govern elision in L1 (e.g. *strict rules* may be simplified by omitting the /t/, but *strict order* must feature the /t/ in its pronunciation)
- Long and short vowels distinguishable (e.g. /iː/ vs. /ɪ/ in *heat* vs. *hit*); regional qualities in L2 speech allowed if used consistently, except for /ɜː/
- Production and placement of nuclear stress (e.g. *Does SHE want to have the coat?* vs. *Does she want to have the COAT?*), and dividing utterances into word groups

What is interesting to note is that, for example, in the case of the production of consonant sounds, the dental fricatives /θ/ and /ð/ are not considered to be necessary for intelligible communication to take place. These sounds are often difficult to master for learners of English (Seidlhofer 2004: 217), so it might prove beneficial for them to know that such sounds may be replaced by others, such as /s/ and /z/ or /t/ and /d/, without having to fear that their messages could be misunderstood. Seidlhofer (2011: 128) thus argues that, "[f]rom an ELF perspective, accent is perfectly acceptable (and even desirable as an expression of identity) as long as it does not cause serious intelligibility problems".

In terms of pragmatics, a general finding from studies of ELF interaction is that ELF is characteristic of a "high level of cooperation and mutual support" (Seidlhofer 2004: 218). Moreover, ELF communication happens in a highly efficient manner, despite the fact that the adherence to native-like norms does not play an important role for speakers of ELF, i.e.

> the language code only accounts for part of the success or failure of communication; at least as important is a more general communicative capability, such as sensitivity to the limits of shared systemic and schematic knowledge, as well as accommodation skills. (Seidlhofer 2004: 222)

This heightened focus on communicative success rather than on adherence to norms allows speakers to "free up resources for focusing on capabilities that are likely to be crucial in ELF talk", such as "supportive listening, asking for repetition, paraphrasing" (Seidlhofer 2004: 226–227). ELF speakers thus engage in communication which "involves accommodation, negotiation and adjustment of forms to achieve successful communication" (Schneider 2013: 47). Moreover, because their "systemic/linguistic and schematic/cultural backgrounds vary from case to case", it is all the more important to "appreciate the negotiated nature of the interaction […] and the way speakers co-construct the medium of communication to best suit their needs." (Seidlhofer, Breiteneder & Pitzl 2006: 13).

In summary, it can be said that, from the perspective of a native speaker of English as well as a teacher of English as a foreign language, the phonological and pragmatic features of ELF would most likely be considered as errors, and might be even viewed as requiring correction. However, from an ELF perspective, these 'errors' "appear to be generally unproblematic and no obstacle to communicative success" (Seidlhofer 2004: 220). This is because, again, speakers of ELF "[focus] on features of maximal functional value and [discard] those that are surplus to their communicative requirement [...] [,] focusing on what is essential in the language to make it more efficient for their purposes" (Seidlhofer 2011: 156). Such a mindset allows for highly efficient communication, which is a fundamental component of safe aviation operations. This aspect will therefore be discussed in more detail in sub-chapter 3.2.3.

2.2.3. Native vs. non-native speakers of English

No other language has such a high number of non-native speakers as does English (Trudgill & Hannah 2017: 8–9). This special status presents its own set of problems, mainly because the very use of the terms *native speaker* and *non-native speaker* evokes connotations that place speakers of English on a dichotomous scale regarding their ability to communicate effectively (Seidlhofer 2011: 5–6). Yet, when thinking about the purposes of a lingua franca – namely "to make use of the (only) language

shared by all interactants […] in order to achieve the fullest communication possible" (Seidlhofer 2011: 18) – a distinction between native and non-native speakers does not prove necessary, as it might not reflect the reality of how ELF communication works.

Firstly, ELF speakers whose mother tongue is not English usually do not aim for mastery concerning their language skills – in fact, this might even be "perceived as unnecessary, unrealistic, and, at least by some, as positively undesirable" (Seidlhofer 2011: 50). Users of ELF interact with each other in order to achieve successful communication, regardless of whether certain expressions actually meet criteria of what is considered to be standard. As an example, Seidlhofer (2011: 126) discusses the use of the apparently defective plural form of *evidences* by former Secretary-General of the United Nations, Ban Ki-moon, which would not be expected to be used by native speakers, but which nonetheless may be deemed entirely appropriate in the context. The use of *evidences* may rather reflect the user's creativity within the language system as well as "the exploitation of the virtual resources of the language for making appropriate reference to things" (Seidlhofer 2011: 127). Thus, what the Common European Framework of Reference (CEFR) regards as indicating near-perfect or native-like proficiency (e.g. "Can convey finer shades of meaning precisely by using, with reasonable accuracy, a wide range of modification devices" (Council of Europe 2001: 74)) is secondary to "a sensitivity on the part of both interactants to the need to co-operate in the negotiation of understanding" (McNamara 2012: 201).

Secondly, ELF interaction requires each of the interactants to adjust to their conversational partner not only on a linguistic, but also on an interactional level. The latter might prove difficult for native speakers, as Seidlhofer argues:

> [I]f anything, [being a native speaker] is more likely to be a drawback because […] it is non-native ELF speakers who often find it easier to use English appropriately in intercultural settings. (Seidlhofer 2011: 41)

One reason for this might be the lack of experience of interactions with non-native speakers that native speakers may be involved in. Since they usually participate in interactions with their 'native peers' more often than with non-native speakers, speakers of ENL might not have had enough experience in the communicative interaction with non-native speakers. In contrast, L2 speakers of English may find such situations easier because they often have more exposure to other speakers of ELF

with different L1s. Moreover, both native and non-native speakers might subconsciously act upon a 'standard language ideology', which is the "belief that imposed language uniformity is good for society and that the standard variety is the only legitimate one" (Seidlhofer 2011: 42). Such a disposition only widens any pre-existing gaps between interlocutors of differing language skills, and fails to establish mutual rapport that would facilitate effective and constructive communication.

Another aspect of the native/non-native dichotomy that almost inevitably gives rise to problematic communication is that of a perceived inferiority of non-native speakers of English. This issue ties into what has already been mentioned in the previous paragraph, namely the notion of a 'standard language ideology'. Non-native speakers of English face the difficulty of having to adhere to a standard which has been set up by ENL communities, especially with regard to expressions that seem to be wrong in the eye of the native speaker (Seidlhofer 2011: 40). The circumstances are even further exacerbated by the notion of English being perceived as "the 'property' of the British and Irish", thus leaving non-native speakers with a feeling "that they are disadvantaged by succumbing to the 'owners' of the language, i.e. the British and the Irish" (Seidlhofer 2011: 55). This notion rather applies to Europe and the European Union, but taking the argument one step further, it can be said that the English language is being perceived as the 'property' of nations found in the inner circle of Kachru's three circles of English (e.g. USA, Australia, New Zealand). In order to prevent such imbalance, Seidlhofer (2011: 40) suggests that

> it will not do to discuss these issues and resulting problems of inequity, however critically, while at the same time persisting in passing native-speaker judgements as to what is appropriate usage in predominantly non-native ELF contexts.

Rather, non-native speakers should be "taken seriously as legitimate users, not just learners or speakers of an interlanguage in need of improvement towards the norms of a standard native variety" (Seidlhofer 2011: 9).

3. Aviation English

> Aviation English describes the language used by pilots, air traffic controllers, and other personnel associated with the aviation industry. Although the term may encompass a wide variety of language use situations, including the language of airline mechanics, flight attendants, or ground service

> personnel, most research and teaching focus on the more specialized communication between pilots and air traffic controllers, often called radiotelephony. (Moder 2013: 227)

Moder's definition of aviation English indicates the different uses of this language variety, whilst pinning down its most relevant use to the communicative interaction between pilots and air traffic controllers. It is exactly this type of communication that is of interest in this paper. Therefore, all of the following chapters discuss the use of aviation English between pilots and air traffic controllers exclusively. Before identifying key features of this variety[7], an overview of the official bodies that are or were involved in the establishment and regulation of aviation English shall be provided.

3.1. Organizations and their language proficiency requirements

3.1.1. ICAO

The International Civil Aviation Organization (ICAO) is a specialized agency of the United Nations and was founded on April 4, 1947. Its key function can be summarized as being the world's leading agency in providing regulations for global air traffic in order to minimize safety threats and maximize the benefits of air travel. To this end, it has devised a series of Standards and Recommended Practices (SARPs) which each member state is obliged to follow in order to ensure compliance with global norms. As of today, the ICAO counts 192 member states (International Civil Aviation Organization 2017).

The core principles which guide ICAO's operations are rooted in the Chicago Convention, signed by 52 states on December 7, 1944. The convention lists several responsibilities which each member state has to adhere to, such as "not to use civil aviation for any purpose inconsistent with the aims of this Convention" (Article 4), "to adopt all practicable measures, through the issuance of special regulations or other-

[7] In some of the literature, aviation English is also referred to as (restricted) register (e.g. Ragan 1997). While this is true in that registers are used for particular social settings, I still chose to use the term 'variety' since radiotelephony communication can theoretically also occur by using other languages (e.g. Spanish or French; cf. Figure 1 on page 26). In accordance with the figure, the overarching 'register' of all these varieties would thus be 'aviation language'.

wise, to facilitate and expedite navigation by aircraft between the territories of contracting States" (Article 22), or to issue licenses for the installation and operation of radiotelephony devices in aircraft as well as the purposeful use thereof by flight crew (Article 30) (International Civil Aviation Organization 1944).

Adding to its importance for global aviation is the convention's historical relevance with regard to the development of aviation English. The convention's starting point is marked by the invitation from the U.S. president, Franklin D. Roosevelt, "of over 50 states to gather in Chicago and discuss the future of legal regulations for the international civil aviation" (Kraśnicka 2016: 111–112). At the same time, this gathering can be perceived as the starting point of aviation English becoming the standard language for radiotelephony communication, since

> [t]he conference was clearly dominated by the American and British delegations and their actions (as both countries at the time had the best negotiating position in terms of the aircraft operations in the world) with strong involvement of Canadians and Australians. The four nations' native language is English. (Kraśnicka 2016: 111–112)

Moreover, the fact that after World War II the U.S. became the leading nation in terms of aircraft design and manufacturing (Estival, Farris & Molesworth 2016: chapter 1, "History of English as the language of communication in aviation")[8] further corroborated the tendency of aviation English establishing itself as a standard in the aviation industry, as the operation of aircraft required more and more aviation personnel to be able to understand aircrafts' systems. This development is reminiscent of Seidlhofer's (2011: 42) identification of a 'standard language ideology' (cf. sub-chapter 2.2.3), as it provided a linguistic advantage to those aircraft operators whose native language was English. Adding to that, the quote above from Kraśnicka (2016: 111–112) indicates that certain countries (USA, Great Britain, Canada, Australia) obtained a 'privilege' over others in the sense that their common native language virtually became the shared language based on their status in and contributions towards the community of international aviation. Other member countries of the ICAO thus had to adhere to this (imposed) standard. For these reasons, the development of English as the language used for international aviation can be viewed as already problematic from a

[8] Whenever the location of a citation from Estival, Farris and Molesworth (2016) contains text enclosed in double quotation marks (such as in this example), it reflects the name of the sub-heading under which the corresponding quote can be found in the e-book (this is because the e-book does not feature page numbers, and its sub-chapters are not numbered).

cultural point of view. Notwithstanding, the issue is mitigated insofar as the ICAO does not regard the English language as a standard for radiotelephony communications – as stated in *Annex 10 to the Convention on International Civil Aviation*, "[t]he air-ground radiotelephony communications shall be conducted in the language normally used by the station on the ground or in the English language" (International Civil Aviation Organization 2001b: 5-3).[9] English therefore came to be the language of aviation "by default, not by official policy" (Campbell-Laird 2004: 253), and its use thus needs to be understood as a recommendation by the ICAO, since the organization as such "has no regulatory control and is merely an advisory entity" (Campbell-Laird 2004: 253) due to it being a branch of the United Nations.

Whilst technical problems as a contributing factor in aviation incidents and accidents have been reduced over the years, the focus has recently shifted to human factors, in particular language-related communication issues, which the ICAO has been attempting to develop preventive measures for. One such measure has been the implementation of language proficiency requirements. These requirements focus on the skills of listening and speaking, which are defined to consist of the sub-skills of pronunciation (phonological competence), structure (grammatical competence), vocabulary (lexical competence), fluency, comprehension, and interaction (International Civil Aviation Organization 2010: 2-8 - 2-9). Based on these skills, the ICAO devised a language proficiency rating scale divided up into six distinct levels of proficiency (cf. Figure 8 in Appendix), all of which focus on spoken language only. In order for radiotelephony communication to be successful, the ICAO considers proficiency at level 4 (= operational) as a prerequisite for pilots and air traffic controllers (International Civil Aviation Organization 2010: 2-1). It is important to note that for a pilot's or controller's language proficiency to be rated as level 4, the individual needs to demonstrate proficiency at level 4 across all six skills of the ICAO's definition of language proficiency (International Civil Aviation Organization 2010: 4-8). Another point worth mentioning are the descriptors of each category within level 4: While pilots and air traffic controllers have to be able to make themselves understood most of the time, ICAO's language proficiency requirements allow for occasional errors and

[9] Note that "5-3" is not a typing error apparently indicating a page range, but denotes the third page in section 5 of the corresponding document (as this is the actual numbering used in this document as well others). Adding to that, in case of quotations extending several pages, the hyphen is longer (–) compared to the hyphen used for indicating pages such as in the current instance (-).

mistakes. For example, a speaker's pronunciation can "sometimes interfere with ease of understanding", "[e]rrors may occur" with regard to grammatical structures, and "[t]here may be occasional loss of fluency" (cf. Figure 8 in Appendix). This already hints at a feature that ELF and aviation English have in common: in order for interlocutors to communicate efficiently, conveying the intended meaning by means of an adequate use of language is of greater importance than communication that is nearly devoid of errors.

3.1.2. FAA

The Federal Aviation Administration (FAA) is the national aviation authority of the U.S. It came into existence upon the passage of the Federal Aviation Act of 1958, which aimed at the regulation of aviation in terms of operational safety. Today, the FAA is an organization within the U.S. Department of Transportation (before it became part of the Department of Transportation, the FAA went by the name 'Federal Aviation Agency'), and governs all aspects related to civil aviation, such as the licensing of aircraft, the regulation of aviation safety standards, and the certification of aviation personnel (Federal Aviation Administration 2017a).

According to FAA regulations, pilots and air traffic controllers working for American air carriers or at American airports or airfields must "[b]e able to read, speak, write, and understand the English language" (Federal Aviation Administration 2018a; Federal Aviation Administration 2018b). This applies not only to personnel already holding a valid FAA certificate, but also to individuals who apply for an FAA-approved pilot or air traffic controller license (Federal Aviation Administration 2017b: A-1). The FAA's measures to minimize errors in radiotelephony communication thus differ in this respect from those of the ICAO, since the former act as a regulatory force rather than as a suggestion. What connects the two organizations, though, is the language proficiency level they deem necessary for personnel to be able to communicate effectively. In other words, according to the FAA's *Advisory Circular 60-28B*,

> the FAA, as a supporting member of the International Civil Aviation Organization (ICAO), has agreed that, to be consistent with currently established ICAO guidance, the ICAO Operational Level 4 standards for English language proficiency would be applied to all FAA-certificated airmen/individuals. (Federal Aviation Administration 2017b: 2)

However, Estival, Farris and Molesworth (2016: chapter 3, "Impact of ICAO LPRs on language testing for native speakers") argue that, in reality, "[i]n the US, all pilots' licences receive an English proficient endorsement that does not indicate the level of proficiency" – the corresponding FAA certificate thus merely informs that the holder is able to communicate with regard to ATC communication, but not how well they might actually perform. Considering the native/non-native discrepancy discussed in sub-chapter 2.2.3, this could mean a reduced awareness of the interlocutors' roles and thus a lack of appropriate communicative strategies that should be applied in situations where speakers have to face differing language skills.

With the FAA constituting the aviation authority of a single nation, the primary difference to the ICAO is its regulatory nature. While the ICAO issues recommendations in the form of SARPs, which are not legally binding, the FAA requires aviation personnel to comply with its regulations. This also applies to the language used for radiotelephony communication, even though the FAA does not provide explicit information on what language has to be used. However, given that English is the most widely spoken language in the USA, it is implicitly understood that English shall be used to this end. Another difference between the ICAO and the FAA is the phraseology that each of the administrative bodies have established for the use in ATC communication. Some examples of this discrepancy will be addressed in sub-chapter 6.1.

3.2. Linguistic characteristics of aviation English

3.2.1. Standard Phraseology

Standard phraseology in radiotelephony communication comprises numerous predefined phrases that are to be used in certain situations during a flight. Some of these phrases and their applications in different phases of a flight will be presented in subchapter 3.5. In the current sub-chapter, aviation English will be looked at from a structural and a functional point of view, considering that "[t]here are differences between natural English and ATC-English on every linguistic level" (Breul 2013: 74).

Starting on the lexical level (the phonological level will be discussed in detail in sub-chapter 3.2.2), one of the characteristics of aviation English is its highly specialized vocabulary. To list all the different terms and phrases would not be feasible, as

they are not only quite numerous, but also differ in what the ICAO and the FAA regard as standard phraseology. Instead, the reader is referred to chapter 12 of the document *Air Traffic Management* (International Civil Aviation Organization 2001a) as well as to the *Pilot/Controller Glossary* (Federal Aviation Administration 2014), which contain roughly 500 or 700 words and phrases, depending on which reference document (ICAO or FAA) is consulted. The differing numbers can be explained by the fact that the *Air Traffic Management* document only lists the standard phraseology that is necessary for pilots and air traffic controllers to signal transmissions or to issue commands, while the *Pilot/Controller Glossary* also includes descriptions of abbreviations (such as *ATC*) and general terms that are used in the domain of aviation (such as *airport, obstacle*). Interestingly, the FAA's document also accounts for terminological differences between the ICAO and the FAA by including those ICAO phrases that differ from the corresponding FAA ones (sub-chapter 6.1 will come back to this issue). For a more coherent understanding of the phraseology of aviation English, the two glossaries are further complemented by the *Manual of Radiotelephony* (International Civil Aviation Organization 2007) and by chapter 4 of the *Aeronautical Information Manual* (Federal Aviation Administration 2017c), respectively. These documents describe how the phraseology ought to be applied in various situations, and they provide example dialogues between air traffic controllers and pilots to illustrate the use of standard phraseology in context.

A list of some of the most important words and phrases can be gleaned from Table 1 below (the table was taken from the source document as is, without omission or addition of words or phrases). Taking a look at the different word categories in the table, one can find that verbs and nouns amount to the majority of the terms, while adjectives and adverbs appear very rarely (Estival, Farris & Molesworth 2016: chapter 2, "the 'phraseology' proper: words and phrases to use"). Verbs usually denote directives or commands issued towards a pilot, while nouns are mostly used as proper names to label certain navigational points. Regarding adjectives, the most important ones would be *unable*, which is used in situations where the speaker finds it impossible to comply with a request, and *clear*, which can either be used when issuing a clearance, or when referring to the meteorological condition of a cloudless sky – either way, confusions are very unlikely to occur since the correct meaning can be inferred from context (Estival, Farris & Molesworth 2016: chapter 2, "the 'phraseology'

proper: words and phrases to use"). Concerning adverbs, *immediately* is used in situations which require urgent actions (e.g. vacating the runway for a landing aircraft). As these situations are not uncommon, *immediately* can be regarded as the most frequent adverb used in aviation English (Estival, Farris & Molesworth 2016: chapter 2, "the 'phraseology' proper: words and phrases to use").

Table 1. ICAO Standard Words and Phrases (International Civil Aviation Organization 2001b: 5-6 – 5-7)

Word/Phrase	*Meaning*
ACKNOWLEDGE	"Let me know that you have received and understood this message."
AFFIRM	"Yes."
APPROVED	"Permission for proposed action granted."
BREAK	"I hereby indicate the separation between portions of the message." *(To be used where there is no clear distinction between the text and other portions of the message.)*
BREAK BREAK	"I hereby indicate the separation between messages transmitted to different aircraft in a very busy environment."
CANCEL	"Annul the previously transmitted clearance."
CHECK	"Examine a system or procedure." *(Not to be used in any other context. No answer is normally expected.)*
CLEARED	"Authorized to proceed under the conditions specified."
CONFIRM	"I request verification of: (*clearance, instruction, action, information*)."
CONTACT	"Establish communications with . . ."
CORRECT	"True" or "Accurate".
CORRECTION	"An error has been made in this transmission (*or* message indicated). The correct version is . . ."
DISREGARD	"Ignore."
HOW DO YOU READ	"What is the readability of my transmission?"
I SAY AGAIN	"I repeat for clarity or emphasis."
MAINTAIN	"Continue in accordance with the condition(s) specified" or in its literal sense, e.g. "Maintain VFR".
MONITOR	"Listen out on (frequency)."
NEGATIVE	"No" *or* "Permission not granted" *or* "That is not correct" *or* "Not capable".
OVER [10]	"My transmission is ended, and I expect a response from you." *Note. — Not normally used in VHF communications.*
OUT	"This exchange of transmission is ended and no response is expected." *Note. — Not normally used in VHF communications.*
READ BACK	"Repeat all, or the specified part, of this message back to me exactly as received."

[10] Note the contradictory use of the phrase 'over and out', which is wrongly considered part of aviation English phraseology by people who wrongly regard it as professional (Estival, Farris & Molesworth 2016: chapter 2, "grammatical categories").

RECLEARED	"A change has been made to your last clearance and this new clearance supersedes your previous clearance or part thereof."
REPORT	"Pass me the following information . . ."
REQUEST	"I should like to know . . ." *or* "I wish to obtain . . ."
ROGER	"I have received all of your last transmission." *Note. — Under no circumstances to be used in reply to a question requiring "READ BACK" or a direct answer in the affirmative (AFFIRM) or negative (NEGATIVE).*
SAY AGAIN	"Repeat all, or the following part, of your last transmission."
SPEAK SLOWER	"Reduce your rate of speech."
STANDBY	"Wait and I will call you." *Note. — The caller would normally re-establish contact if the delay is lengthy. STANDBY is not an approval or denial.*
UNABLE	"I cannot comply with your request, instruction, or clearance." *Note. — UNABLE is normally followed by a reason.*
WILCO	(*Abbreviation for "will comply".*) "I understand your message and will comply with it."
WORDS TWICE	a) *As a request:* "Communication is difficult. Please send every word, or group of words, twice." b) *As information:* "Since communication is difficult, every word, or group of words, in this message will be sent twice."

Two remarks shall be made about the table above before continuing with syntactic properties of aviation English. Firstly, the words *affirm* (pronounced AY-firm, i.e. stress is placed on the first syllable) and *negative* are to be used instead of a simple *yes* or *no* in an answer. This substitution represents an important improvement of the phraseology, since the latter two words are phonologically too weak and can be easily misheard or ignored (Estival, Farris & Molesworth 2016: chapter 2, "syntactic structures"). Secondly, the table offers an idea of the distribution of lexical categories, with verbs being the most numerous (15 instances) followed by adjectives (7 instances) and adverbs (1 instance). The fact that there are only 2 nouns represented in the table is somewhat misleading, since the majority of nouns in radiotelephony communication stem from navigational charts or aircraft's call-signs. More important, however, is the number of imperatives found among the verbs (13 instances), which indicates the use of commands and orders that is typical of ATC communication. This also makes aviation English an instance of ESP, as we have already seen in sub-chapter 2.1.2 that the preference of a certain grammatical structure is a characteristic feature of English for specific purposes.

On the syntactic level, aviation English "aims to reduce each message to its logico-semantic content" (Estival, Farris & Molesworth 2016: chapter 2, "syntactic

structures"). This means that messages contain only a few grammatical words and are thus shorter than their equivalents in natural English. Moreover, the sentence structure is simplified through the use of main clauses only, "with no embedding of subordinate clauses such as relative or that-complement clauses" (Estival, Farris & Molesworth 2016: chapter 2, "syntactic structures"). Also, different pieces of information, such as altitude or distance, are "juxtaposed in a paratactic relation", as the following example shows (Estival, Farris & Molesworth 2016: chapter 2, "syntactic structures"):

> ATC: Lima Sierra India, maintain 1800, join downwind runway 06, report 2 miles.

Theoretically, this juxtaposition allows transmissions to contain numerous "information units" (Estival, Farris & Molesworth 2016: chapter 2, "syntactic structures"). The term designates the separate parts that instruct the recipient of the transmission to perform an action or that report information to the recipient so that he/she has the most current information available. In the previous example, the information units would be *maintain 1800* (which instructs the pilot to keep the altitude of 1,800 feet at which the aircraft is currently flying), *join downwind runway 06* (which instructs the pilot to approach the airport by flying parallel and in opposite direction to the landing runway), and *report 2 miles* (which instructs the pilot to contact the air traffic controller as soon as the aircraft is at a distance of 2 nautical miles from the airport). Studies have shown that an increase in the number of information units raises the chances for miscommunication to occur, since the pilot has to cope with an increase in cognitive load (Morrow, Lee & Rodvold 1993; Howard 2008; Barshi & Farris 2016). Message length (i.e. the number of information units in a transmission) is a result of the speaker's decision given the situational context (air traffic controllers tend to issue longer messages in situations of high workload; cf. (Morrow, Lee & Rodvold 1993)), and does not constitute a linguistic aspect of aviation English itself. Therefore, the consequences of message length will not be further discussed in this paper.

The most salient feature of aviation English with regard to syntax, however, is the use of deletions or ellipsis (e.g. *traffic on final runway 16* instead of ***landing*** *traffic* ***is*** *on* ***the*** *final* ***approach to*** *runway 16*). Even though the messages do not represent grammatical sentences, the risk of miscommunication is relatively small because the "rigid syntax of ATC messages already takes into account the small semantic contribution of those omitted elements, which is why they are not part of the messages in

the first place" (Estival, Farris & Molesworth 2016: chapter 2, "syntactic structures"). The upside of such a reduction of sentences to their content words is an increase in time efficiency in the handling of air traffic. However, the ensuing semi-artificial nature of the sublanguage (Robertson 1987: VIII; Breul 2013: 77) has one crucial consequence: native speakers of English need to learn aviation English just as non-native speakers need to. This has two reasons. Firstly, native speakers of English are in the position of a language learner because of their unfamiliarity with the code of aviation English (when listening to radiotelephony communication, speakers without practice usually do not understand what is being talked about). This means that becoming proficient in radiotelephony communication requires practice, just as learning a foreign language requires practice (Estival, Farris & Molesworth 2016: chapter 2, "Aviation English as a restricted code"). Thus, "being a native speaker of English does not guarantee proficiency in Aviation English" (Estival, Farris & Molesworth 2016: chapter 1), but would rather be helpful, at most, in learning this variety of English. A second reason for why native speakers of English cannot automatically be assumed to be proficient in aviation English may be a lax attitude towards utilizing standard phraseology as compared to non-native speakers of English. In a study involving interviews with Korean air traffic controllers, Kim and Elder (2009: 23.13) found that pilots whose L1 was English were reportedly more likely to use verbose language than pilots for whom English was an L2. Native speakers of English therefore need to be aware of the specialized communicative context when using aviation English. This especially applies to situations in which standard phraseology cannot provide for effective communication due to its restrictive characteristics, as the following paragraphs will show.

Standard phraseology in aviation English does not cater for the entirety of possible scenarios that might occur during any given stage of a flight. As the ICAO (International Civil Aviation Organization 2001b: 5-1) states in its *Annex 10 to the Convention on International Civil Aviation*, standard phraseology "shall be used in all situations for which it has been specified. Only when standardized phraseology cannot serve an intended transmission, plain language shall be used". Whilst there is no official definition of plain language in the regulations of ICAO and FAA (Estival, Farris & Molesworth 2016: chapter 1, "The role of 'plain' language"), it is described as the

> spontaneous, creative and noncoded use of a given natural language, although constrained by the functions and topics (aviation and non-aviation) that are required by aeronautical radiotelephony communications, as well as by specific safety-critical requirements for intelligibility, directness, appropriacy, non-ambiguity and concision. (International Civil Aviation Organization 2010: 3-5)

The fact that the use of plain language, or 'plain English' in the case of international radiotelephony communication, is "constrained by [...] functions and topics" indicates that, whilst this variety of language comprises an extension of aviation English in that its repository consists of words and phrases that are typically not considered to be part of standard phraseology, it also forms a subset of aviation English. Figure 1 below illustrates the relationship between plain English and aviation English.

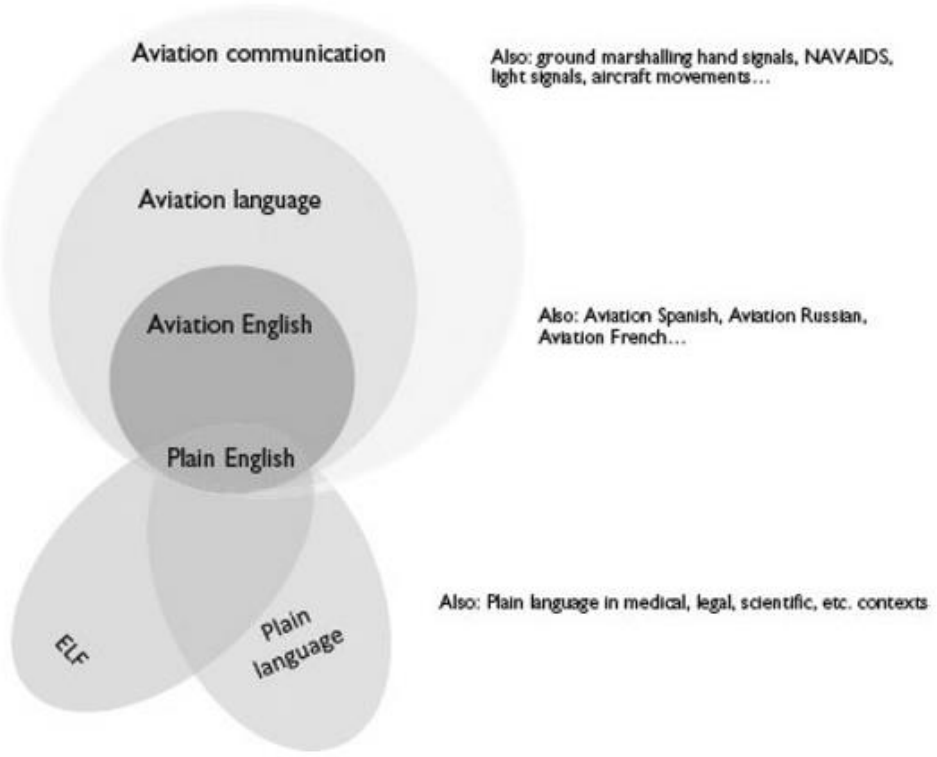

Figure 1. Relations between aviation communication, aviation language, Aviation English, ELF and plain language (Estival, Farris & Molesworth 2016: chapter 1, "The role of 'plain' language")

The figure places aviation English in a broader context by showing its relationship to aviation communication in general (which also includes light signals, for example), aviation language, ELF, and plain language (which is not the same as plain English,

since it also encompasses the 'simplified' language used in other specialized domains such as medicine or law). With regard to ELF, it is worth pointing out that Estival, Farris and Molesworth (2016: chapter 1) view it as a language that is used by non-native speakers of English and native speakers of English likewise (cf. corresponding definitions in sub-chapter 2.2.2), which of course applies to aviation English in particular. This relationship is therefore illustrated by the intersecting areas of "ELF" and "Aviation English" in Figure 1. At the same time, the intersection of these two areas with "Plain language" shows that plain English incorporates features of both aviation English and ELF, i.e. it still incorporates standard phraseology wherever possible, but it also relies on less regulated speech and thus may require strategies to negotiate meaning between ELF speakers.

Because plain English forms a subset of aviation English, the same level of proficiency, i.e. level 4, applies to the use of plain English (International Civil Aviation Organization 2011: APP 1-1). With regard to the attainment of this level (cf. Figure 8 in Appendix), it is due to their linguistic competences that "native speakers of English have a distinct advantage" (Estival, Farris & Molesworth 2016: chapter 1, "The role of 'plain' language"). However, when it comes to the actual use of plain English, native speakers of English may face difficulties in radiotelephony communication, as they have to restrict their use of idiomatic expressions, dialectal features, or figures of speech during transmissions. The use of these features has the potential to compromise operational safety, regardless of the recipient's L1: while non-native speakers of English might not be familiar with the finer details of the language, using plain English in native-to-native communication can result in the production of ambiguous messages, as the accident of Eastern Air Lines Flight 401 (cf. sub-chapter 3.2.3) shows. It is therefore important that pilots and air traffic controllers keep their transmissions as simple and unambiguous as possible, while including all the information necessary for the recipient to understand the speaker's message.

Even though communication happens in a less regulated fashion when plain English is used, this does not mean that aviation personnel is exempt from using technical terminology in order to convey their messages. This aspect distinguishes aviation English from other domains that are marked by specialized language, such as medicine or law, in which 'plain language' is used to communicate with laypeople, such as patients and clients, in order to allow them to better grasp the meanings of

and concepts behind certain terminology (Estival, Farris & Molesworth 2016: chapter 1, "The role of 'plain' language"). Additionally, the lack of standardization in using plain English does not mean that radio discipline is to be disregarded. Pilots and air traffic controllers still have to follow rules such as those described in the following three sub-chapters. In particular, the use of plain English should "not be taken as licence to chat, to joke or to degrade in any way good radiotelephony techniques" (International Civil Aviation Organization 2007: 3-2).

Taking US Airways Flight 1549 (also known as 'The Miracle on the Hudson') as an example, one can see how the use of non-standard phraseology was necessitated by the exceptional circumstances the cockpit crew had found themselves in. The aircraft was hit by a flock of birds shortly after takeoff from LaGuardia airport in New York City, resulting in a total loss of power on both engines and thus rendering the plane a glider. Realizing that they were too far away from an airport to safely land the airplane on ground, the pilot decided to ditch the aircraft on the Hudson river, and did so successfully, thus saving the lives of all 155 people on board. Below are some of the transmissions exchanged between the air traffic controller ("DEP", i.e. the controller handling departures from LaGuardia airport) and the pilot ("RDO-1") (National Transportation Safety Board 2010: 174–179):

15:28:05
DEP
Cactus fifteen twenty nine, if we can get it for you do you want to try to land runway one three?
[…]
15:28:10.6
RDO-1
we're unable. we may end up in the Hudson.
[…]
15:28:49.9
RDO-1
I'm not sure we can make any runway. uh what's over to our right anything in New Jersey maybe Teterboro?
[…]
15:29:02
DEP
you wanna try and go to Teterboro?
[…]
15:29:25
RDO-1
we can't do it.
[…]

15:29:28
RDO-1
we're gonna be in the Hudson.

The pilot uses the phraseological word UNABLE to inform the air traffic controller that he cannot comply with the controller's offer for assistance (cf. Table 1). However, in the same transmission, the pilot utters the words "we may end up in the Hudson", which is later reinforced by repeating "we're gonna be in the Hudson". Standard phraseology does not provide explicit terminology for emergency water landings, but rather outlines those pieces of information that should be provided by the pilot in case of emergency (e.g. aircraft identification, nature of distress, pilot's intention; cf. International Civil Aviation Organization 2007: 9-2; Federal Aviation Administration 2017c: 6-3-2). Therefore, the pilot of US Airways Flight 1549 needs to resort to the use of plain English in order to communicate his intentions as clearly and unmistakably as possible – which in this case means to let the controller know where exactly the aircraft is supposed to be coming down so that subsequent emergency operations can be initiated as quickly as possible.

3.2.2. Spelling Alphabet

Besides the use of standard phraseology, the ICAO has developed an international spelling alphabet in order to minimize the risk of misunderstandings in the pronunciation of letters, groups of letters and numbers. The focus of this sub-chapter is on the ICAO's phonetic alphabet; therefore, the following historical overview by no means features a comprehensive overview of spelling alphabets in general, but rather outlines the steps involved in arriving at the alphabet that is now used for radiotelephony communication.

Regarding the English language, there are certain groups of letters that can be easily confused due to similarities in the phonetic properties of their names, such as A, H, J, K; B, C, D, E, G, P, T, V, Z; F, S, X; I, R, Y; L, M, N; and Q, U, W (Armed Services Technical Information Agency 1959: 1). Given that aviation personnel operate in a high-stakes environment, it is necessary to use a designated spelling alphabet. The first international spelling alphabet that was agreed upon as a standard after the establishment of the ICAO was the 'Able-Baker' alphabet (cf. Table 6 in Appendix), which had been used in the military before (Armed Services Technical Information Agency

1959: 10). However, a universal use across the airline industry soon became problematic, as the alphabet proved unsuitable for speakers of French and Spanish (the other two working languages of the ICAO) due to the phonetic properties of certain words from the Able-Baker alphabet. Therefore, the development of a new spelling alphabet was commissioned, thereby considering specific requirements according to which a word had to (Armed Services Technical Information Agency 1959: 11):

(1) Be a live word in each of the three working languages.
(2) Be easily pronounced and recognized by airmen of all languages.
(3) Have good radio transmission and readability characteristics.
(4) Have a similar spelling in at least English, French, and Spanish, and the initial letter [had to] be the letter the word identifies.
(5) Be free from any association with objectionable meanings.

After a process of drafting, reviewing, and incorporating comments from member states, a new version came into existence on April 1, 1952 (Armed Services Technical Information Agency 1959: 11–13). However, this version (cf. Table 7 in Appendix) was not accepted unanimously by aviation personnel, as many of them were still too accustomed to the Able-Baker alphabet, and thus reverted to the old version. What followed were a thorough analysis of the new alphabet and testing against the old version. Specifically, the goal for improvement was to increase the efficiency of the system as well as to replace confusable words with less confusable ones (Armed Services Technical Information Agency 1959: 13). In the end, research indicated that

> substantial improvement in the efficiency of the ICAO phonetic alphabet can be made by the substitution of five (5) phonetic equivalents as follows:
>
> COCA changed to CHARLIE
> EXTRA changed to X-RAY
> METRO changed to MIKE
> NECTAR changed to NOVEMBER
> UNION changed to UNIFORM (North Atlantic Treaty Organization 1954: 1)

While the replacements for the letters C (Charlie), X (X-Ray), M (Mike) and U (Uniform) were backed by test results indicating high articulation scores, the decision for replacing *Nectar* with *November* was based on the fact that the former could be easily confused with the word for the letter V, which is *Victor* (Armed Services Technical Information Agency 1959: 14–18). Hence, on March 1, 1956, NATO proposed to its member states the spelling alphabet which is in use today (North Atlantic Treaty Organization 1955). Table 2 below shows the

alphabet's individual letters, the orthographic representations of the words used for spelling the letters, their approximate phonetic representations using the Latin alphabet, and their phonetic representations using symbols from the International Phonetic Alphabet.

Table 2. Phonetic spelling for the transmission of letters (International Civil Aviation Organization 2001b: 5-4)

Letter	*Word*	*Latin alphabet representation*	*International Phonetic Convention*
A	Alfa [11]	AL FAH	ˈælfa
B	Bravo	BRAH VOH	ˈbraːˈvo
C	Charlie	CHAR LEE or SHAR LEE	ˈʧaːli or ˈʃaːli
D	Delta	DELL TAH	ˈdelta
E	Echo	ECK OH	ˈeko
F	Foxtrot	FOKS TROT	ˈfɔkstrɔt
G	Golf	GOLF	gʌlf
H	Hotel	HO TELL	hoːˈtel
I	India	IN DEE AH	ˈindia
J	Juliett [12]	JEW LEE ETT	ˈdʒuːliˈet
K	Kilo	KEY LOH	ˈkiːlo
L	Lima	LEE MAH	ˈliːma
M	Mike	MIKE	maik
N	November	NO VEM BER	noˈvembə
O	Oscar	OSS CAH	ˈɔska
P	Papa	PAH PAH	pəˈpa
Q	Quebec	KEH BECK	keˈbek
R	Romeo	ROW ME OH	ˈroːmio
S	Sierra	SEE AIR RAH	siˈera
T	Tango	TANG GO	ˈtængo

[11] Some tables use *Alpha*, which can be problematic for those non-native speakers of English who do not know that *ph* is pronounced as /f/ (Wilson 2018).
[12] Some tables use *Juliet*, which can be problematic for native speakers of French who pronounce this version with a silent *t* at the end (Wilson 2018).

U	Uniform	YOU NEE FORM or OO NEE FORM	ˈjuːnifɔːm or ˈuːnifɔrm
V	Victor	VIK TAH	ˈvikta
W	Whiskey	WISS KEY	ˈwiski
X	X-ray	ECKS RAY	ˈeksˈrei
Y	Yankee	YANG KEY	ˈjænki
Z	Zulu	ZOO LOO	ˈzuːluː

Note: Stressed syllables are marked by underscores

It is interesting to note that the publication of the spelling alphabet in 1956 did not cater for the spelling of numbers. Why this does not appear to have been a matter of concern is not known, but there now also exist rules analogous to the spelling of letters (International Civil Aviation Organization 2001b: 5-5). Table 3 below lists the numbers and their approximate phonetic representations using the Latin alphabet (there are no phonetic transcriptions provided that use symbols from the International Phonetic Alphabet).

Table 3. Phonetic spelling for the transmission of numbers (International Civil Aviation Organization 2001b: 5-5)

Numeral or numeral element	*Pronunciation*
0	ZE-RO
1	WUN
2	TOO
3	TREE
4	FOW-er
5	FIFE
6	SIX
7	SEV-en
8	AIT
9	NIN-er
Decimal	DAY-SEE-MAL

Hundred	HUN-dred
Thousand	TOU-SAND

Note: Stressed syllables are marked by capital letters

The pronunciations of the numbers 3, 5, 9, and 1,000 deserve special attention, as they differ from the corresponding pronunciations in ENL. As with the pronunciation of individual letters in aviation English, the reason behind the peculiar spelling of the numbers 5 and 9 is to avoid confusions due to phonetic similarity (Estival, Farris & Molesworth 2016: chapter 2, "Pronunciation"): /faɪv/ and /naɪn/ are of the same length in terms of syllables, and they share the same diphthong /aɪ/, thus making the consonants the only distinguishing phonemes (which themselves can cause problems in understanding due to the similarities of /f/ – /v/ and /n/ – /m/). The pronunciation of 9 has therefore been expanded by an additional syllable, rather than the pronunciation of 5, as this additionally solved the problem of the similarity to the pronunciation of the German word for *no*, which is *nein* (pronounced as /naɪn/). This was an important step towards resolving ambiguities in the language system of aviation English, since it reduced the risk of confusion among L1 speakers of German, who are quite numerous in radiotelephony communication due the international context of aviation.

With regard to the numbers 3 and 1,000, the adaptation of the pronunciations was also done under consideration of non-native speakers of English: the pronunciation of the dental fricative /θ/ is known to be difficult for this group of speakers (Estival, Farris & Molesworth 2016: chapter 2, "Pronunciation"). As already mentioned in sub-chapter 2.2.2 in connection with the Lingua Franca Core, the substitution of this sound with others that are similar, but easier to pronounce (such as /t/) does not impact intelligibility and can aid non-native speakers in conveying their messages. For native speakers of English, on the other hand, it is unusual to learn these versions of pronouncing numerals, but they help prevent confusions. It also means that not only non-native speakers, but native speakers, too, have to learn the code of aviation English (Estival, Farris & Molesworth 2016: chapter 2, "Pronunciation").

Even though the phonetic alphabet of aviation English contributes to the reduction of misunderstandings in radiotelephony communication, it is not completely failsafe, as the crash of Flying Tiger Line Flight 66 demonstrates. While approaching the

airport in Kuala Lumpur, the cockpit crew received instructions from the air traffic controller to descend their aircraft to an altitude of 2,400 feet, the literal instruction being "descend two four zero zero" (Aviation Safety Network 2018). However, the pilot understood "descend to four zero zero" (i.e. 2,000 feet below the assigned altitude), repeated the instruction to the controller, and initiated the descent. None of the participants in the conversation noticed the mistake, which ultimately resulted in the airplane impacting a hillside at 600 feet. As already mentioned in sub-chapter 3.2.1 in connection with the use of *affirm* and *negative* instead of *yes* and *no*, weak forms are particularly prone to being misheard or ignored, which explains the confusion of *two* and *to* as well as the air traffic controller's failure to notice the pilot's wrong repetition of the instruction. In order to eliminate the potential for said confusion, today's standards require instructions for descending an aircraft to take the form *descend and maintain* (Federal Aviation Administration 2014: M-1) – in the case of Flying Tiger Line Flight 66, the instruction should therefore have been *descend and maintain two-thousand four-hundred feet*.

Although a single confusion of similar-sounding words such as *two* and *to* (or even the adverb *too*) can have such far-reaching consequences, one major contributing factor to the accident was the fact that the pilot's wrong repetition went unnoticed. The importance of such repetitions in the prevention of miscommunication will therefore be elaborated in sub-chapter 3.2.4.

3.2.3. Discourse structure

From a functional point of view, aviation English needs to meet certain criteria in order to allow for effective communication. Howard (2008: 374) states that "[t]he modern aviation system requires precision, accuracy, efficacy, and predictability", all of which are features that characterize the standard phraseology underlying aviation English.

The need for precise and accurate communication is based on the idea that it should prevent speakers from having to re-transmit a message. It can happen that imprecise or inaccurate language does not trigger the action that the speaker expects his/her interlocutor to perform, which subsequently necessitates clarification or cor-

rection. Such situations are unfavorable as they can occupy the communication channel at times where traffic is very dense and transmission times have to be kept as short as possible. The aim of reducing transmission times is also achieved by "syntactic modifications of natural English" which, in essence, "can be described as deletions or ellipsis" (cf. sub-chapter 3.2.1) (Breul 2013: 75). In order for this to not cause any misunderstandings or ambiguities, it is essential for all interlocutors to not only have a shared understanding of the same code, but to also have a shared understanding of the situation and the context in which they operate.

Precision and accuracy are further catered for by "communication [which] is task focused", and thus free of "banter" (Howard 2008: 373). As already mentioned before, the use of plain English does not allow air traffic controllers and pilots to chat with each other or to initiate conversations that do not contribute to the (safe) operation of an aircraft. Adding to that, when using plain English, the lower degree of restrictiveness and the more open choice of words and phrases might tempt speakers to produce language that is more open to interpretations. A notorious example for this risk factor is the crash of Eastern Air Lines Flight 401. During their final approach to Miami International Airport, the cockpit crew, upon pulling a lever to lower the airplane's landing gear, noticed that the lamp which normally indicated that the nose gear was down, was not lit. Without this indicator, the crew could not verify whether the landing gear was actually in its lowered position. The pilots became so occupied with trying to solve the problem that they failed to realize that the airplane had meanwhile entered a slow but steady descent (there were no visual cues from outside since the flight was carried out during nighttime). The air traffic controller who they were in contact with, however, noticed the plane's deviation from its previously assigned altitude. He therefore asked whether the crew was aware of the anomaly by uttering "Eastern, ah, four oh one, how are things coming there?" (Tajima 2004: 462). Contrary to the controller's intention, the cockpit crew assumed that the controller was referring to their progress in solving the issue with the indicator lamp, and thus failed to prevent the aircraft from crashing into the Everglades. The accident shows that the use of plain English is ought to be as unambiguous as possible, which precludes the use of colloquialisms or figures of speech – an aspect that especially native speakers of English have to grapple with.

In terms of efficacy, Breul (2013: 77) argues that aviation English, as he identifies it as a "semi-artificial [sublanguage]", is "deliberately designed so as to be capable of expressing only a limited set of meanings", thus allowing for pilots and controllers to exchange large amounts of information within relatively short time. Moreover, there is a reduced risk of misunderstandings, as the chance of a message carrying multiple interpretations is lowered. Pilots and air traffic controllers, upon hearing standardized phrases, know which (unambiguous) meanings these phrases carry with them, and so can communicate with each other without having to rely on questions asking for clarification. On the other hand, the conveyance of "limited set of meanings" which aviation English is streamlined to means that aviation personnel are likely to encounter situations for which there is no standard phraseology available (cf. subchapter 3.2.1). In such cases, i.e. in cases where plain English has to be used, the efficacy of radiotelephony communication strongly relies on an interlocutor's linguistic knowledge and his/her ability to communicate his/her intended message as clearly as possible. Contrary to what might be expected, this not only applies to non-native speakers of English, who may have a linguistic disadvantage compared to native speakers, but also to native speakers who must ensure clear and unambiguous communication by refraining from the use of idiomatic expressions, for instance (cf. Easter Air Lines Flight 401 mentioned above, where the use of an ambiguous question led to a crash).

The fourth feature, predictability, is a characteristic of "restricted registers" (Ragan 1997: 26–27), which Ragan identifies as specialized registers in which either the situation or the language is predictable if one of these two aspects applies. Predictability in aviation English is ensured through the situational context, which "further restricts the set of possible messages" (Frick & Sumby 1952: 595). For example, if a pilot is given the clearance to taxi (i.e. move the aircraft on the ground) from the parking position to the runway, he/she may expect, upon arriving at the runway, to receive the clearance for a take-off. The knowledge of what is to be expected can facilitate communication, but it also has a critical downside, which is that of expectation bias. In situations that deviate from standard procedures (e.g. adjustments to a previously planned flight path, or emergency situations), radiotelephony communication can be hampered if an interlocutor's reception of information is influenced by what he/she expects to hear. In such cases, the aspect of predictability represents somewhat of a

contradiction to Howard's (2008: 374) request for efficacy, since it may happen that transmissions need to be repeated or rephrased, thus occupying the radio channel for a prolonged period of time. It is therefore important for recipients to attentively listen to messages so that expectation bias can be avoided.[13]

Morrow, Lee and Rodvold (1993: 286) identify three communicative acts in radiotelephony communication: initiate – present – accept. The first two of these, 'initiate' and 'present', define the structure of a message, or in other words, in which order what kind of information is presented in a transmission. Estival, Farris and Moelsworth (2016: chapter 2, "dialogue turns") explain the basic structure of a transmission, using the initial transmission of an interlocutor as an example:

Who I am talking to:	Receiving station: aircraft or ground station
What I am:	Emitting station: aircraft or ground station
Who I am:	Name or call-sign
Where I am:	Position / Altitude
What my intentions are:	Route, arrival, etc.

The basic structure can thus be summarized as 'addressee – addresser – command'. Similarly, whenever an air traffic controller issues a response (which corresponds to Morrow, Lee and Rodvold's (1993: 286) third communicative act, "accept"), the message has to contain information about 'Who I am talking to' as well as the instructions targeted at the pilot. The pilot then needs to read back the instructions by repeating them (cf. sub-chapter 3.2.4), followed by information about 'Who I am' (Estival, Farris & Molesworth 2016: chapter 2, "dialogue turns"). The 'addressee – addresser – command' structure not only ensures that the station being addressed is made aware of a relevant transmission right at the beginning of the message, but also that messages are acted upon by those who are the intended recipients.

3.2.4. Read-backs

Next to a standardized phraseology, a phonetic alphabet for the pronunciation of letters and numbers, and a highly structured way of communicating, a further means of preventing miscommunication in radiotelephony communication is the repetition of crucial information by the receiving end of a transmission – a process that is often

[13] The paragraphs from the beginning of this sub-chapter up to this point were taken from Konrath (2017: 2–3) with some modifications.

termed the 'read-back' of the pilot or air traffic controller. The need for read-backs is argued by the ICAO (2007: 2–13) as follows:

> The stringency of the read-back requirement is directly related to the possible seriousness of a misunderstanding in the transmission and receipt of ATC clearances and instructions. Strict adherence to read-back procedures ensures not only that the clearance has been received correctly but also that the clearance was transmitted as intended. It also serves as a check that the right aircraft, and only that aircraft, will take action on the clearance.

The need for 'ensuring' (as Frick and Sumby (1952: 596) termed it likewise) that a message has been successfully understood by the recipient is of central importance in radiotelephony communication. This is, firstly, due to the lack of nonverbal communication, which would otherwise aid in the transfer of a speaker's message to the listener. Pilots and air traffic controllers are solely dependent on auditory information, making radiotelephony communication prone to misunderstandings. Secondly, impediments due to technical aspects of radiotelephony communication (such as background noise; cf. sub-chapter 3.4) can sometimes lead to misunderstandings because nothing or only part of a message was understood. Thirdly, by acknowledging each other's transmissions, pilots and air traffic controllers "agree that they share the same mental model" (Morrow, Lee & Rodvold 1993: 286) – that is, they both understand the task they are working towards and share their understanding of the situational context.

The ICAO's *Air Traffic Management* provides for a clear attribution of the pilot's and the air traffic controller's roles with regard to read-backs. Regarding the former, the document lists those pieces of information which are definitely to be read back (International Civil Aviation Organization 2001a: 4-5):

a) ATC route clearances;

b) clearances and instructions to enter, land on, take off from, hold short of, cross, taxi and backtrack on any runway; and

c) runway-in-use, altimeter settings, SSR codes, level instructions, heading and speed instructions and, whether issued by the controller or contained in automatic terminal information service (ATIS) broadcasts, transition levels.[14]

Thus, for example, a message containing information about windspeeds and wind directions does not have to be read back, as it is intended to solely provide information to the pilot without requiring him/her to comply with a command. In fact, reading back such information would occupy the radio channel, which, even during such a short period of time, could be used for other, more important transmissions instead.

Regarding the role of the air traffic controller in terms of read-backs, the document *Air Traffic Management* writes as follows (International Civil Aviation Organization 2001a: 4-6):

> The controller shall listen to the read-back to ascertain that the clearance or instruction has been correctly acknowledged by the flight crew and shall take immediate action to correct any discrepancies revealed by the read-back.

Due to its importance, this active listening process is often termed the 'hear-back' of the air traffic controller (Kim & Elder 2009: 23.3). Thus, it is only after the air traffic controller deems the pilot's read-back correct that the message can be considered as fully understood by the recipient. In case the read-back contains wrong information or lacks part of the original message, the controller "shall transmit the word 'NEGATIVE I SAY AGAIN' followed by the correct version" (International Civil Aviation Organization 2007: 2-14).

3.3. Aviation English as ESP and as ELF

Referring back to chapter 2, and taking into consideration the characteristics of aviation English that have been discussed so far, this sub-chapter demonstrates how aviation English qualifies as an example of ESP and of ELF.

[14] SSR = secondary surveillance radar, i.e. radar that not only detects the position of an aircraft, but also collects additional information such as its altitude. The SSR code thereby helps the radar to uniquely identify an aircraft and distinguish it from other aircraft in the same airspace.
ATIS is an information service found at larger airports, which provides aeronautical information such as weather information or active runways.

Starting with features shared with ESP, aviation English firstly qualifies as a language for specific purposes due to similarities on the lexical level. The standard phraseology of aviation English is marked by a mixture of both regular expressions that are subsumed under the term of plain English as well as a special vocabulary which is context-dependent – the word *taxi*, for example, refers to an aircraft's movement on the ground, but outside the context of aviation it usually denotes a type of car (or transport service). Hence, in order for aviation personnel to communicate effectively, knowledge of the context and a shared meaning are key in radiotelephony communication (Campbell-Laird 2004: 258).

Secondly, there is an underlying goal in the use of aviation English: "The single, most important thought in pilot-controller communications is understanding" (Federal Aviation Administration 2017c: 4-2-1). In order to achieve this goal, specific forms are utilized in the established phraseology to perform a certain function. ESP's strand of discourse analysis has shown how an understanding of this form-function relationship greatly enhances one's understanding of texts (cf. sub-chapter 2.1.1), and it allows for an understanding of how language is used "to cause things to be done" (Kennedy & Bolitho 1984: 2–3). For example, imperatives are used to have the recipient complete a task, while questions perform the function of requesting information (the former is a typical feature of aviation English, since radio transmission often contain instructions of air traffic controllers issued towards pilots; cf. Table 1). A comprehensive list of functions associated with radiotelephony communication is provided by the *Manual on the Implementation of ICAO Language Proficiency Requirements* (International Civil Aviation Organization 2010: B-1 – B-4), which lists 116 items in a catalogue of communicative language functions grouped into the four categories of "triggering actions", "sharing information", "management of pilot-controller-relation", and "management of dialogue". With the help of this categorization, the phrase *climb and maintain 17,000 feet*, for example, can be assigned the function of 'giving an order' (which is a triggering action), while the question *Are you ready for immediate departure?* would perform an act of 'asking about readiness/availability' (which belongs to the category of sharing information). Each utterance thus fulfills a specific function in the context of radiotelephony communication, which signifies the goal-orientedness of aviation English.

Thirdly, in accordance with Widdowson's (1998: 12) statement that "mastery [i.e. mastery of a special variety of the English language] is not the same as general proficiency in English", the specialized phraseology of aviation English is not the same as the plain English used in radiotelephony communication for situations which are not covered by standard phraseology. This means that native speakers of English cannot automatically be assumed to be competent in the use of standard phraseology, thus necessitating separate training for this group of speakers, just as for non-native speakers of English. Sub-chapter 6.2 expands more on the aspect of pilot and air traffic controller training.

Besides its characteristics shared with ESP, aviation English also shares aspects with ELF communication. The most prominent one is the fact that interlocutors do not share a common mother tongue due to the international context of radiotelephony communication. With English being the international language of aviation, this means that aviation personnel with differing competencies in English have to overcome linguistic boundaries in order to communicate effectively. After all, the goal is, as already mentioned in the discussion regarding ESP, a shared understanding among aviation personnel. This does not necessarily mean a native-like use of the language, but rather the construction of shared meaning (cf. sub-chapter 2.2.2). To achieve this, interlocutors can employ different communicative strategies, such as rephrasing and repetition, the latter of which manifests itself in the form of read-backs. Furthermore, Seidlhofer's (2011: 129) cooperative imperative also applies to the context of radiotelephony communication, since aviation personnel share the mutual intention of communicating in as clear and effective a way as possible. This is primarily achieved by adhering to standardized procedures and by utilizing standard phrases, thus lowering the risk of misunderstandings.

As a result of the circumstance that aviation English is used in situations in which speakers more often than not do not share a common mother tongue, communicative acts will always involve a combination of native and non-native speakers of English talking to each other. While in most cases native speakers have the advantage of a higher degree of everyday linguistic proficiency, they might find it harder than non-native speakers of English to communicate in an ELF setting (cf. sub-chapter 2.2.3). This also brings up the differentiation between native and non-native speakers of English: in the context of radiotelephony communication, differentiating between

these two groups of speakers only applies to the use of plain English, which requires general language proficiency to be at a high level to ensure successful communication. With regard to the use of standard phraseology, however, talking about native speakers of aviation English is rather a misnomer, since "it is a speech variety that must be learned even by native speakers of English" (Estival, Farris & Molesworth 2016: chapter 1). The reason for this is to be found in the heavily regulated nature of aviation English, which requires strict adherence by aviation personnel and barely allows for any creative use of the language. Moreover, the syntactical feature of ellipsis runs counter to what native speakers are familiar with in their use of the English language. So it can be said that there are de facto no native speakers of aviation English, but rather a mixture of native and non-native speakers of English who participate in radiotelephony communication (this dichotomy, however, might still be problematic given the context of ELF communication – cf. sub-chapter 2.2.3).

Lastly, a quote by Mackay and Mountford (1978: 4; Wang 2008: 152–153; Wang 2008: 152–153) shall be addressed here. The authors consider aviation English as a restricted repertoire rather than a language of its own, since "[k]nowing a restricted 'language' would not allow the speaker to communicate effectively in a novel situation, or in contexts outside the vocational environment". What Mackay and Mountford seem to exclude here, however, is the use of plain English in radiotelephony communication. Plain English requires general language proficiency and thus actually allows for the users to communicate in novel situations – in fact, the very purpose of the use of plain English is to resolve situations which interlocutors have usually not been previously faced with. Similar to the way speakers of ELF communicate with each other, speakers of plain English would employ different strategies to negotiate meaning. These strategies can be learned and enhanced through that part of pilot and air traffic controller training which focuses on the improvement of general language proficiency. Therefore, while aviation English is sometimes described as a restricted register characterized by the idiosyncrasy and predictability of its use (Ragan 1997: 27–28), its users also have the possibility to utilize their linguistic resources in novel situations.

3.4. Radiotelephony communication – technical aspects

In addition to an understanding of the standard phraseology of aviation English, some basic information about the underlying technology of radiotelephony communication is helpful in order to better grasp the interactions between pilots and air traffic controllers.[15]

From a technical point of view, communication between an aircraft's cockpit crew and an air traffic controller requires both parties to be equipped with a radio system capable of transmitting and receiving radio signals, thus allowing for two-way communications to take place. Since communication is primarily voice-based, the systems need to have an option to transmit signals only when a party actually attempts to speak – otherwise, undesired sound signals would be transmitted, and the channel between pilot and air traffic controller would be constantly occupied, making it impossible for other aircraft in the controller's airspace to transmit messages. To this end, Push-to-talk (PTT) technology is used, in which either party needs to first press a button before phrasing their message.

An aircraft's radio system can operate on different channels within a particular, very-high frequency (VHF) spectrum, ranging from 118.000 MHz to 136.975 MHz, with spacings of 25 kHz in-between[16] (Roger-Wilco 2010). The different channels are required in order to contact different radio stations providing air traffic control services. For example, an aircraft standing at the gate, with all its passengers already onboard, will have to tune in to the frequency of ground control (e.g. 121.600 at Vienna International Airport (SkyVector 2018)) and request a clearance to leave the gate and start its engines. Later, when the plane is about to take off, the pilots must switch over to the frequency of the control tower (e.g. 119.400 at Vienna International Airport (SkyVector 2018)) and request the permission to enter the runway and depart. Once airborne, the cockpit crew will be handed over to a frequency usually occupied by a controller who is responsible for departing and arriving flights in the vicinity of an airport (e.g. 128.200 at Vienna International Airport (SkyVector 2018)).

[15] Citations have been used rather sparingly in this sub-chapter, as I already had pre-existing background knowledge on this topic and am thus drawing on this knowledge to explain certain aspects myself.
[16] Due to the world-wide increase in air traffic, the spacing has been further reduced to steps of 8.33 kHz, providing a total of 2,280 channels (Roger-Wilco 2010).

Besides the primary means of communication via voice, there exists another method called controller-pilot data link communications (CPDLC). With CPDLC, messages between pilots and air traffic controllers are exchanged in the form of text via a data link, and these messages "correspond to the phraseologies used in the radiotelephony environment" (International Civil Aviation Organization 2001a: 14-1). Essentially, CPDLC "offers the potential to relieve some congestion, enhancing existing communications between the air and the ground, and offering unambiguous transmission of routine messages between controllers and pilots" (Eurocontrol 2018). These benefits are mainly language-related, but since the mode of communication is written rather than spoken language, CPDLC does not play a role in the analytic part of this paper, and thus does not necessitate further discussion here.

Even though the focus of this paper is on language-related miscommunication, the fact that technical aspects can also have a negative impact on communication shall be briefly highlighted here. As already mentioned in the beginning of this sub-chapter, pilots and air traffic controllers utilize PTT technology to initiate a communicative act with the other party. While this serves to cancel out constant noise if neither pilot nor air traffic controller are speaking, it occupies the channel on the corresponding frequency as long as one party is transmitting (i.e., 'pressing the button'). While this circumstance is not a major issue in low-density airspace under normal operating conditions, communication can become cumbersome, if not problematic in case of an emergency situation in a highly congested traffic area, as pilots on the same frequency will have limited opportunities to transmit their messages (however crucial) to the corresponding air traffic controller, who needs to give priority to the aircraft in distress. Moreover, if two parties attempt to transmit at the same time, an unpleasant, screeching sound will be heard by all other participants on the same frequency, thus rendering the original messages of both transmitting interlocutors inaudible as they cancel out each other. We will see in sub-chapter 4.2.2 how this issue contributed to the deadliest accident in aviation history.

Besides simultaneous transmissions, there are also other technological constraints that can hamper radiotelephony communication, as described by Howard (2008: 372):

> [T]ransmission quality varies by radio, both parties must monitor and transmit on a common frequency [which essentially is the cause for sim-

> ultaneous transmissions], static and ambient noise are constant impediments to clear signal transmission and reception, and even the quality of headsets and microphones serves to facilitate or inhibit good communication.

Despite continuous efforts that are taken to reduce these technological limitations, they exist regardless of how well-designed the language system is that is used for ATC communication. Another disadvantage that can be added to Howard's list is the fact that with radiotelephony communication, pilots and air traffic controllers have no visual cues that might otherwise aid them in understanding the messages they receive. The resulting lack of paralinguistic features requires the interlocutors to pay increased attention to transmissions, or else misunderstandings are more likely to occur.

3.5. Example of communication from departure to arrival

Now that the most salient features of aviation English have been discussed, an example of what can be considered a typical, routine flight should help the reader in obtaining a better picture of the applied use of aviation English. The emphasis will be clearly placed on radiotelephony communication that occurs during a flight, i.e. all other tasks that pilots and air traffic controllers must perform besides communicating with each other will not be considered. The sample dialogues that follow are mainly taken from Fecker (2010), a collection of information about several aspects of aviation, including history, aircraft types, airports, airlines, and air safety. Each dialogue is followed by an explanation of its phrases and meaning. Although the dialogues in Fecker's (2010) book are also followed by explanations, they focus on aspects of a flight that happen besides radiotelephony communication. Since these are not of interest here, the dialogues are explained by my own words. Furthermore, since Fecker (2010) does not provide dialogues for all the stages of a flight that are discussed in this sub-chapter, some of the dialogues were invented for the purpose of this paper, based on Fecker's (2010) samples. A short explanation preceding these dialogues informs the reader about this circumstance.[17]

[17] With the exception of the directly quoted dialogues, citations have been used rather sparingly in this subchapter, as I was drawing on my own knowledge on this topic and am thus explaining certain aspects myself.

Usually, the first time a pilot contacts an air traffic controller happens with the position of clearance delivery, an air traffic control service which approves (or disapproves) of flight plans previously submitted by the cockpit crew. Apart from checking whether the pilots are up-to-date with the latest weather information, clearance delivery assigns a squawk code[18] and a departure route for the aircraft's climb out of the airport's vicinity. Thus, a pilot's first transmission might look something like this:

> 'FRANKFURT DELIVERY, CACTUS 632 TO BOSTON, INFORMATION GOLF, REQUEST STARTUP'. (Fecker 2010: 252)

As already mentioned in sub-chapter 3.2.1, messages need to be phrased according to a distinct structure: addressee – addresser – command. In this case, the controller responsible for issuing route clearances at Frankfurt airport is contacted by the pilot of US Airways Flight 632 (*Cactus* being the telephony designator) bound to Boston, whose intention it is to start up the aircraft's engines. Additionally, the pilot informs the controller that the weather information he is up-to-date with carries the letter G (pronounced as *Golf* in accordance with the rules for the phonetic spelling of letters, cf. Table 2).[19]

What follows is a back-and-forth between the pilot and the air traffic controller in order to ensure that every command issued has been understood by each party:

> Delivery: 'CACTUS 632, GOLF IS CORRECT, CLEARED TO DESTINATION BOSTON VIA BIBOS, SQUAWK 2163, WHEN AIRBORNE CONTACT LANGEN RADAR ON 120.850. STARTUP APPROVED.'
> Pilot: 'CLEARED TO BOSTON VIA BIBOS, SQUAWK 2163, WHEN AIRBORNE LANGEN RADAR ON 120.850. STARTUP APPROVED, CACTUS 632.'
> Delivery: 'READBACK CORRECT. CONTACT APRON AT 121.850.'
> Pilot: '121.850, CACTUS 632.' (Fecker 2010: 252)

After confirming that the pilot has got the most recent weather information, the controller issues the clearance by stating the initial route the pilot has to fly (labelled BIBOS), assigns him a unique squawk code, provides him with the frequency on which to contact the air traffic controller once the aircraft has taken off, and approves the startup of the aircraft's engines. The pilot reads back the clearance and is then provided with the frequency of the next air traffic controller's position, which is that of the apron[20].

[18] A four-digit code used by a plane's transponder, which allows it to be uniquely identified by radar systems of ATC.
[19] Every time weather information is updated, a new letter is assigned (running from *Alpha* to *Zulu*).
[20] The area of an airport at which aircraft are parked, refueled, and boarded.

Since the aircraft is still parking at the gate, and since it is incapable of reversing on its own, it needs to be 'pushed back' by a tug. This procedure necessitates a separate request, lest the aircraft obstruct the path of other airplanes taxiing:

> Pilot: 'FRANKFURT APRON, CACTUS 632, AT GATE A 21, REQUEST PUSHBACK.'
> Apron: 'CACTUS 632 PUSHBACK APPROVED. FOR TAXI CONTACT APRON ON 121.700.'
> Pilot: '121.700, CACTUS 632.' (Fecker 2010: 253)

At some larger airports (such as Frankfurt am Main Airport), the apron position might be divided up into two separate parts, each controlled by a different air traffic controller so as to manage the amount of traffic more smoothly. Therefore, the pilot is provided with a new frequency, namely that of the controller who is responsible for ground movements between the apron and the runway.

As soon as the pushback process is complete, the pilot contacts the ground controller and requests a clearance for taxiing to the runway:

> Pilot: 'APRON, CACTUS 632 READY TO TAXI.'
> Apron: 'CACTUS 632, TAXI TO HOLDING POINT 18 VIA GOLF AND NOVEMBER. ADVICE [sic][21] WHEN READY.'
> Pilot: 'HOLDING POINT 18 VIA GOLF AND NOVEMBER. WILCO. CACTUS 632.' (Fecker 2010: 253)

The aircraft is sent on its way to runway 18 via the taxiways labelled G(olf) and N(ovember), and is instructed to stop and advise the air traffic controller in the control tower before entering the runway.[22] Referring back to Table 1, it is important to note that the pilot must not use *Roger* instead of *Wilco* in the given situation, since the command *advise when ready* requires the pilot to not only acknowledge that he/she has "received all of [the] last transmission" (cf. Table 1), but that the command will also be complied with.

Shortly before arriving at the holding point for the assigned runway, the pilot switches to yet another frequency, this time that of the airport's control tower:

> Pilot: 'TOWER, CACTUS 632 HEAVY, INTERSECTION NOVEMBER, READY FOR DEPARTURE.'

[21] The verb form *advise* (imperative) should be used here, since the controller is instructing the pilot to 'advise the controller as soon as the pilot is ready to receive further instructions'.
[22] Runways are labelled according to the magnetic heading (1° to 360°) they are oriented against. The labels are rounded to the nearest ten, and the trailing zero is omitted. Thus, for landing on runway 18, an aircraft needs to fly a southern heading in order to align itself with the runway's centerline.

> Tower: 'CACTUS 632 HEAVY, WIND CALM, CLEARED FOR TAKE OFF RUNWAY 18.'
> Pilot: 'CLEARED TAKE OFF RUNWAY 18.' (Fecker 2010: 254)

The airplane's call-sign now features the term *heavy*, which indicates its wake turbulence category.[23] This addition to the call-sign serves as a reminder for the air traffic controller to allow enough time to pass so that the next airplane does not have to risk passing through turbulent air, thus ensuring a safe departure. What is also worth mentioning is the use of the words *take off*, which are only to be used in connection with a clearance for taking off (International Civil Aviation Organization 2007: 2-13). Since, in the initial call, the pilot is informing the air traffic controller that they are ready to depart, without having received a clearance yet, he/she uses the word *departure*.

As the aircraft climbs out of the airport's vicinity, the pilots tune in to the frequency of approach control (which was provided by clearance delivery, cf. page 45).[24] The crew is given instructions to transition to a higher altitude and to fly towards a specific waypoint (a flight level of 100 thereby denotes an altitude of 10,000 feet (≈ 3,000 meters), the last two zeros being always omitted when referring to flight levels):

> Pilot: 'LANGEN RADAR, CACTUS 632 HEAVY, AIRBORNE IN FRANKFURT.'
> Langen Radar: 'CACTUS 632 HEAVY, RADAR IDENTIFIED, CLIMB TO FLIGHT LEVEL 100, TURN RIGHT INBOND [sic] BIBOS INTERSECTION.' (Fecker 2010: 254)

While en route, one of the crew's tasks is to handle transitions to other flight levels and frequency changes as the aircraft passes through different layers of airspace. Since Fecker (2010) does not provide an explicit example for the communication during this phase of flight, the following dialog, which is likely to happen based on Fecker's (2010) information provided thus far, has been constructed:

> London Control: 'CACTUS 632 HEAVY, DESCEND AND MAINTAIN FLIGHT LEVEL 340 TO AVOID TRAFFIC 12 O'CLOCK 4 MILES.'
> Pilot: 'DESCEND AND MAINTAIN FLIGHT LEVEL 340, CACTUS 632 HEAVY.'
> […]

[23] Wake turbulence is turbulent air generated by an aircraft's engines. The more massive the aircraft, the stronger the forces within the field of turbulent air. Aircraft can be assigned one out of four categories, depending on their maximum takeoff mass: Light, Medium, Heavy, Super (the latter is only used for the Airbus A380, the world's largest passenger airplane).

[24] The controller at the approach control position ensures that predefined departure and arrival routes are complied with (mainly to alleviate traffic congestion or for reasons of noise abatement).

Boston Center: 'CACTUS 632 HEAVY, CONTACT BOSTON APPROACH AT 118.25.'
Pilot: 'GOING TO 118.25, CACTUS 632 HEAVY.'

As they approach their destination, the pilots prepare the aircraft for the descent. The flight is handed over from the center controller, who is responsible for the coordination of en route flights passing through the controller's airspace, to an approach controller, who is in charge of directing incoming aircraft to their destination airports (again, Fecker (2010) does not provide an example for this phase of flight, hence a constructed example is used):

Boston Approach: 'CACTUS 632 HEAVY, YOU ARE 70 MILES NORTHEAST OF THE AIRPORT. DESCEND AND MAINTAIN FLIGHT LEVEL 090. EXPECT VECTORS FOR ILS RUNWAY 22 LEFT.'
Pilot: 'DESCEND AND MAINTAIN FLIGHT LEVEL 090, EXPECT VECTORS FOR ILS RUNWAY 22 LEFT, CACTUS 632.'

The air traffic controller informs the pilot about the expected method of the approach and landing: *expect vectors* signals the pilot that he/she will be instructed to fly certain headings until the airplane is on its final approach to the runway, which will then be landed on using the aircraft's instrument landing system (ILS).[25]

Before the aircraft touches down on the runway, the pilot contacts the control tower of the destination airport and informs the controller about the upcoming landing:

[Pilot:] 'BOSTON TOWER CACTUS 632 HEAVY 6 MILES FINAL RWY 22 LEFT. RUNWAY IN SIGHT.'
[Boston Tower:] '632 HEAVY, BOSTON TOWER, CLEARED TO LAND RUNWAY 22 LEFT. WIND 180 DEGREES 8 KNOTS.'
[Pilot:] 'CLEARED TO LAND 22 LEFT, CACTUS 632.' (Fecker 2010: 264)

Even though the airplane is already aligned with the runway's centerline and about to land, the pilot still needs to obtain the corresponding clearance from the tower controller (it might for example happen that another airplane on the ground inadvertently enters the runway, in which case the tower controller instructs the landing airplane to initiate a go-around[26]). In this case, however, the pilot receives the clearance

[25] If weather conditions do not allow for landing an airplane visually, the pilot can do so with the help of the aircraft's ILS system. The system provides the pilot with a steady glide path which he/she has to fly using the aircraft's instruments only. Alternatively, the glide path can also be fed into the autopilot, which then completes the landing semi- or fully automatically.
[26] A maneuver in which the landing is aborted and the aircraft is configured for climbing.

together with information on wind direction and wind speed. Since a read-back of the latter is not necessary (cf. page 38), the pilot only reads back the clearance for landing.

After having touched down, the aircraft exits the runway onto one of the taxiways and is handed to another air traffic controller for one last time. The ground controller issues directions to the cockpit crew to taxi to their assigned gate. Upon arrival, the pilot's last transmission for the flight might look as follows:

> [Pilot:] 'BOSTON GROUND, CACTUS 632 AT THE GATE, SHUTTING DOWN'. (Fecker 2010: 264)

With this message, the pilot signals the controller that he/she is about to shut down the aircraft's electronic systems, thus making it unable for him/her to receive and transmit any further messages.

This sub-chapter provided an insight into the radiotelephony communication that occurs during a typical commercial flight. The understanding gleaned from this overview allows the reader to retrace the sequence of events in sub-chapter 4.2, which discusses language-related miscommunication in past aviation accidents, and sub-chapter 5.4, which analyzes reports gathered from NASA's Aviation Safety Reporting System (ASRS) database.

4. Language-related factors impeding communication

4.1. Research on language-related miscommunication in radiotelephony communication

Even though aviation English has been designed to maximize flight safety, it is not a perfect system, and therefore instances of miscommunication are inevitable. In an analysis of 42 hours of recorded radiotelephony communication from four TRACONs (Terminal Approach Control)[27] in the United States, Morrow, Lee and Rodvold (1993: 301) found that procedural deviations by pilots occurred more often when air traffic

[27] An ATC radar service which directs approaching and departing aircraft in the vicinity of a larger airport.

controllers produced messages which included more than two information units[28] (e.g., *turn left heading 270* consists of one information unit (instruction prompting a change in the aircraft's direction of flight); *turn right heading 180, descend and maintain 5,000, speed 230 knots* involves three information units (instructions prompting a change in the aircraft's direction of flight, its altitude, and its speed, respectively)). Such procedural deviations (e.g. omission of a call-sign, partial read-back) are problematic because they violate "system rules and aviator expectations" (Howard 2008: 375), thus infringing the aspect of predictability (cf. sub-chapter 3.2.3). Moreover, they specifically occur in emergency situations (Campbell-Laird 2004: 258), a time during which all participants involved need to operate at the maximum of their capabilities and, therefore, communication must run flawlessly. Similar to Morrow, Lee and Rodvold's study, Barshi (1997) suggested that the length of controllers' messages should be reduced to three information units so that pilots could better process the information contained in the messages (Barshi 1997, referred to in Estival, Farris & Molesworth 2016: chapter 5, "Empirical investigations"). Although the studies from Barshi (1997) and Morrow, Lee and Rodvold (1993) as well as Howard's and Campbell-Laird's assessments identified deviations from standard phraseology as contributing factors to miscommunication, the question remains whether the deviations occur due to an increase in cognitive workload on the side of an interlocutor, or whether the deviations happen merely due to poor adherence to standard phraseology. In case of the former, the studies' and assessments' findings do not reflect miscommunication caused by the language system of aviation English, but rather miscommunication caused by the interlocutors' difficulties of processing a multitude of information within a very short period of time.

Tajima (2004: 456–462) provides a more language-related view on miscommunication by analyzing fatal aviation accidents from the past in the light of the problematic use of aviation English. For instance, he states that the crashes of American Airlines Flight 965 and Avianca Flight 052 were primarily caused by a lack of "English proficiency beyond phraseologic use" (457), but that Eastern Air Lines Flight 401 suffered the same fate due to "[n]on-phraseologic and too colloquial English" (461) used

[28] Morrow, Lee and Rodvold use the term 'speech act', but this seems unsuitable for the purposes of this (linguistic) diploma thesis, as confusions may arise due to the term's more familiar denotation in pragmatics.

by native speakers of English on both sides. This latter finding shows that language-related miscommunication does not only happen when non-native speakers of English are involved (as was the case with American 965 and Avianca 052), but may also occur in a context where only native speakers communicate with each other. The issue of the use of colloquial English in radiotelephony communication is also raised by Sullivan & Girginer (2002: 401), who mention a Turkish pilot stating in an interview that "when he was flying in [the] United States he heard numbers such as 132.25 pronounced as 'one thirty two and a quarter' rather than 'one three two point two five'", the former of which basically indicates non-conformity to standard terminology.[29]

Estival, Farris and Molesworth (2016: chapter 2, "non-standard phrases") also discuss the problematic use of colloquial, non-standard expressions in the context of radiotelephony communication, by giving the following example:

> ATC knew the pilot of aircraft ABC (not the real call-sign), who was requesting a clearance for Sydney (in an abbreviated format because of a prior exchange), and used a non-standard colloquial term instead of the standard location designator.
>
> (51)
> a. ABC: … Request clearance.
> b. ATC: Tower, Alpha Bravo Charlie. Cleared for the Smoke.
>
> Most English NSs [i.e., native speakers] and many of the local pilots would probably understand that 'The Smoke' refers to the city of Sydney.

The problem in this particular case is that pilots who are on the same radio channel and whose L1 is not English, are denied the possibility to develop situational awareness, i.e. they cannot create a complete mental picture of their surroundings, thus increasing the risk of potential conflict. Tajima (2004: 464–465), in this context, also refers to "language alienation", the phenomenon of being left out of communication because one is in the minority in terms of the languages spoken in a given situation. This poses serious risks to aviation safety as pilots are precluded from the possibility to participate in communication as well as to monitor ongoing radiotelephony communication in order to gain an overview of the situation (e.g. surrounding traffic). It is thus "the use of colloquial, non-phraseologic, and fast-rate English ATC communi-

[29] This paragraph and the paragraph above it were taken from Konrath (2017: 3–5) with minor modifications.

cation [which] alienates non-native-English-speaking pilots, just as use of a non-English language in a non-English airspace alienates English-speaking pilots flying there" (Tajima 2004: 466).

Regarding the aspect of pronunciation, Tiewtrakul and Fletcher (2010) found that the accents of aviation personnel had an impact on the intelligibility of transmissions (especially when it comes to the pronunciation of numbers, such as the frequencies of radio channels). In particular, their study showed that non-native to non-native communication was most prone to misunderstandings. Similarly, interviews with Korean pilots and air traffic controllers revealed that "[c]omprehending a variety of accents was the most frequently mentioned challenge for radiotelephony communication for all parties, whether native speakers of English or not" (Kim & Elder 2009: 144). These findings can be explained through the environment in which aviation personnel have to operate: Speakers of ELF co-construct their messages by negotiation of meaning (cf. sub-chapter 2.2.2), but the efficient and oftentimes fast-paced nature of radiotelephony communication does not allow for such processes to take place.

Following this overview of past research that has been conducted on the issue of miscommunication in radiotelephony communication, the next sub-chapter goes into more detail by taking a closer look at specific aviation accidents from the past. With the focus being placed on language-related miscommunication, linguistic factors that contributed to the development of the accidents are highlighted and discussed.

4.2. Past accidents/crashes caused by miscommunication

As with every aviation accident, there is usually a number of unfavorable events preceding a major anomaly. In the context of analyzing aviation accidents, Cookson (2009: 22.4) refers to the 'Swiss cheese' model developed by James Reason in 1990, which illustrates the way in which certain events or circumstances need to be linked together so that an accident can occur (cf. Figure 2).

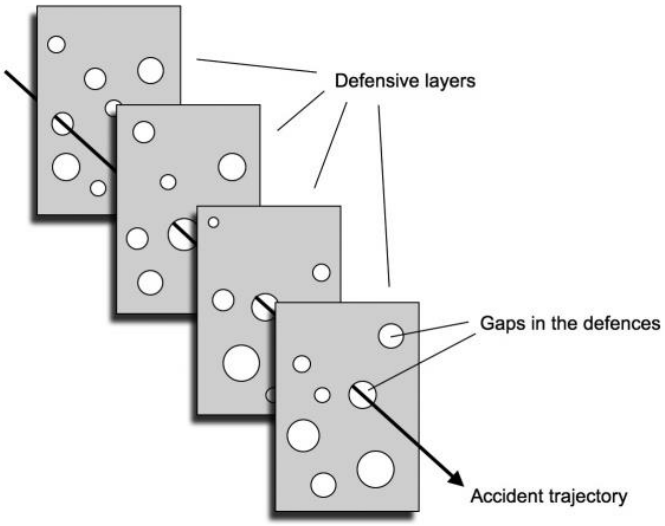

Figure 2. Swiss cheese model (Cookson 2009: 22.4)

The 'defensive layers' of the model represent means to ensure safety during a flight, such as technical backup systems or operational safety procedures. Since no system is 100% failsafe, there may exist 'gaps' inside these defensive layers which can disrupt flight operation. Looked at individually, these gaps in themselves are no cause for concern – it is only when they are aligned in a way such that the 'accident trajectory' can pass through them, i.e. that the effects of multiple deviations from normal operations are combined in a certain way, that countermeasures prove futile in avoiding an accident.

The aim of the following sub-chapters is not to provide all details surrounding the three accidents that are discussed, but rather to raise awareness of the problematic aspects of an incorrect use of aviation English. Therefore, the focus will be on language-related factors which contributed to the chain of events, or which were identified as root causes for the accidents – in other words, and in analogy with the Swiss cheese model, not all defensive layers are discussed, but only those that pertain to language. Nevertheless, for the sake of comprehensibility, the individual texts will provide some context with additional details wherever necessary.

4.2.1. September 10, 1976 – Zagreb

The first accident to be discussed was a mid-air collision between a Hawker Trident from British Airways (call-sign 476) on its way from London to Istanbul, and a Douglas DC-9 from Inex-Adria Airways (call-sign 550) on its way from Split to Cologne.

Flight 476 was cruising at Flight Level (FL) 330 when it made initial contact with the air traffic controller who was in charge of the airspace in which the collision occurred (Air Accidents Investigation Branch 1976: 1):

10.0419'' [30]	BE 476:	476 Klagenfurt at 02, 330 estimating Zagreb 14.
	Zagreb:	Bealine 476, roger, call me passing Zagreb, flight level 330, SQUAWK Alfa 2312.
10.04'40''	BE 476:	2312 is coming.

A few minutes later, flight 550 was leveling out at FL 260 and was about to receive clearance to climb to a higher flight level. Because of the congested airspace, the air traffic controller could only offer FL 350 for the Inex-Adria aircraft to climb to. This was acknowledged by the crew (Air Accidents Investigation Branch 1976: 3):

10.07'40''	Zagreb:	Adria 550 recleared flight level 350.
10.07'45''	JP 550:	Thank you, climbing 350, Adria 550.

The airspace over Zagreb was divided into a lower (ranging from 300 meters to FL 250), a middle (ranging from FL 250 to FL 310) and an upper sector (from FL 330 upwards), each of which was handled by a different air traffic controller (Air Accidents Investigation Branch 1976: 27–29). Since flight 550 was instructed to climb to FL 350, it was handed over to another controller (handling the upper sector of the airspace) as it was passing FL 310. After they had switched over to the corresponding frequency, the pilot of flight 550 contacted ATC as follows (Air Accidents Investigation Branch 1976: 30):

10.14'04'	JP 550:	Good morning Zagreb, Adria 550.
14'07''	Zagreb:	Adria 550, Zagreb, Good morning, go ahead.
14'10''	JP550:	325 crossing, Zagreb at 14.
14'14''	Zagreb:	What is your present level?
14'17''	JP550:	327

The air traffic controller was immediately alarmed, as he knew that flight 476 was still at FL 330 and that both airplanes' trajectories were crossing each other. Figure 3 shows the aircrafts' flight paths in the final 10 minutes before the collision.[31] The northbound aircraft thereby represents Inex-Adria Airways Flight 550, the aircraft

[30] The minute marker of the first timestamp was missing in the original document, which is why it was also omitted for the direct quote.

[31] Even though the contents of the box to the left of the illustration are unreadable, they are not relevant to the discussion in this sub-chapter, as they consist of technical data such as the aircrafts' speeds, headings, and distances travelled within the final 10 minutes of their flights.

with a heading of 115 degrees (i.e. on an east-south-easterly course) represents British Airways Flight 476.

Immediately after his realization of the conflict, the air traffic controller, obviously agitated, issued instructions to flight 550 in order to keep some distance between the two aircraft (Air Accidents Investigation Branch 1976: 31):

10.14'22''	Zagreb:	.....e..... maintain now on that level and report passing Zagreb.
14'27''	JP550:	What level?
14'29''	Zagreb:	At which you are now climbing because .....e..... you have an aircraft in front of you at ..... (unreadable) 335 from left to right.
14'38''	JP550:	OK maintain precisely 330.

Flight 550 could only level off at FL 330 as it takes some time for an airplane to switch from a climb phase into horizontal flight. It is unclear why the air traffic controller told the crew that the other aircraft was at FL 335; however, this circumstance is not further discussed in the accident report. Moments after this last transmission from the Inex-Adria aircraft, the two airplanes collided over Zagreb.

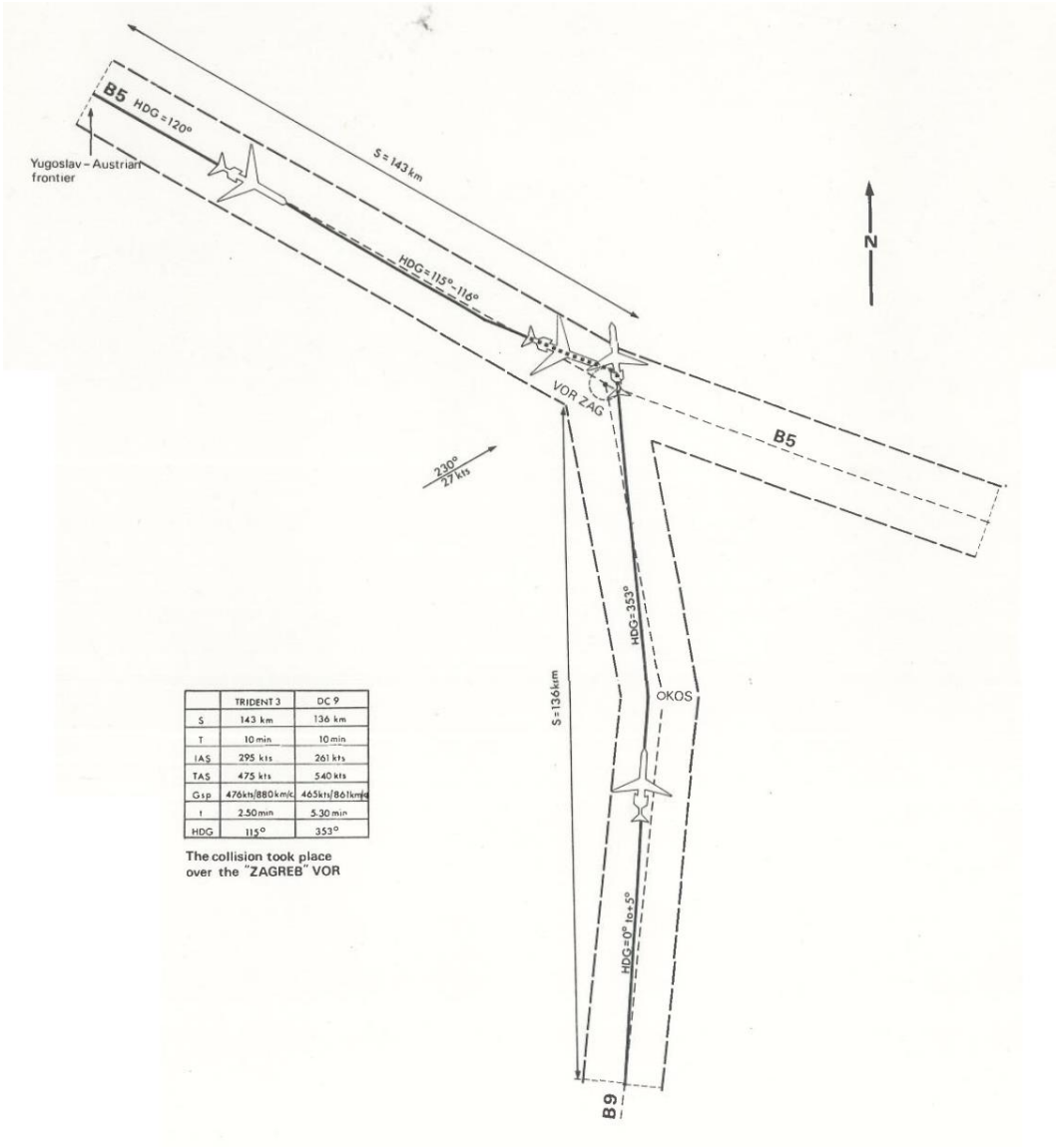

Figure 3. Flight paths of British 476 and Inex-Adria 550 (Air Accidents Investigation Branch 1976: 41)

The investigation revealed as main causes the air traffic controller's failure "to provide the prescribed separation between the aircraft", an "untimely recognition of [the] conflict situation" as well as the "application of unprecise measures for prevention of the collision" (Air Accidents Investigation Branch 1976: 38–39). While the accident report mentions that the corresponding air traffic controller was overloaded due to the absence of an assistant controller, it also states that he did not obey certain rules and regulations: The analysis of radiotelephony communication between the air traffic controller and each of the two flights showed that while communication between ATC and flight 476 was conducted in English, the air traffic controller, in ad-

dressing flight 550, switched to Serbo-Croatian during the last few transmissions before impact. The transmissions in question are the ones that occurred between 10.14'22'' and 10.14'38'', i.e. at the time where the air traffic controller realized the critical situation and thus initiated corrective measures to avoid a catastrophe. Although the communication between the controller and the Inex-Adria pilot resulted in the desired action taken (i.e. stopping the climb), the fatal 'hole' according to the Swiss cheese model was the crew of British Airways Flight 476 not catching the content of the conversation as they did not speak Serbo-Croatian, which in turn denied them the possibility to intervene. Cookson (2009) states that the controller's code-switching may have happened either deliberately, "to ensure his message would be immediately understood" by the Inex-Adria pilot, whose L1 was Serbo-Croatian (Cookson 2009: 22.6), or unconsciously to relieve "higher cognitive workload required to speak a second language" because the air traffic controller already was under high time and workload pressure (Cookson 2009: 22.7). While code-switching in ELF is usually "seen as a crucial bilingual pragmatic resource" (Jenkins, Cogo & Dewey 2011: 284), this does not hold for the context of radiotelephony communication: here, the use of a language other than English represents a violation of the cooperative imperative (Seidlhofer 2011: 129). This prevented the crew of British Airways flight 476 from updating their mental model of the airspace around them – therefore, they did not realize that flight 550, which was about to cross a navigational point at the same time as flight 476 would have, was actually on the same flight level.

In its conclusion of the report on the mid-air collision over Zagreb, the Air Accidents Investigation Branch (1976: 39) formulated recommendations for the international aviation community, out of which one is aimed at the proper use of aviation English:

> For air-ground radio-telephony communications a standard phraseology in the English language [is] to be used by Air Traffic Control Units and aircraft during the flight along the airways and in the zones used for international air services.

The recommendation hints at the importance of a shared vocabulary and shared contextual knowledge, which, together with the compliance with standard phraseology, are prerequisites for effective communication (especially when it comes to ELF com-

munication). To conclude, the linguistic factor that played a major role in the development of this accident was thus the air traffic controller's code-switching from English to Serbo-Croatian.

4.2.2. March 27, 1977 – Tenerife

The collision of two Boeing 747 (one belonging to the Dutch airline KLM, call-sign 4805, the other to the American airline Pan American, call-sign 1736) on March 27, 1977 on the runway of Los Rodeos Airport in Tenerife, Spain, has been the most fatal aviation accident so far in the history of aviation. A total of 583 people lost their lives when the two planes collided on the airport's runway, with 61 people being the only survivors aboard the Pan American aircraft.

As with most aviation accidents, the crash in Tenerife was preceded by a chain of unfavorable events that all played a role in the unfolding of the disaster. To begin with, the airport was congested because all flights bound to nearby Las Palmas airport had to be diverted to Tenerife due to a bomb explosion in the terminal area of Las Palmas airport. The numerous diversions resulted in taxiways being blocked by parking aircraft, thus requiring departing and landing traffic to taxi on the airport's only runway (which was, of course, also used for take-offs and landings; cf. Figure 4). This required increased situational awareness from air traffic controllers and pilots. Another detrimental factor was the quick deterioration of the weather conditions as low-lying clouds swept over the terminal control area. As the runway and taxiways became covered in fog, visibility on the ground was practically zero, which meant that pilots and air traffic control had to rely all the more on precise and unmistakable radiotelephony communication.

Besides these factors, there were a number of shortcomings in the interactions between the air traffic controller and the crew of the KLM aircraft. First, the Spanish air traffic controller's accent had an impact on radiotelephony communication, as the following excerpt shows[32] (Air Line Pilots Association 1978: Appendix 2):

1701:19.5
GRD Seven one two stand by

[32] GRD = air traffic controller responsible for movements on the ground; CAM-1 = captain's voice inside the cockpit; CAM-3 = flight engineer's voice inside the cockpit; RDO-2 = first officer's radio transmissions to the air traffic controller; APP = air traffic controller responsible for flights approaching the airport

Break clipper one seven three six leave the runway dah three one dah on to (our) left
((GRD clearance given with Spanish accent, difficult to distinguish between 'our' and 'your' and 'first' and 'third'))

1701:27.3
CAM-1 What
CAM-3 Using runway three one

1701:28.6
RDO-2 I am sorry, say again please

1701:31.6
GRD Leave the runway the third one (your) left

[...]

1701:37.7
RDO-2 Okay, ah, taxi down the runway and ah leave the runway at the first intersection on the left, is that correct? ((1701:44.4))

1701:45.6
GRD Negative the third one, the third one and change one one nine point seven

1701:51.1
RDO-2 Okay, the first one and one nineteen seven changing ((1701:53.9))

[...]

1702:03.6
RDO-2 Ah we were instructed to contact you and also to taxi down the runway, is that correct? ((1702:07.4))

1702:08.4
APP Affirmative, taxi into the runway and ah leave the runway third, third to your left, third ((background conversation in the tower))

1702:16.4
RDO-2 Third to the left okay ((1702:18.3))

[crew still not entirely sure whether ATC said 'third' or 'first']

[...]

[crew realizes that it must be the third turn after seeing that "[t]he first one is a ninety degree turn", which would have been very difficult to make with a Boeing 747]

703:29.3
RDO-2 Would you confirm that you want the clipper one seven three six to turn left at the third intersection ((1703:35.4))
((PAA: 'third' drawn out and emphasized))

[...]

1703:36.4
APP The third one sir, one two three third third one ((1703:38.3))

The air traffic controller's initial command towards the Pan American pilot to "leave the runway [...] three one" may have confused the cockpit crew, as the airport did not feature a runway with a heading of 310 degrees. What the controller probably meant was that the aircraft should vacate the runway at the third exit (i.e. 'C3') along the runway. Figure 4 shows a map of the airport's runway and taxiways, and marks different points in time together with the corresponding locations of the airplanes during the final minutes of the accident (T_1, T_2, T_3, T_4). What is of interest for the current discussion is the point in time at which the Pan American aircraft reached the exit onto taxiway C3 (T_3 = 1702:08; by this time, the KLM aircraft had already reached the end of the runway).

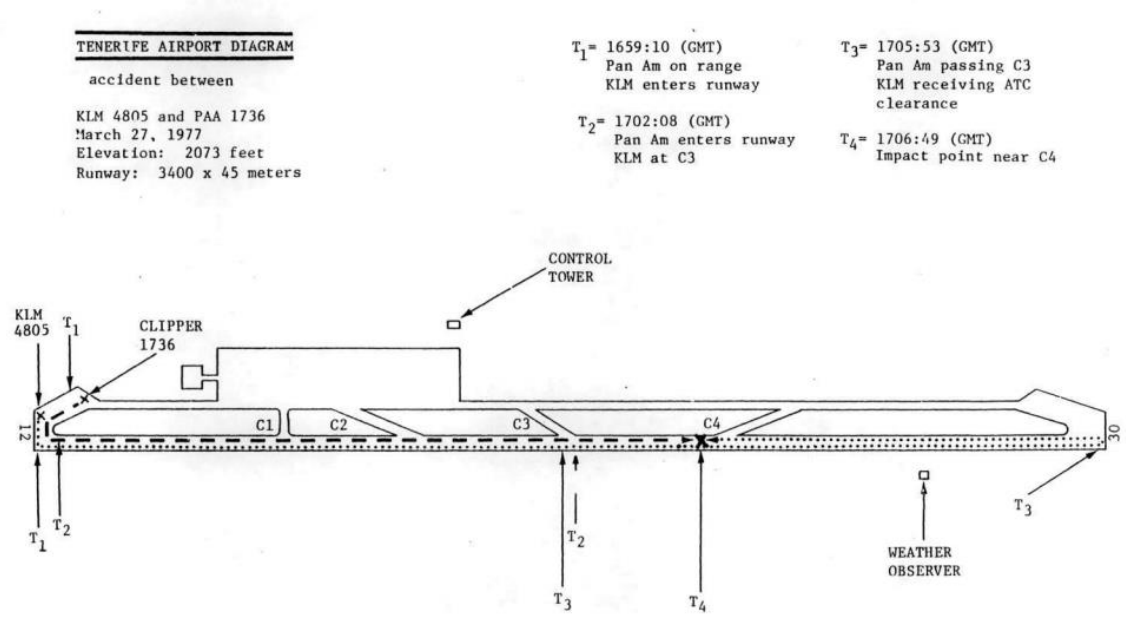

Figure 4. Tenerife airport diagram (Air Line Pilots Association 1978: Appendix 2)

The figure also shows the point in time at which the two aircraft collided on the runway (T_4 = 1706:49) together with the point of impact, which happened close to the

exit onto taxiway C4. The Pan American crew thus apparently missed turning onto C3, probably due to the very low visibility and the crew's concentration on listening to the air traffic controller's clearance issued to the KLM pilot at T_3 (Air Line Pilots Association 1978: 20).

The transmissions following the initial confusion ("leave the runway […] three one") then show that the pilot had difficulties understanding the ordinal number *third*, which, given the controller's accent and possible additional noise due to transmission quality and surrounding noise in the cockpit, was mistaken as *first*. This misunderstanding can be explained by the difficulty of producing the voiceless dental fricative /θ/, which is oftentimes replaced by /f/ by non-native speakers of English (cf. the Lingua Franca Core mentioned in sub-chapter 2.2.2). Moreover, the distinction between /d/ and /t/ (the final sounds of the words *third* and *first*) can be difficult if the voicing of /d/ is not prominent enough. This might have led the pilot to think that the controller's produced word ended with a /t/. The ensuing read-backs and clarifications (the controller had to repeat his command four times) further indicate that communication was not optimal at all. Only after the controller's strategy of counting to three was it completely clear to the pilot what the actual message was.

Second, the first officer of the KLM aircraft used ambiguous terminology when he read back a clearance issued by the air traffic controller, after having positioned the aircraft for take-off (Air Line Pilots Association 1978: Appendix 2):

> 1706:09.6
> KLM Ah roger sir we're cleared to the papa beacon flight level niner zero, right turn out zero four zero until intercepting the three two five and we're now (at takeoff) ((1706:17.9))

The problem lies in the phrase "we're now (at takeoff)"[33], as this probably resulted in the air traffic controller interpreting the situation differently from the way intended by the KLM pilot. What the pilot might have meant was that the aircraft was already in the process of taking off (i.e. applying thrust to the engines). The reason for the use of the prepositional phrase "at take-off" might be that, due to the pilot's L1 being Dutch, "a preposition may be used with the infinitive form of a verb to indicate an action currently being performed" (Cookson 2009: 22.10). Of course, the Spanish air

[33] The single parentheses indicate questionable parts of transmissions. In this case, it is not entirely clear whether the pilot said "We are now – uh – takin' off" or "We are now at takeoff" (Air Line Pilots Association 1978: 12). In case of the former, the air traffic controller probably would have been alarmed right away.

traffic controller could not have known this – instead, his interpretation rather was that of the plane being 'at take-off position', i.e. standing still at the beginning of the runway and waiting for the take-off clearance (Cookson 2009: 22.10). The ATC clearance preceding the pilot's read-back, however, was only "giving permission to fly the first part of the route", and did not include a clearance for take-off (Cookson 2009: 22.10). As a countermeasure to prevent such misunderstandings from happening, the ICAO recommends that "[t]he words 'TAKE OFF' [be] used only when an aircraft is cleared for take-off, or when cancelling a take-off clearance. At other times, the word 'DEPARTURE' or 'AIRBORNE' is used" (International Civil Aviation Organization 2007: 2-13).

Third, the KLM captain, who was in charge of the aircraft's controls, did not follow standard procedures. For example, he initiated the take-off roll without having received a take-off clearance from the air traffic controller. Moreover, he did not abort take-off upon hearing the air traffic controller ask the Pan Am crew to "report the runway clear" (Air Line Pilots Association 1978: Appendix 2).

Lastly, a factor which is not directly linked to the use of aviation English, but which nevertheless had been identified as being central in the course of the accident, was a simultaneous transmission of the air traffic controller and the pilot of the Pan American aircraft. As already mentioned in sub-chapter 3.4, simultaneous transmissions render the original messages almost inaudible, and a screeching sound is heard instead. In the case of the Tenerife accident, the two messages which canceled out each other were transmitted after the KLM pilot's message "we're now (at takeoff)", and were (Air Line Pilots Association 1978: 12):

a) the air traffic controller's instruction towards the KLM aircraft to "stand by for takeoff, I will call you" and
b) the Pan American pilot's "and we're still taxiing down the runway – the CIipper one seven three six".

The cockpit crew of the KLM aircraft thus neither received the instruction to wait for their takeoff clearance, nor were they fully aware of the Pan American aircraft still taxiing on the runway. The decisions the captain made were therefore not only non-compliant with standard procedures, but were also based on wrong assumptions and a lack of situational awareness.

Among several conclusions which the Air Line Pilots Association arrived at, one of them stresses the language barrier that percolated radiotelephony communication: "Throughout the events leading to the accident, it is evident that language difficulties, including accent and idiomatic usage, degraded information transfer" (Air Line Pilots Association 1978: 26). As a corrective measure, the association recommends that

> [a]ll aeronautical communications should be conducted with precise standardized terminology. Rigid standards should be applied to ensure that all personnel involved in commercial aeronautical communications are fluent in English and speak with minimal accent. (Air Line Pilots Association 1978: 27).

Speaking "with minimal accent" thereby hints at the Spanish air traffic controller's pronunciation, which was difficult to understand for both crews of the airplanes involved in the accident. As already mentioned, with radiotelephony communication there are no other means of communication between interlocutors besides using one's voice only, which makes clear and unambiguous communication all the more important. As the recommendation by the Air Line Pilots Association suggests, one way of achieving this goal is to ensure that aviation personnel meet certain criteria with regard to language skills. This will be discussed in more detail in sub-chapter 6.2.

To summarize the linguistic aspects of this accident, the most problematic factor was L1 interference in the speech of the first officer of the KLM aircraft, which caused ambiguity during a critical stage of flight. The air traffic controller's use of the word *take-off* might have led the KLM crew to believe that they had received a clearance for take-off (preventive measures taken after the crash thus involved a distinction to be made between the terms *take-off* and *departure*). Additionally, the air traffic controller's accent impeded radiotelephony communication (e.g. pronunciation of *third*, which was confused with *first*).

4.2.3. January 25, 1990 – Long Island

Avianca Flight 052 was scheduled to fly from Bogotá to New York with a layover in Medellín. During their stop in Medellín, the crew had the aircraft refueled up to its maximum take-off weight, thus providing sufficient fuel for reaching their alternate

destination airport[34] in Boston in case they had to divert for any reason (National Transportation Safety Board 1991: 23). After an uneventful cruise across the Caribbean Sea and the Atlantic Ocean, the aircraft was successively instructed to enter three holding patterns (with a total holding time of 77 minutes) due to inclement weather and a highly congested airspace at New York's John F. Kennedy airport (National Transportation Safety Board 1991: 2). Because of the long time the airplane had to spend in the holding patterns, it did not have enough fuel anymore to reach the alternate destination airport in Boston. This is the first time the first officer informed the air traffic controller about a potential shortage of fuel, thus trying to direct the controller's attention to the aircraft (National Transportation Safety Board 1991: 4):

20,44,50	AVA052 -	Zero five two well I think we need priority we're passing (unintelligible)
[...]		
20,46,24	AVA052 -	It is Boston but we can't do it now we we will run out of fuel now.

What is puzzling about the first transmission is the pilot's apparent insecurity regarding the circumstances the crew found themselves in. The second transmission also lacks vital information that would clearly inform the air traffic controller about the situation: even though the pilot mentions that they "will run out of fuel now", he fails to use standard phraseology as specified by the ICAO and the FAA: "If the remaining usable fuel supply suggests the need for traffic priority to ensure a safe landing, you should declare an emergency due to low fuel and report fuel remaining in minutes" (Federal Aviation Administration 2017c: 5-5-7). Since the aircraft was in an urgency condition, the pilot should have used "the radiotelephony urgency signal PAN PAN […] at the commencement of the first […] urgency communication" (International Civil Aviation Organization 2001b: 5-19).

Shortly after the above conversation, the crew received the clearance to land at JFK airport. However, the pilot flying eventually aborted the landing because he was unable to see the runway as it was clad in fog. As the crew was instructed to fly the

[34] "alternate airport" (FAA) or "alternate aerodrome" (ICAO) are the official terms for denoting an airport to which an aircraft could divert in case of anomalies (Federal Aviation Administration 2014: A-10).

corresponding pattern for a go-around, the first officer repeated that the aircraft was low on fuel[35] (National Transportation Safety Board 1991: 5):

21,23,39	TWR -	Avianca 052 heavy Roger climb and maintain two thousand turn left heading one eight zero
21,23,43	CAM1 -	We don't have fue -
21,24,06	CAM1 -	Tell them we are in emergency
21,24,08	RDO2 -	That's right to one eight zero on the heading and we'll try once again we're running out of fuel
21,24,15	TWR -	Okay
21,24,15	Note -	Avianca 052's engines began flaming out from fuel starvation less than 9 minutes after this point.
21,24,17	CAM1 -	What did he say
21,24,22	CAM1 -	Advise him we are emergency
21,24,26	CAM1 -	Did you tell him
21,24,28	CAM2 -	Yes sir I already advised him

Since he was not very proficient in English, the captain had the first officer handle all of the communication with ATC and asked him to translate the transmissions (National Transportation Safety Board 1991: 58). The captain became aware that they were in a distress situation, which is why he ordered the first officer to "[t]ell [ATC] we are in emergency". Declaring an emergency results in the emergency aircraft being given "absolute priority over all other communications" by air traffic control (International Civil Aviation Organization 2001b: 5-20), but the pilot needs to make sure that he/she fronts the emergency call with the words *mayday-mayday-mayday* (International Civil Aviation Organization 2001b: 5-19). In the case of Avianca 052, these words were never uttered by the first officer, even after the captain explicitly asked him to "[a]dvise [ATC] we are emergency". Instead, the first officer seemed to believe that by informing air traffic control about the fuel problem the aircraft would automatically be handled as if it were an emergency.

Despite the situation becoming graver, the first officer remained unassertive in his conversations with the air traffic controller[36] (National Transportation Safety Board 1991: 5):

21,26,35	APPR -	And Avianca 052 heavy I'm gonna bring you about fifteen miles north east and then turn you

[35] TWR = air traffic controller responsible for aircraft taking off from and landing at the airport; CAM1 = captain's voice inside the cockpit; RDO2 = first officer's radio transmissions to the air traffic controller; CAM2 = first officer's voice inside the cockpit

[36] APPR = air traffic controller responsible for flights approaching the airport; CAM3 = flight engineer's voice inside the cockpit

		back onto the approach is that fine with you and your fuel
21,26,43	RDO2 -	I guess so thank you very much
[…]		
21,30,32	APPR -	Avianca 052 climb and maintain three thousand
21,30,36	RDO2 -	Negative sir we just running out of fuel we okay three thousand now okay
21,30,44	APPR -	Okay turn left heading three one zero sir
21,32,39	CAM3 -	Flame out flame out on engine number four
21,32,43	CAM3 -	Flame out engine number three essential on number two
21,32,49	CAM1 -	Show me the runway
21,32,49	RDO2 -	Avianca 052 we just lost two engines and we need priority please

It is only with the last transmission (i.e. the pilot informing ATC about the loss of power) that the air traffic controller was able to understand the serious complications which the crew of Avianca 052 was dealing with. Yet, the first officer seems to have mitigated the urgency of performing a landing by ending his transmission with the politeness marker "please". Shortly after these transmissions, Avianca 052 crashed onto a hillside in Long Island, killing 73 of the 158 people on board the aircraft (National Transportation Safety Board 1991: 1).

Since the pilot did not clearly communicate the problematic situation, the air traffic controller had no reason to assume that the aircraft was actually in an emergency. By hearing the words "running out of fuel", the air traffic controller might have assumed that the aircraft was running out of the trip fuel needed for the flight from Medellín to New York, but would then still have enough reserve fuel (as is mandatory in the airline industry) to continue its flight for some time, thus not necessitating immediate priority. Adding to that, the pilot thanked the controller at times where he should have been assertive (see, for example, the transmission at 21,26,43). The aspect of politeness and mitigation is contested in the aviation community: On the one hand, deviations from protocol should be kept at a minimum, which can be achieved through strict adherence to standard phraseology and by avoiding the use of mitigating strategies, for example (Howard 2008: 376). On the other hand, Linde (1988) argues that mitigation might act as "a kind of social oil" (Linde 1988: 396) in intra-cockpit communication settings (i.e. pilot-to-pilot communication in the cockpit of an aircraft), which can prevent interpersonal conflicts and misunderstandings from arising. Whether the first officer's use of politeness markers impacted communication can

therefore not be answered definitively – however, they certainly should have been accompanied by the use of the standardized *mayday* phrase for emergencies in order to clearly convey the situation to the corresponding air traffic controller.

Lastly, the controller at APPR position was initially unaware of any fuel problems at the time the aircraft was handed over to him by the previous controller (responsible for en route traffic) – in particular, he did not catch the message at 20,46,24 (see above) in which the pilot states that they would not be able to reach their alternate destination airport anymore. This circumstance, too, prevented ATC from realizing the gravity of the situation (National Transportation Safety Board 1991: 61–62).

In summary, language-related factors that resulted in miscommunication and eventually led to the crash were identified to be the captain's low level of English proficiency and the first officer's failure to declare an emergency by using the standard phrase *mayday-mayday-mayday*.

5. Analysis of ASRS reports

The discussions of the three fatal accidents from the previous sub-chapter have shown which devastating consequences language-related miscommunication can have. These accidents represent individual cases, since there are usually multiple safety barriers that have to fail in order for a serious accident to occur (cf. Swiss cheese model at the beginning of sub-chapter 4.2). The purpose of the empirical part that follows is to show that language-related miscommunication does not only occur with major accidents, but that it is also a reality in everyday aviation operations. In doing so, the paper stresses the relevance of a proper use of aviation English to aviation safety.

For the purpose of simple access, Table 8 in the appendix represents a condensed version of the datasets that have been worked with, since including the datasets with all the information provided in the online database would not be feasible. Sub-chapter 5.3 contains a description of how to obtain the original and comprehensive results of the database query, so that the reader can retrace the steps from the original datasets up to the manually selected datasets that were eventually used in this chapter.

5.1. Research questions

On the basis of the discussions and linguistic analyses of the three accidents from chapter 4, the following research questions were formulated for the empirical part of this paper:

i) Are there incidents in everyday radiotelephony communication between pilots and air traffic controllers in which language-related miscommunication resulted in problematic, although non-lethal situations?
ii) Are there recurring causal or contributing factors that lead to language-related problems in the communication between pilots and air traffic controllers?
iii) Does the level of working experience of pilots and air traffic controllers play a role in the occurrence of language-related miscommunication?

As already mentioned, the purpose of the empirical part of this paper is to show that language-related miscommunication is not only a causal or contributory factor in fatal aviation accidents, but that it occurs in everyday situations of flights as well (which, however, do not end fatally when other safety measures effectively avert a catastrophe; cf. Swiss cheese model from sub-chapter 4.2). The first research question therefore addresses this issue. The remaining two research questions were formulated to further investigate the aspect of everyday language-related miscommunication.

A further aspect that would have been interesting to address is the question whether there is a difference between native and non-native speakers of English in terms of the number of language-related incidents of miscommunication as well as in terms of the nature of these incidents. However, since the database does not provide information about the participants' linguistic backgrounds, such a research question cannot be answered in this paper and was therefore not included in the list of questions above.

5.2. What is ASRS?

Data were collected from the Aviation Safety Reporting System (ASRS) provided by NASA. The database comprises reports which contain information on and descrip-

tions of aviation incidents. Aviation personnel involved in an incident can submit reports on a voluntary and anonymous basis, and are ensured that their reports are treated confidentially based on the program's immunity policy (Aviation Safety Reporting System n.d.b). This is essential with regard to possible violations of procedures, since the reports should not be used to punish people for their mistakes, but "to learn preventive means from these people's precious experiences" (Tajima 2004: 455).

The database can be searched for reports by using filters such as aircraft type, weather conditions, location of incident, date of incident, or phase of flight during which the incident occurred. Before it is entered into the database, each report has to be analyzed and classified with regard to these filters, which is done by aviation experts who have accumulated several years of experience in the aviation industry (Aviation Safety Reporting System n.d.a). Moreover, the experts issue alerts to the respective aviation authorities as a result of their analyses of potential safety hazards. Some of these analyses are also published in the program's monthly newsletter 'Callback', together with statistics regarding the number of monthly safety alerts and reports filed.

5.3. Selection of datasets

For the purposes of this paper, the database was filtered so that only language-related reports would be displayed by the system's search engine. Thus, the following search criteria were employed:

- Setting a filter for 'Reporter Function' with the following items:
    - All items from the category 'Air Traffic Control': Approach, Coordinator, Departure, Enroute, Flight Data / Clearance Delivery, Flight Service, Ground, Handoff / Assist, Instructor, Local, Oceanic, Other / Unknown, Supervisor / CIC [Controller in Command], Traffic Management, Trainee
    - All items from the category 'Flight Crew': Captain, Check Pilot, First Officer, Flight Engineer / Second Officer, Instructor, Other / Unknown, Pilot Flying, Pilot Not Flying, Relief Pilot, Single Pilot, Trainee
- Setting the date of incident between January 2017 and January 2018

- A text search[37] (both for the narrative and the synopsis of a report) with the following search string:

  (PRONUNCIATION OR ACCENT OR PHRASEOLOGY OR "%OTHER LANGUAGE" OR CODESWITCH% OR "CODE SWITCH%" OR PROFICIEN% OR NEAR((LANGUAGE,INTERFER%), 10) OR "LANGUAGE BARRIER")

The search criterion of the first bullet point narrowed down the number of reports that were of interest to this paper, i.e. it returned only those reports in which pilots and air traffic controllers were participants of an incident. This way, reports which, for example, involved communication between mechanical staff were excluded from the query. However, the query still returned reports in which two controllers had communicated with each other, or in which a pilot had communicated with the ramp agent at the parking gate. Therefore, the results had to be perused manually in a second step (more on that later).

The search criterion of the second bullet point was applied in order to reduce the number of reports for reasons of feasibility. Without a restriction on the date of the incidents (which would have queried reports ranging from January 1988 to the date as of current), a total of about 2,800 reports would have been returned.

Finally, the search criterion of the third bullet point provides for the selection of reports where language-related miscommunication was a key factor. To this end, the linguistic factors identified in the discussion of the three fatal accidents above served as the search elements for a text search within the ASRS database. Thus, code-switching (cf. sub-chapter 4.2.1), L1 interference and pronunciation/accent (cf. sub-chapter 4.2.2), as well as non-conformity to standard phraseology and lack of English proficiency (cf. sub-chapter 4.2.3) served as the basis for creating a search string.[38] In order to account for the variations in words used by different reporters to describe the same

[37] The reports' texts were searched for keywords since the ASRS database does not feature a pre-defined label or category for tagging incidents involving language-related miscommunication.

[38] Note that language proficiency not only includes speaking skills (with pronunciation/accent being one aspect), but also listening skills (cf. Figure 1 in Appendix; reading and writing skills only have little importance with regard to the use of aviation English in radiotelephony communication and are therefore not considered here at all). Therefore, a report mentioning a participant's lack of English proficiency could be understood as the participant having difficulties in uttering English sentences, but it may also indicate difficulties in processing English sentences as a listener (identifying the exact nature of the lack of English proficiency depends on the details of a report's narrative).

type of incident, wildcards were used (e.g. 'proficien%', which would include reports that mention the word 'proficient' or 'proficiency'; the % sign thereby acts as a placeholder for any number of letters). The NEAR keyword searches for two words (in this case 'language' and variations of 'interference') which are within a certain distance from each other (in this case, within a range of 10 words). This way, incidents describing any kind of interference other than interference from one's mother tongue (such as radio waves interfering with the radio equipment of an aircraft) were excluded. Besides the linguistic factors taken from the discussion of the fatal accidents, the term 'language barrier' was also included in the search string, thus expanding the number of reports that the database query yielded. This was done because, after having skimmed the contents of some reports, I noticed that the term re-appeared regularly in some of the reports' narratives and synopses.

The resulting query thus returned 103 reports, which were stored as a .xls file for offline use. Using Microsoft Excel, the reports were then individually read through and further filtered depending on two criteria. Firstly, reports had to include radiotelephony communication between a pilot and an air traffic controller only. As already mentioned earlier, even though the online database was queried for reports which involved a pilot or an air traffic controller, this still allowed for the selection of reports which featured intra-cockpit communication or communication between two air traffic controllers, for example. Secondly, the keywords used for the text search had to reflect some involvement of a linguistic factor in radiotelephony communication. For instance, even though the keyword 'proficiency' had been searched for in the narratives and synopses, this not only returned reports which mentioned an interlocutor's potential lack of English proficiency, but also reports which addressed a pilot's proficiency in terms of flying an aircraft, for example, and thus did not feature any linguistic component in the occurrence of the incident. That is, the context in which the keywords of the text search occurred had to be verified.

The manual filtering process left a total of 53 reports. In a second step of reading the reports' narratives and synopses, I assigned each report one category out of the five linguistic factors identified in the discussions from sub-chapters 4.2.1 – 4.2.3 (i.e., the categories 'phraseology', 'language proficiency', 'code-switching', 'pronunciation/accent' and 'L1 interference'). Furthermore, in order to cater for research ques-

tion ii), each report was assigned a label that summarizes the cause for the corresponding event of miscommunication (e.g. 'incomplete read-back' or 'non-standard phraseology'), so that more detailed evaluations of the data were possible. Following the process of categorizing and labeling, two reports were excluded from the filtered selection of datasets: one because the narrative simply mentioned a 'language barrier' having played a role in the event, without providing additional information that would have made a categorization of the report possible; and another one because, even though the narrative mentioned a lack of English proficiency, it was neither clear whose proficiency was meant, nor did the report contain any further details about the nature of miscommunication, thus making it impossible to determine whether the lack of proficiency was related to the production or the reception of language. The final list of incident reports therefore comprised 51 reports.

Lastly, using fields other than the narrative and synopsis of each report, I extracted information about the corresponding pilot's number of flight hours and air traffic controller's number of years of service (however, not all reports provided information on the latter two, so the corresponding data was rather limited). [39] Also, based on each report's narrative, I determined whether it was the pilot or the controller (or both) who had been the originator of the corresponding incident (this information was used for the answer to research question iii)).

Since the table containing all the information of the 51 reports is too large to present in this paper, the reader is referred to the website of ASRS (asrs.arc.nasa.gov) where the reports can be searched for using the criteria and manual adjustments mentioned above. For the sake of easier access, an abbreviated and reader-friendly version of the table is included in the appendix (cf. Table 8).

An important note should be mentioned here: Since the reports from the ASRS database are voluntary, it is very likely that some incidents might not have been reported at all. For the same reason, it is also possible that reports show biases in their narratives, or that they differ in the words used for describing similar incidents. The latter aspect is a major reason for why the filter using the text search might not have

[39] Only those flight hours were noted which did not involve hours 'on type', i.e. flying the type of aircraft that the pilot flew at the time of the incident. Rather, a pilot's total number of flight hours, regardless of aircraft type, was used for the analysis. Additionally, in case both pilots' number of flight hours were listed, the average of both numbers was calculated (the same was done for air traffic controllers, in case there had been more than one controller involved in an incident).

caught all of the incidents that involved language-related miscommunication. With these caveats in mind, it is safe to assume that there are in fact more incidents involving language-related miscommunication than were gathered from the database, and that the selection used for the following sub-chapter represents a lower boundary of the number of incidents where language-related miscommunication was a major or contributing factor. Hence, the selection of data does not imply any claim to completeness. Nevertheless, the primary aim of this chapter is to show how language-related miscommunication manifests itself in everyday aviation operations and thus to stress the relevance of a correct use of aviation English to aviation safety.

5.4. Results

The research questions formulated in sub-chapter 5.1 will be answered in succession. The first question thus to be addressed is the following:

i) *Are there incidents in everyday radiotelephony communication between pilots and air traffic controllers in which language-related miscommunication resulted in problematic, although non-lethal situations?*

This can be clearly answered with 'Yes'. As the database query and the subsequent filtering already have shown, there are numerous instances in which language-related issues played a major or contributing role in the development of non-lethal aviation incidents. Based on the categorization of the reports (cf. page 71), the following distribution regarding language-related miscommunication was found:

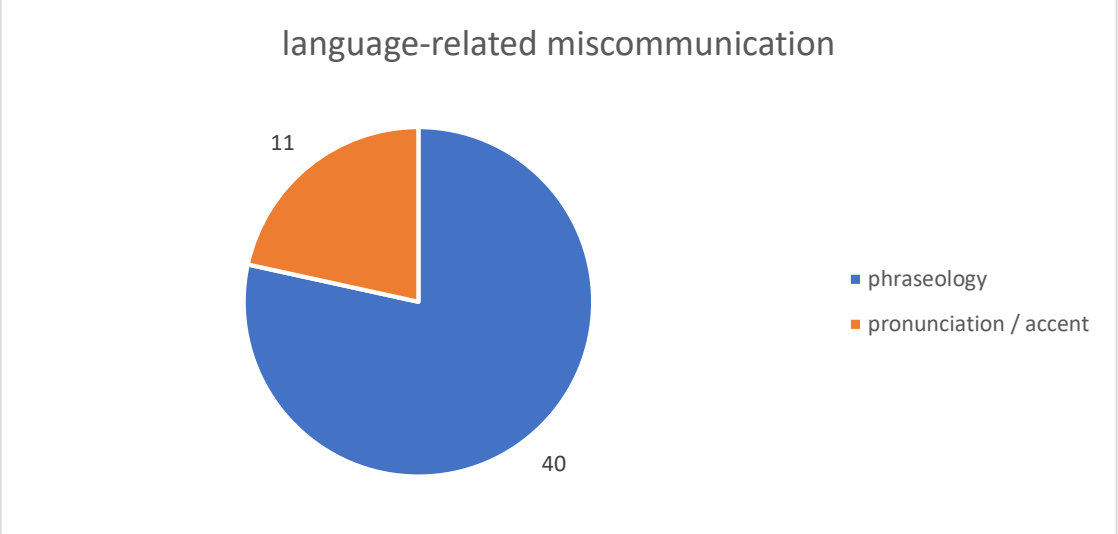

Figure 5. Language-related issues, in absolute numbers

Note that the categories 'code-switching', 'L1 interference' and 'language proficiency' are not featured in the diagram, since there were no reports that indicated miscommunication based on these categories. This does not imply that these issues do not exist in everyday radiotelephony communication – after all, the timespan of the selected reports covers a year, meaning that a database query with a wider timespan might have returned incidents involving these three issues. However, a detailed evaluation of these factors is not possible due to the lack of corresponding reports in the given dataset.

As the pie chart shows, the majority of incidents were caused by some issue with the use of phraseology. The rest of the incidents were identified to be the result of problems with pronunciation or an accent that had been difficult to understand for an interlocutor. How exactly these two factors manifested themselves in the incidents will be discussed by answering the following research question.

ii) *Are there recurring causal or contributing factors that lead to language-related problems in the communication between pilots and air traffic controllers?*

The answer to the previous question already revealed that pronunciation and/or accent as well as the use of standard phraseology are often key factors when it comes to miscommunication in radiotelephony communication. In order to identify language-related factors of miscommunication more specifically, the manually-created labels

summarizing the causes of an incident were analyzed. Starting with miscommunication based on phraseology, Figure 6 below provides an overview of the corresponding language-related factors that reporters had mentioned in their narratives.

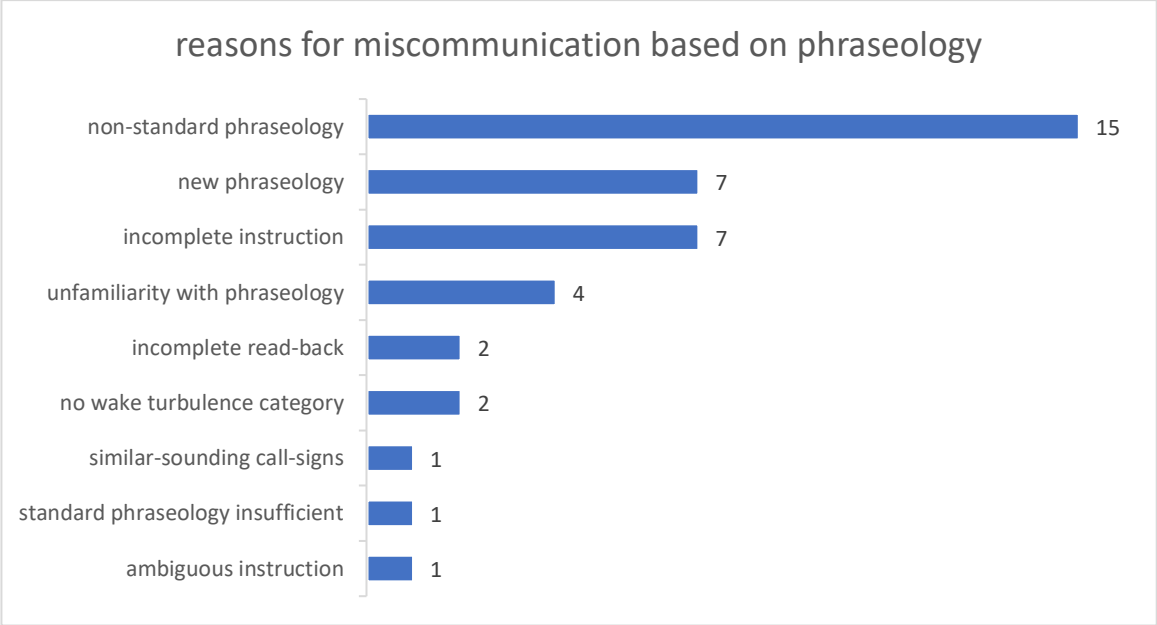

Figure 6. Causal and contributing factors of language-related miscommunication (phraseology)

Making up 37.5% of the factors, the most prominent one was found to be the use of non-standard phraseology, i.e. the production of messages which did not include prescribed standard words or phrases when in fact these should have been used. One example of this is demonstrated by the narrative of an air traffic controller (report number 1416530):

> Aircraft X was given a 20 degree off course vector for an aircraft heading southbound. Aircraft X asked how much longer on this heading. I then told the pilot the computer did not like the heading and that I needed him to turn an additional 10 degrees right. His unprofessional response was Roger.

As mentioned in Table 1 from sub-chapter 3.2.1, the standard phrase *Roger* is never to be used as a response to a transmission that requires a pilot to read back an instruction or a clearance. In this case, as the air traffic controller had instructed the pilot of "Aircraft X" to change its course by 10 degrees to the right, the pilot's response should have been *Wilco* at least, i.e. an acknowledgment that the instruction will be complied with, or a repetition of the instruction, followed by the aircraft's call-sign (in

order to ensure that the correct aircraft received the transmission; cf. sub-chapter 3.2.3). The pilot's brief response did not provide the air traffic controller with information about whether the pilot was able to make the turn and whether he/she correctly understood the amount of degrees by which the aircraft needed to be turned. Thus, the air traffic controller lacked information for the safe management of air traffic.

The second most prominent factors were the production of incomplete instructions as well as pilots' difficulties with newly introduced phraseologies. Incomplete instructions were identified as those cases in which a transmission was lacking crucial information in order for the recipient (mostly pilots) to properly proceed with their operations. The following narrative, which describes an aborted landing during an aircraft's final approach to its destination airport, demonstrates how an ambiguous situation can evolve when an air traffic controller fails to provide a complete instruction to the pilot (report number 1418741):

> The controller instructed us to climb and maintain 4000 feet. No other instructions. Normally when a controller breaks you off the approach, he says something like 'approach clearance cancelled, track the localizer, climb and maintain 4000 feet'. This guy only said to climb to 4000 feet, and nothing else. Since we were unsure of what the controllers plan was, we didn't know if we should reconfigure the airplane for a go-around or if we could expect to resume the approach momentarily. […] The main cause of this event was the approach controller not clearly communicating his plan for exactly what he wanted us to do. As a crew, we need to know a bit more than 'climb to 4000'. I need to know what his plan is for us so we can react accordingly and configure the airplane properly.

The event's result was miscommunication because, as the pilot notes, the information contained in the controller's instruction was not sufficient enough to make his intentions clear to the cockpit crew. The controller's actions can be viewed as a breach of the cooperative imperative (Seidlhofer 2011: 129), since his/her transmission was not contributing to a mutual understanding of the situation. This, however, is crucial in radiotelephony communication, as was already mentioned in previous chapters: pilots and air traffic controllers not only have to rely on auditory information only, but their communication happens in an ELF setting, which requires them to cooperate with each other. Moreover, the interactions between the pilot and the air traffic con-

troller did not feature any negotiation of meaning, which in fact could have been initiated by the pilot by asking for clarification (he/she was obviously not sure about the controller's intentions in the first place).

The label 'new phraseology' was used for reports in which pilots described confusing situations because an airport or a country had introduced new standard phrases for procedures during departure and arrival of aircraft. The two phrases in question were *descend via STAR*[40], which is issued as an aircraft initiates its approach to the destination airport, thereby instructing the pilot to follow a pre-defined flight path (Federal Aviation Administration 2014: D-2); and *climb via SID*[41], which also instructs a pilot to fly a pre-defined route, but is used during an aircraft's climb out of an airport's vicinity (Federal Aviation Administration 2014: C-4). The analysis of the datasets revealed that pilots had difficulties in adjusting to the new phraseologies when controllers used them in combination with a clearance to a specific altitude, since it was not clear to the pilots whether they had to observe the altitude restriction pertaining to the SID or the altitude restriction they had received from ATC. Since all of the incidents occurred at airports in the US and in Canada, this finding supports the argument that aviation English is a code that needs to be learned by all of its speakers, regardless of whether they are native speakers of English or not. The same applies to the four incidents labelled as 'unfamiliarity with phraseology', as one report from an American pilot shows (report number 1490741):

> There is a problem with the way Melbourne delivers clearances and how pilots copy and interpret the clearance. Here is a typical clearance […] which is different from the United States. […] I have talked with three crews who have been charged with a pilot deviations coming out of Melbourne.

The reason for the pilot's confusion was that he/she was not used to the specific phraseology used for departures out of Melbourne, since it differed from FAA phraseology which the American pilot was familiar with (as a result, the pilot flew the wrong SID, which was then quickly corrected by the air traffic controller). This again shows that aviation English is a language variety that not only has to be learned by non-native

[40] STAR = Standard Terminal Arrival Route. A STAR describes the flight path an aircraft must follow during its approach to the destination airport, in order to facilitate efficient air traffic management. It usually includes speed and altitude restrictions at pre-defined navigational points along the flight path.
[41] SID = Standard Instrument Departure. A SID describes the flight path an aircraft must follow after take-off, in order to facilitate efficient air traffic management in the vicinity of an airport. It usually includes speed and altitude restrictions at pre-defined navigational points along the flight path.

speakers of English, but also by native speakers: even though two native speakers of English were involved in communication, misunderstanding occurred because there was no shared meaning of the code that had been used in this particular case.

The issues 'incomplete read-back' and 'no wake turbulence category' were found to play a role in 2 incidents each. One example for an incomplete read-back (report number 1439710) was a pilot reading back a landing clearance without re-stating the runway they were about to land on. The pilot subsequently aligned the aircraft with the wrong runway, which caused the air traffic controller to halt all departures that had been planned to take off on that runway. With regard to the issue of omitting an airplane's wake turbulence category during transmissions, sub-chapter 3.5 already mentioned that this information adds to the safe operation of aircraft, as it allows for pilots to expect turbulent air in a timely manner and thus react to such a situation appropriately. Without knowing about another aircraft's wake turbulence category, a pilot might get "bounced around pretty good", as one of the reports mentions (report number 1480951). What both of the issues have in common is that the pilot and the air traffic controller were not fully informed about the situational context, which prevented them from engaging in a cooperative act of communication.

Finally, similar-sounding calls-signs, insufficient standard phraseology, and an ambiguous instruction were each found once to have contributed to the development of an incident, with the former being the most interesting factor to discuss here. Such incidents occur when there are two or more aircraft on the same radio channel sharing call-signs that differ in small ways only, such as a difference in one digit or swapped positions of two digits. For example, two Lufthansa aircraft might be confused with each other if one's call-sign is LH443 while the other's is LH434. Situations involving similar-sounding call-signs pose a safety risk to aviation operations because a message intended for one pilot might be mistakenly complied with by another pilot. Other factors such as an unclear pronunciation or expectation bias can further greatly increase the risk of confusing two call-signs. This language-related factor thus requires both the speaking and the listening side of a transmission to be extremely attentive to corresponding messages (especially during critical phases, such as take-off and landing), as a mistaken instruction can result in fatal consequences.

The second category of miscommunication (pronunciation/accent) was also broken up into more detailed language-related factors, which are shown in Figure 7 below:

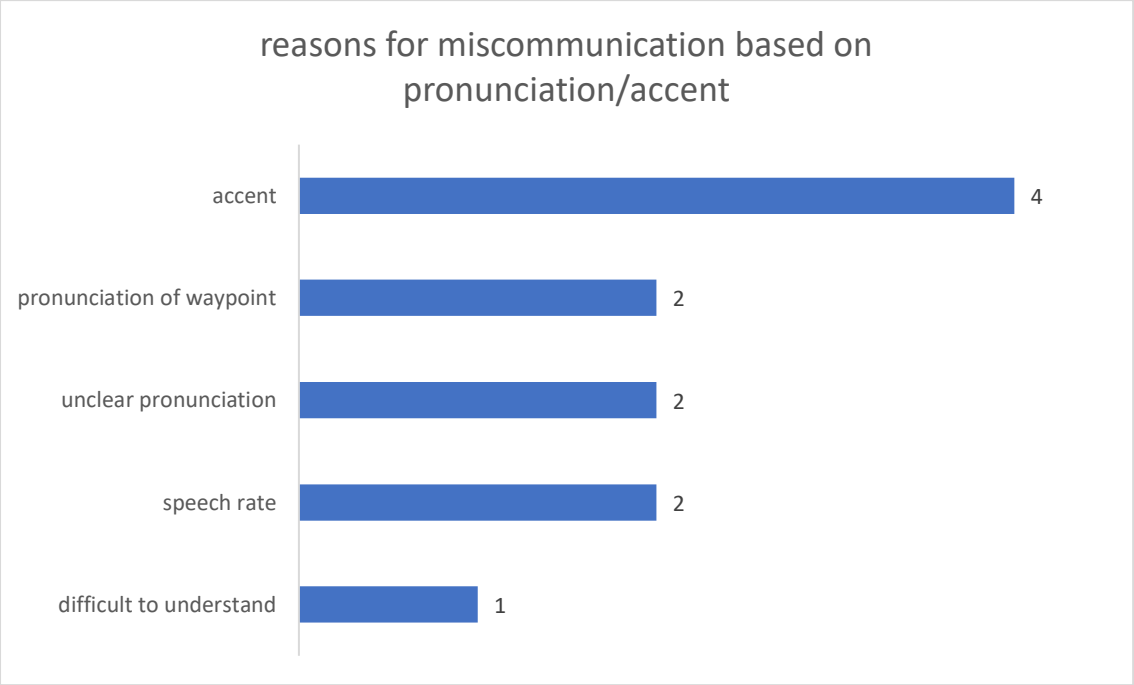

Figure 7. Causal and contributing factors of language-related miscommunication (pronunciation/accent)

Out of the 11 incidents with an underlying pronunciation/accent issue, 4 were linked to a more or less accented language use of an interlocutor. In one case, for example, the pilot had difficulties in distinguishing runways '02' and '20' from each other when the air traffic controller assigned them the runway to land on (report number 1473165). The incident's narrative points out that both runway labels contain the same digits, thus hinting at the potential risk of mixing up the two labels. No additional details regarding this confusion are mentioned in the narrative, thus leaving the question open whether the controller actually complied with the pronunciations from the spelling alphabet (cf. Table 3 in sub-chapter 3.2.2), or whether other phonological aspects (such as difficulties in producing sounds from the Lingua Franca Core, cf. subchapter 2.2.2) had an impact on the intelligibility of the controller. In another incident (report number 1441656), a controller's instructions had to be repeated multiple

times due to his/her strong accent. Similar to the previous report, there are no additional details surrounding the nature of the controller's accent, which makes an in-depth evaluation difficult. However, an interesting difference between the two reports can be seen: in the latter, the pilot and the air traffic controller seem to have engaged in negotiation of meaning (which took several turns), while the pilot from the former report apparently did not ask the controller to clarify his/her intended message. Asking for clarification, as will be discussed again in sub-chapter 6.2, is a crucial communicative strategy in both ELF communication in general as well as radiotelephony communication in particular, as it allows interlocutors to facilitate mutual understanding and thus to contribute to efficient communication.

There were 2 instances each in which the pronunciation of a waypoint[42], a generally unclear pronunciation, and a speaker's rate of speech caused problems in radiotelephony communication. With regard to the former, the problematic aspect was that generally, waypoints (such as GISPO, which is located west of Vienna International Airport (SkyVector 2018)) are pronounceable without the need to spell out each letter (i.e., GISPO would be pronounced as /gɪspoʊ/). However, the pronunciation of some waypoints is not always unambiguous, as the following report shows (report number 1434404):

> [Enroute ATC] in our descent I believe pronounced DRMMM as 'Drum' while the approach controllers were pronouncing the same intersection as 'Dream'. I believe Drum would be appropriate for literal translation of this intersection since no vowel exists between R and M. So when we were told to slow at 'Dream' we mistook it for the next closest pronunciation on the STAR as RAIIN.

The result of the miscommunication was that the aircraft deviated from its designated flight path, thus increasing the risk of conflict with other traffic. As the narrative shows, the waypoint in question, DRMMM, was the cause for a misunderstanding because of an ambiguity in the waypoint's pronunciation. Since DRMMM does not contain a vowel, /ə/ (schwa) can be inserted to be able to utter the waypoint as one word. In order to arrive at a meaningful word for the waypoint's pronunciation, a speaker might resort to 'Drum' rather than 'Dream' due to the perceptual closeness of /ʌ/ (rather than /ɪː/) to /ə/ (both are central vowels; cf. Yule 2010: 34–35), which might

[42] Waypoints are names for navigational spots used by both pilots and air traffic controllers to communicate the flight path of an aircraft.

explain the pilot's preference of the former over the latter. Moreover, since the production of /ɪː/ involves slightly more effort due to it being a tense vowel (thus involving more muscles), 'Drum' may be preferred based on the principle of least effort (Zipf 1949: 1–2). The second incident in the dataset involved the waypoint HIIPR, the issue with this waypoint being that while ATC pronounced it as /hɑɪpər/, the pilot had been used to it being pronounced as /hɪpər/, which is why the pilot failed to recognize the waypoint when it was mentioned by the controller. The problem with both incidents (DRMMM and HIIPR) is that there are no standards or rules mandated by aviation authorities as to how to pronounce waypoints, which thus comes at a cost in terms of mutual understanding and a shared knowledge of the situational context. One possible solution for reducing the risk of ambiguous pronunciations could be to spell out the waypoint letter by letter in case of doubt, just as the numbers and letters in callsigns are pronounced individually using the phonetic alphabet.

Regarding the label 'unclear pronunciation', one incident involved the pronunciation of the word 'tire', which was hard to understand for the pilot and sounded to him/her like 'tail', thus causing a short period of confusion (report number 1446676). It may be that the controller failed to produce the word-final /r/ sound, which can be difficult to pronounce for some L2 speakers of English. However, since the report's narrative does not reveal any detailed information about the controller's linguistic background, the assumption that the controller was a non-native speaker of English may as well not hold true. In this case, regional variations in pronouncing the word may have contributed to the misunderstanding.

Regarding the two incidents in which speech rate played a role, it should be noted that rapid speech is not uncommon in radiotelephony communication (especially in congested airspace). In general, interlocutors are attuned to the fast-paced nature of transmissions. However, as one of the incidents shows, rapid speech can become problematic when the speaker's lack of strategic competence leads to prolonged occupation of the radio channel by having to re-transmit the same message. Adapting one's speech after difficulties in understanding arise – as is typical of ELF communication (Cogo & Dewey 2006: 70–73) – is therefore an important strategy in order to facilitate the efficient and safe management of air traffic.

Finally, the label 'difficult to understand' refers to an incident in which "the ground and tower controllers were not easy to understand. [The pilot] had to ask

them to repeat the taxi instructions more slowly so they could be understood better" (report number 1490310). Based on this description, it is not sure whether the controllers' pronunciations were unclear, or whether they had difficulties in expressing themselves (hence the rather vague label 'difficult to understand'). It is assumed that, since the pilot had to ask for a slower repetition of the instructions, the controllers' fast speech was the cause for suboptimal communication.

iii) *Does the level of working experience of pilots and air traffic controllers play a role in the occurrence of language-related miscommunication?*

In order to answer this question, the pilots' and controllers' hours and years of service were noted wherever there were corresponding data in the reports (as already mentioned in sub-chapter 5.3, this was not always the case – out of the 51 reports analyzed, there were 12 that included information on pilots' total hours of flying, and 14 that included information on controllers' years of service). Moreover, it was important to note which person had been the originator of a language-related problem where possible – for example, in case of an issue with non-standard phraseology, it was important to distinguish whether it was a pilot's or a controller's non-compliance with standard phraseology that had led to miscommunication. Thus, with regard to pilots' working experience, the following table was created:

Table 4. Working experience of pilots and language-related factors of miscommunication

experience pilot (hours)	Controller	Pilot	Grand Total
400-2400	**1**		**1**
non-standard phraseology	1		1
2400-4400		**1**	**1**
accent		1	1
4400-6400	**1**		**1**
incomplete instruction	1		1
10400-12400	**2**	**1**	**3**
unfamiliarity with phraseology		1	1
non-standard phraseology	1		1
speech rate	1		1
12400-14400	**3**	**1**	**4**
unfamiliarity with phraseology		1	1
accent	1		1
no wake turbulence category	1		1

unclear pronunciation	1		1
14400-16400	**1**		**1**
non-standard phraseology	1		1
Grand Total	**8**	**3**	**11**

The pilots' numbers of flight hours were grouped into intervals, and the columns 'Controller' and 'Pilot', respectively, display the number of instances in which a controller or a pilot was identified as the originator of a situation involving language-related miscommunication. Based on this information, we can see that, even though there were 3 and 4 instances in the middle and higher ranges of flying experience, respectively, the language-related factors contributing to these incidents were mainly found to be caused by controllers. A relationship between working experience and language-related miscommunication could therefore not be established in these instances. All other intervals featured only one corresponding language-related factor, with both pilots and controllers interchangeably being responsible for miscommunication. This result thus shows that no clear pattern is discernible given the data above, providing no indication as to whether working experience of pilots plays a role in language-related miscommunication.

With regard to controllers' working experience, the following table was created (the structure of the table matches that of Table 4):

Table 5. Working experience of controllers and language-related factors of miscommunication

experience controller (years)	Controller	Pilot	Grand Total
1-5	**4**	**1**	**5**
incomplete instruction	2		2
non-standard phraseology	2	1	3
5-9	**1**	**3**	**4**
new phraseology		1	1
no wake turbulence category	1		1
incomplete read-back		1	1
non-standard phraseology		1	1
9-13	**1**		**1**
non-standard phraseology	1		1
13-17		**1**	**1**
incomplete read-back		1	1
21-25	**1**		**1**
unfamiliarity with phraseology	1		1
Grand Total	**7**	**5**	**12**

In Table 5, the controllers' numbers of years of service were grouped into intervals. Even though the resulting information is mostly similar to that gleaned from Table 4, in that no clear pattern is discernible with regard to working experience, the first interval (1-5 years of working experience) includes 4 incidents of language-related miscommunication in which a controller was identified to have issued an incomplete instruction or to have used non-standard phraseology. Among these incidents, one involved a controller "[mixing] up the appropriate order of the phraseology" (report number 1472490). Given this finding, it can be said that, during the first few years of service, the working experience of controllers can be a contributing factor in language-related miscommunication. Further research investigating this aspect may offer more definite answers and more detailed insights into the relationship between working experience and the use of aviation English.

What both tables have in common is that 'unfamiliarity with phraseology' was an issue with pilots and controllers who had high levels of working experience. As an example, one incident (report number 1486310) involved a controller not knowing which phraseology he/she could use for issuing instructions towards a special operations aircraft. This prompted the controller to have each of his/her transmissions verified by a supervisor, thus impacting the efficiency of radiotelephony communication. In this particular case, the controller's unfamiliarity with standard phraseology may have stemmed from a lack of pre-defined procedures and/or phrases that are to be used in situations involving special operations ("I was not sure what we could, nor what we could not tell an aircraft participating in '[Special Operation].'"), which would then have necessitated the use of plain English (whether this really happened cannot be gleaned from the report's narrative). Another possible reason for an interlocutor's unfamiliarity with standard phraseology can be that changes to well-established standards and procedures, which aviation personnel have been familiar with over many years, require considerable effort towards their implementation. In summary, therefore, a pilot's or controller's high working experience does not necessarily imply that changes to the vocabulary of aviation English are adapted seamlessly, but that this aspect poses a potential safety risk.

6. Implications

6.1. The need for a standardized language system

The paper so far has discussed the status quo of aviation English and has provided empirical data to show that, even though the current language system has undergone changes in order to minimize safety risks, there are still challenges the international aviation community is faced with. This sub-chapter discusses ideas about the future development of aviation English and ways of improving the current state of this language system.

First of all, it is safe to say that a standardized language system like aviation English is necessary given the high-stakes environment that aviation personnel find themselves in. The advantages are obvious: a shared code allows for all interlocutors to partake in communication and thus to interact on a mutual basis. This is essential for ensuring maximum safety in the air, an aspect which has been given highest priority ever since the advent of civil aviation. The aviation accident over Zagreb has shown how disastrous the consequences can be if radiotelephony communication is conducted in a language that is not shared by all participants on the same frequency: Pilots and/or air traffic controllers are denied the possibility to update their mental models, which greatly inhibits their situational awareness. The results from the paper's analytical part hint towards the notion that instances of miscommunication due to a mismatch in the language are very rare, which can be viewed as a general acceptance of a uniform language used in aviation. Still, civil aviation authorities, flight schools and airline companies are encouraged to continue reinforcing the idea of a shared language for radiotelephony communication, since it is in the interest of all stakeholders that aviation be made as safe as possible.

With aviation English belonging to the realm of ESP, it can provide for efficient communication among speakers who are familiar with the code used, as they employ words and phrases with distinct meanings. However, there are still expressions which, due to ambiguity, may confuse aviation personnel whose native language is not English. Jones (2003: 239–240) identifies "[t]wo sorts of ambiguity [that] need purging. The first sort is due to synonyms, where a meaning has more than one expression. The second sort is the reverse, where a given expression has more than one

meaning". Regarding phrases which share very similar meanings, he mentions the examples of *say/confirm/verify*, which are used to "check information already given", and *immediately/expedite/without delay*, which indicate instantaneous action, but at the same time are "all more complex than the simple word *now*" (Jones 2003: 239–240). The second sort of ambiguity arises from words such as *aircraft* (denoting both the singular and the plural form) and *Tango* (phonetic spelling for the letter T, but also designating an air taxi or a helicopter) (Jones 2003: 241). Adding to these linguistic idiosyncrasies, discrepancies between the phraseologies mandated by the ICAO and the FAA can further aggravate radiotelephony communication. Even though the potential for confusion has been recognized and rectified for some commands (e.g. *line up and wait* (ICAO) vs. *position and hold* (FAA); *when ready* (ICAO) vs. *at pilot's discretion* (FAA)) (Estival, Farris & Molesworth 2016: chapter 2, "Changes in the phraseology"), there are still examples which require improvement, such as *vacate* (ICAO) and *exit* (FAA), or *stop* (ICAO) and *hold* (FAA) (Jones 2003: 240).

Another problematic factor that was mentioned in the analysis of the ASRS reports were similar-sounding call-signs. Even though only one instance of similar-sounding call-signs was featured in the data, the issue is still relevant: a survey conducted by Eurocontrol (2006: 16) found that call-sign confusion ranked highest among factors contributing to communication problems. Further support for this finding comes from a study conducted by the aviation authority of the United Kingdom, the Civil Aviation Authority, which revealed that 73% of reported incidents of call-sign confusion resulted in "increased workload for controllers and flight crew where thinking time was reduced and RTF [radiotelephony] usage time increased" (Civil Aviation Authority 2000: 5). It is thus not only because of its frequent occurrence, but also because of its potential for serious conflict that the issue of similar-sounding call-signs requires special attention when it comes to resolving misunderstandings in radiotelephony communication. One way of addressing this problem would be to temporarily rename the designators in question, so that orthographic and/or phonological differences between two call-signs become more evident (International Civil Aviation Organization 2007: 2-9). Alternatively, controllers can "minimize errors by emphasizing certain numbers/letters, by repeating the entire call sign, [or] by repeating the prefix" (Federal Aviation Administration 2017c: 4-2-3).

With the problems outlined in this sub-chapter, one might ask whether English is suitable to fulfill the demands for an international standard language in the aviation industry. After all, language-related issues persist despite the language system having undergone numerous rectifications with the aim of mitigating miscommunication, such as the substitution of *nine* with *niner*, the implementation of a phonetic spelling alphabet, or the need for read-backs after commands containing important information. Why should the ICAO and the FAA not revert to another language, one with less potential for confusion due to the nature of the language itself? Jones (2003: 244), for instance, considers establishing Esperanto as the international language for aviation, as the goal of avoiding miscommunication is to be achieved with a language that is "characterized by formal rules for its grammar and structure" – an idea which, as Crystal (2003: 109) points out, is likely to be met with resistance:

> A proposal for a new international glossary has been discussed for some time. The problem is plain: it is relatively easy to set up a working party which will compile a single terminology for world use; the difficulty comes in persuading everyone to comply with it (which is likely to mean changing a country's traditional practice).

It is in fact not only individual countries facing this challenge, but also the ICAO and the FAA themselves, as their differing phrases for the same function prove. What Crystal therefore suggests instead is the improvement of aviation personnel's language proficiency in English. Some considerations are discussed in the following sub-chapter. Yet, regardless of which language is utilized in radiotelephony communication, there remain questions that cannot be answered due to the impossibility of figuring out what the interlocutors actually think during their transmissions, thus limiting the extent to which research can gain insight into the impact of a standardized language system on human interactions. Such questions include the problem of figuring out whether "system constraints [are] too strict, forcing actors to focus more on syntax than content", or whether "system constraints [are] too lax, promoting poor radio discipline" (Howard 2008: 387). With these questions in mind, it also remains arguable whether Jones' (2003: 243) suggestion to "determine the true extent of needed phraseology" for certain stages of a flight would have a discernible effect on the number of instances of miscommunication.

6.2. Considerations for the design of pilot and ATC trainings

With the majority of the incidents analyzed being caused by non-compliance with standard phraseology, this issue deserves particular attention and shall therefore be addressed first. I want to stress again the importance of a standardized language system as discussed in the previous sub-chapter: A shared understanding of the code and of the context it is used in greatly improve the efficiency of communication and reduce the risk of misunderstandings – provided that the interlocutors are proficient in the use of the code and that they consistently adhere to the prescribed standard phraseology, even in situations which deviate from normal operations. One way of ensuring that these requirements are met is to practice specific scenarios and conditions in English language training and thereby allow learners 'to language', i.e. to let them participate in a "dynamic, never-ending process of using language to make meaning" (Swain 2006: 96). This can be done by exposing aviation personnel to situations that are less than favorable in ATC communication, such as accented pronunciation, increased environmental noise, or impediments due to technical issues. This way, pilots and air traffic controllers are able to familiarize themselves with such circumstances beforehand and are thus more likely to react properly whenever they encounter these issues. Additionally, the language of instruction should not be the local language of the training facility, as this might cause problems later on in the learners' careers, given that they are going to navigate in an English-only environment. Instead, after having been verified that they possess language skills equivalent to operational level 4 of the ICAO language proficiency rating scale (cf. Figure 8 in Appendix), learners should be provided a learning environment in which they can speak in and practice their English exclusively. This essentially provides them with a vast array of opportunities to learn not only the 'special purpose' part of aviation English, but also to improve on their general language proficiencies and communicative skills needed for situations in which standard phraseology does not suffice.

Another point to make is that aviation English is a language variety that all of its users need to learn, regardless of their proficiencies in the English language. This is not only due to the highly specialized vocabulary, but also because the use of plain English demands adherence to certain rules which are different from the everyday

use of English (e.g. avoiding idiomatic expressions or refraining from informal chats). It is especially the latter constraint that native speakers of English might have difficulties adapting to (cf. Eastern Air Lines Flight 401 in sub-chapter 3.2.3). The reason for this might not only be that they are used to producing idiomatic speech subconsciously, but perhaps also because of a perceived inferiority of native speakers towards non-native speakers (cf. sub-chapter 2.2.2), in the sense that they tend to regard "anything that does not quite meet NS expectations (based on individual intuition) as an 'error'" and in turn as "symptoms of 'language disease'" (Seidlhofer 2011: 35).

Part of the operational level on the rating scale is the ability to "paraphrase successfully when lacking vocabulary in unusual or unexpected circumstances" (International Civil Aviation Organization 2004), which hints at a speaker's general language proficiency needed for communication involving the use of plain English. An important aspect of the design of pilot and ATC training is therefore not only a focus on standard phraseology and procedures, but on how to utilize one's linguistic skill set to cover those situations in which standard phrases do not suffice. To this end, instructors of aviation English need to consider the heterogeneous target group of their language lessons, with both native and non-native speakers of English being usually present in an aviation English classroom. Taking this into account, ESP's concept of needs analysis (cf. sub-chapter 2.1.2) facilitates the assessment of learners' needs according to target needs and learning needs: while the former comprise "the skills and knowledge students need in the target situation", the latter describe "what students need to do in order to achieve them" (Přírorová 2016: 17). Target needs are the same for all learners of aviation English (namely those skills that comprise level 4 of the ICAO language proficiency rating scale), but learning needs differ among students due to their diverse linguistic backgrounds, one aspect usually being a difference between native and non-native speakers of English in terms of general language proficiency. Therefore, the way how learners of aviation English develop their communicative skills and thus arrive at the operational level can vary greatly, with both native and non-native speakers of English sharing the responsibility for ensuring effective communication: while non-native speakers of English most likely require language training in the skills of speaking and listening, native-speakers of English are likewise

taken into account by undergoing training to improve communicative strategies employed in radiotelephony communication. ELF research has already shown that ELF speakers utilize certain strategies to facilitate communicative success, including the deliberate repetition of "words, phrases or clauses in order to gain time", the co-construction of "utterances whenever an interactant appears to be lost for words", and the accommodation "to each other's speech styles" (House 2012: 174). In situations where misunderstandings arise, ELF speakers utilize these strategies, too, to negotiate meaning and thus resolve the situation (Seidlhofer 2004: 218). Given the intercultural setting of radiotelephony communication, native speakers of English are therefore prompted to adopt these strategies not only if misunderstandings occur, but also to facilitate cooperation with non-native speakers of English as a preventive measure against miscommunication. Asking for clarification in case of doubt, for example, would certainly benefit aviation personnel – using the standardized phrase *Say again* may already be enough for an interlocutor to signal that a transmission needs to be rephrased (International Civil Aviation Organization 2010: 4-6).

Besides non-compliance with standard phraseology, the issue of pronunciation was also featured in the analysis of ASRS reports, including factors such as accent, confusing pronunciations of waypoints, and an interlocutor's speech rate. As mentioned in sub-chapter 2.2.2, for utterances in ELF communication to be comprehensible the phonological characteristics contained in the Lingua Franca Core are necessary. These characteristics do not, however, reflect native-like pronunciation – the production of the dental fricatives /θ/and /ð/, for example, do not have to be mastered by an ELF speaker, and thus are not essential for radiotelephony communication. Seiler (2009: 48), however, regards pronunciations and accents from different varieties of English as problematic for ATC communication and therefore suggests that "pilots and air traffic controllers […] be trained in these varieties, [so that] they can learn to tune into and understand all of these different accents/pronunciations". While such an approach may seem to be in line with ideas about accommodation from ELF research (Beebe & Giles 1984: 8–9), the question is whether a language learner can ever be exposed to all the different accents from different varieties of English. An alternative, more realistic approach would rather be to guide pilot and ATC trainees into using communicative strategies as explained in the previous paragraph. With regard to the pronunciation of waypoints, two reports revealed that misunderstandings

can occur because there exist no standards or rules as to how a waypoint is supposed to be pronounced. A possible, though somewhat laborious solution would therefore be to spell out every single letter of a waypoint, thereby adhering to the spelling alphabet as presented in sub-chapter 3.2.2. Finally, regarding the issue of speech rate, preventive measures can be taken by facilitating accommodation processes between pilots and air traffic controllers. Instructors of aviation English thus may have trainees – both native and non-native speakers of English – practice to "adapt to each other's speech by means of a wide range of linguistic features including speech rates, pause and utterance lengths, pronunciations, etc." (Beebe & Giles 1984: 7–8).

In accordance with the discussion in sub-chapter 2.2.3, the ICAO acknowledges that the attainment of native-like language proficiency for those who speak English as a second or foreign language is not desired, and thus the native speaker should not be considered as a role model for language learning and teaching (International Civil Aviation Organization 2010: 2-6). In fact, the ICAO rating scale (cf. Figure 8 in Appendix) does not reflect native-like proficiency, but is a set of skills that "[a]ll participants in aeronautical radiotelephony communications must conform to […], and there is no presupposition that first-language speakers necessarily conform" (International Civil Aviation Organization 2010: 4-8). This holds especially true for pronunciation, as ELF speakers' pronunciation levels should not reflect native-like competence, but the ability to produce those phonetic details which really influence meaning (Seiler 2009: 45–46) – phonetic details such as aspiration after voiceless plosives in word-initial position, or making long and short vowels distinguishable (cf. Jenkins' (2000) Lingua Franca Core in sub-chapter 2.2.2). This means that a speaker's pronunciation at level 4 of the rating scale may be "influenced by the first language or regional variation" (International Civil Aviation Organization 2004), which further suggests that adherence to ENL is not considered an aim which learners of aviation English need to strive for.

The insights presented above hint towards the idea that "blaming [non-native speakers'] language inabilities or limitations for preventable accidents will not fundamentally solve the problem", thus leading to the idea that "the ultimate goal is 'not to improve their English proficiency itself,' but 'to avoid fatal accidents due to miscommunication'" (Tajima 2004: 467). This view represents a more balanced approach to-

wards solving the issue of miscommunication, as former research has oftentimes suggested an improvement of non-native speakers' language proficiencies in English only, examples of which are "abundant practice in comprehending everyday English speech" (Chatham & Thomas 2000: 22), the development of "vocabulary and conversational English skills for […] non-native speakers of English" (Sullivan & Girginer 2002: 403), and extra training for "foreign aviation personnel" (Jones 2003: 243). Although the aspect of language proficiency needs to be considered, it is also important to examine the role of native speakers of English in the context of radiotelephony communication, as they are equally responsible for a safe execution of aviation operations. Moreover, it needs to be emphasized that the importance of the "use [of] appropriate communicative strategies to exchange messages and to recognise and resolve misunderstandings (e.g. to check, confirm, or clarify information)" (International Civil Aviation Organization 2003: Appendix A-1) holds for both native and non-native speakers, which is why both parties involved require equal consideration when discussing the issue of miscommunication.[43]

Lastly, the results pertaining to research question iii) have shown that the working experience of air traffic controllers in the first few years of service can be a contributing factor in language-related miscommunication. In such cases, preventive measures could include an increased presence of ATC mentors during the first years of a newly certified controller. However, since the data did not contain information about flying hours and years of service for each report, the effect of working experience on the use of aviation English must be stated with caution. Therefore, further research on this aspect is needed to provide a more detailed answer to research question iii). Furthermore, since the empirical part of this paper could not answer the question whether there exists a relationship between instances of language-related miscommunication and an interlocutor's linguistic background (i.e. whether English was his/her L1 or L2), this factor is open for detailed investigation in the course of future studies.

[43] This paragraph was taken from Konrath (2017: 5) with minor modifications.

7. Conclusion

Maximizing operational safety remains the most important goal for the international aviation community. Considering that the human factor represents a vulnerable point in aviation operations, this paper demonstrated the importance of addressing the issue of miscommunication in radiotelephony communication between pilots and air traffic controllers. With the focus on language-related factors impeding communication, it was shown that, even though language barriers may not always be the main reason for aviation incidents and accidents, the very fact of these barriers being contributing factors already requires special attention to be directed towards a discussion of this issue. The conception that aviation English represents an example of English as a lingua franca and English for specific purposes thereby adds to a better understanding of the nature of this variety of English and the circumstances under which its users have to operate, whose highest priority is clear, precise, unambiguous and efficient communication. With regard to its users it was argued that, in accordance with Seidlhofer's (2011) view, a distinction between native and non-native speakers of aviation English seems not reasonable, since the highly specific vocabulary and regulated procedures require all aviation personnel to learn the register from scratch. Even in situations for which the ICAO and FAA do not have standardized words and phrases established, aviation personnel of all linguistic backgrounds have to adapt their communicative strategies in such a way that it is possible for their interlocutors to achieve the common goal of efficient mutual understanding.

Investigations in the aftermath of fatal aviation accidents as well as past research have already greatly contributed to the study of language-related miscommunication, with findings suggesting that code-switching, L1 interference, a non-phraseologic, colloquial use of aviation English as well as regional accents have a negative impact on the intelligibility of radio transmissions. The empirical part of the paper built upon these findings and found that non-compliance with standard phraseology and difficulties in pronunciation were the most prominent factors in language-related miscommunication. Based on these insights, the importance of a standardized language system as well as considerations for the design of pilot and air traffic controller training were discussed. With the notion that English is likely to remain the interna-

tional language for communication in the aviation industry, measures for the improvement of the language system as well as the communicative skills of aviation personnel need to be taken consistently. With regard to the latter, the discussions in this paper have demonstrated that it is not only non-native speakers of English that need to enhance their skills in listening and speaking, but also native speakers who may benefit from focused training in terms of communicative strategies, especially with regard to ELF communication. This way, a sense of a shared responsibility towards the goal of successful radiotelephony communication is fostered, thus placing the emphasis on cooperative measures so that instances of miscommunication can be kept at a minimum.

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9. Appendix

ICAO LANGUAGE PROFICIENCY RATING SCALE

LEVEL	PRONUNCIATION *Assumes a dialect and/or accent intelligible to the aeronautical community.*	STRUCTURE *Relevant grammatical structures and sentence patterns are determined by language functions appropriate to the task.*	VOCABULARY	FLUENCY	COMPREHENSION	INTERACTIONS
Expert 6	Pronunciation, stress, rhythm, and intonation, though possibly influenced by the first language or regional variation, almost never interfere with ease of understanding.	Both basic and complex grammatical structures and sentence patterns are consistently well controlled.	Vocabulary range and accuracy are sufficient to communicate effectively on a wide variety of familiar and unfamiliar topics. Vocabulary is idiomatic, nuanced, and sensitive to register.	Able to speak at length with a natural, effortless flow. Varies speech flow for stylistic effect, e.g. to emphasize a point. Uses appropriate discourse markers and connectors spontaneously.	Comprehension is consistently accurate in nearly all contexts and includes comprehension of linguistic and cultural subtleties.	Interacts with ease in nearly all situations. Is sensitive to verbal and non-verbal cues and responds to them appropriately.
Extended 5	Pronunciation, stress, rhythm, and intonation, though influenced by the first language or regional variation, rarely interfere with ease of understanding.	Basic grammatical structures and sentence patterns are consistently well controlled. Complex structures are attempted but with errors which sometimes interfere with meaning.	Vocabulary range and accuracy are sufficient to communicate effectively on common, concrete, and work-related topics. Paraphases consistently and successfully. Vocabulary is sometimes idiomatic.	Able to speak at length with relative ease on familiar topics but may not vary speech flow as a stylistic device. Can make use of appropriate discourse markers or connectors.	Comprehension is accurate on common, concrete, and work-related topics and mostly accurate when the speaker is confronted with a linguistic or situational complication or an unexpected turn of events. Is able to comprehend a range of speech varieties (dialect and/or accent) or registers.	Responses are immediate, appropriate, and informative. Manages the speaker/listener relationship effectively.
Operational 4	Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation but only sometimes interfere with ease of understanding.	Basic grammatical structures and sentence patterns are used creatively and are usually well controlled. Errors may occur, particularly in unusual or unexpected circumstances, but rarely interfere with meaning.	Vocabulary range and accuracy are usually sufficient to communicate effectively on common, concrete, and work-related topics. Can often paraphrase successfully when lacking vocabulary in unusual or unexpected circumstances.	Produces stretches of language at an appropriate tempo. There may be occassional loss of fluency on transition from rehearsed or formulaic speech to spontaneous interaction, but this does not prevent effective communication. Can make limited use of discourse markers or connectors. Fillers are not distracting.	Comprehension is mostly accurate on common, concrete, and work-related topics when the accent or variety used is sufficiently intelligible for an international community of users. When the speaker is confronted with a linguistic or situational complication or an unexpected turn of events, comprehension may be slower or require clarification strategies.	Responses are usually immediate, appropriate, and informative. Initiates and maintains exchanges even when dealing with an unexpected turn of events. Deals adequately with apparent misunderstandings by checking, confirming, or clarifying.
Pre-operational 3	Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation and frequently interfere with ease of understanding.	Basic grammatical structures and sentence patterns associated with predictable situations are not always well controlled. Errors frequently interfere with meaning.	Vocabulary range and accuracy are often sufficient to communicate on common, concrete, or work-related topics, but range is limited and the word choice often inappropriate. Is often unable to paraphrase successfully when lacking vocabulary.	Produces stretches of language, but phrasing and pausing are often inappropriate. Hesitations or slowness in language processing may prevent effective communication. Fillers are sometimes distracting.	Comprehension is often accurate on common, concrete, and work-related topics when the accent or variety used is sufficiently intelligible for an international community of users. May fail to understand a linguistic or situational complication or an unexpected turn of events.	Responses are sometimes immediate, appropriate, and informative. Can initiate and maintain exchanges with reasonable ease on familiar topics and in predictable situations. Generally inadequate when dealing with an unexpected turn of events.
Elementary 2	Pronunciation, stress, rhythm, and intonation are heavily influenced by the first language or regional variation and usually interfere with ease of understanding.	Shows only limited control of a few simple memorized grammatical structures and sentence patterns.	Limited vocabulary range consisting only of isolated words and memorized phrases.	Can produce very short, isolated, memorized utterances with frequent pausing and a distracting use of fillers to search for expressions and to articulate less familiar words.	Comprehension is limited to isolated, memorized phrases when they are carefully and slowly articulated.	Response time is slow and often inappropriate. Interaction is limited to simple routine exchanges.
Pre-elementary 1	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.

Source: "Manual on the Implementation of ICAO Language Proficiency Requirements", International Civil Aviation Organization (2004).

Figure 8. ICAO Language Proficiency Rating Scale (International Civil Aviation Organization 2004)

Table 6. 'Able-Baker' alphabet used by military (Twidell 2010)

British	**US**
Able/Affirm	Able
Baker	Baker
Charlie	Charlie
Dog	Dog
Easy	Easy
Fox	Fox
George	George
How	How
Item/Interrogatory	Item
Jig/Johnny	Jig
King	King
Love	Love
Mike	Mike
Nab/Negat	Nan
Oboe	Oboe
Peter/Prep	Peter
Queen	Queen
Roger	Roger
Sugar	Sugar
Tare	Tare
Uncle	Uncle
Victor	Victor
William	William
X-ray	X-ray
Yoke	Yoke
Zebra	Zebra

Table 7. ICAO phonetic alphabet, 1952 version (Twidell 2010)

ICAO alphabet 1952
Alfa
Bravo
Coca
Delta
Echo
Foxtrot
Golf
Hotel
India
Juliett
Kilo
Lima
Metro
Nectar
Oscar
Papa
Quebec
Romeo
Sierra
Tango
Union
Victor
Whiskey
Extra
Yankee
Zulu

Table 8. Shortened version of reports analyzed

ACN	Synopsis	category	Label (reason for miscommunication)	experience pilot (hours)	experience controller (years)	originator
1415329	Air carrier flight crew reported beginning their takeoff roll too early with an aircraft that was cleared to back taxi was occupying the runway.	phraseology	non-standard phraseology			Controller
1415992	B737 First Officer reported very confusing ATC communications while on a visual approach to ELP Runway 22.	phraseology	incomplete instruction			Controller
1416530	ZMP Controllers reported of a pilot who did not follow ATC instructions and turned the aircraft to a different heading than what was assigned.	phraseology	non-standard phraseology		7,50	Pilot
1418611	A300 Flight Crew reported being given a PDC for CASTA7 and to expect Runway 25R. After taxi the runway assignment was switched to 25L and fly runway heading. After rotation the Controller stated, 'we need you back on the SID, proceed direct HIIPR' which the Captain did not recognize due to pronunciation and declined, remaining on runway heading.	pronunciation / accent	pronunciation of waypoint			Pilot + Controller
1418741	CRJ-700 Captain reported being issued incomplete, confusing go-around instructions from a TRACON Controller.	phraseology	incomplete instruction			Controller
1425971	A Controller working alone on a mid shift reported leaving their radar position to enter a PIREP in to a computer and did not notice an aircraft descending below its assigned altitude below the Minimum Vectoring Altitude.	phraseology	incomplete instruction		2,00	Controller

1426360	Commercial flight crew reported departing ZGSZ on the SIE7W while the clearance was actually the SIE9W. Many distractions during preflight and the language barrier allowed the error to go undetected.	pronunciation / accent	speech rate	12250,00		Controller
1428344	BNA Departure Controller reported receiving departures from the Tower that were assigned incorrect headings.	phraseology	incomplete read-back		16,00	Pilot
1428945	Air carrier pilot reported they misunderstood Departure Controller's altitude assignment due to new phraseology associated with new OAPM RNAV departures.	phraseology	new phraseology			Pilot
1432421	B767 First Officer reported encountering wake turbulence from a preceding B747 on arrival into EHAM.	phraseology	no wake turbulence category	13000,00		Controller
1434404	A319 flight crew reported missing a speed restriction on the DRMMM1 arrival into ATL when they misunderstood a Controller's pronunciation of DRMMM intersection.	pronunciation / accent	pronunciation of waypoint			Pilot + Controller
1434485	PSP Local Instructor and Developmental both reported of an unsafe situation where SCT TRACON did not follow correct procedures which led to a loss of separation between two aircraft.	phraseology	non-standard phraseology			Controller
1434492	A Tower Controller reported an aircraft on approach flying in an erratic manner, unable to understand taxi instructions and ignored the ramp personnel's instructions.	phraseology	non-standard phraseology			Controller
1434511	SCT TRACON Controller reported confusion from an inbound LGB pilot on a the new Metroplex RNAV Approach clearance.	phraseology	new phraseology			Pilot

1435377	G650 pilot reported contact with an apparent interloper issuing bogus ATC clearances on the Afghanistan FIR frequency.	phraseology	non-standard phraseology			Controller
1439710	SFO Tower Controller reported an aircraft was cleared to land on the left runway, but lined up and landed on the parallel runway.	phraseology	incomplete readback		6,00	Pilot
1441609	A320 flight crew described a runway incursion approaching Runway 8R at MIA. He was head down starting the second engine and reading checklists at the time.	phraseology	non-standard phraseology	10904,00		Controller
1441656	A321 First Officer reported difficulty in teaming with the Captain during an approach.	pronunciation / accent	accent			Controller
1444545	B737 First Officer reported being cleared to descend via the OLAAA 1 Arrival to LAX except with several altitude adjustments. After a runway change and a speed adjustment, two crossing restrictions were missed.	phraseology	new phraseology			Pilot
1445394	Hawker 800 Captain reported misunderstanding a Canadian Controller's instruction to descend to FL240 and descend via NUBER2 arrival. The descent was continued after reaching FL240 without clearance to make the ROKTO crossing restriction.	phraseology	new phraseology			Pilot
1445738	Hawker 800 First Officer reported an altitude deviation occurred that arose from the difference in 'descend via' clearances between Canada and the United States.	phraseology	new phraseology			Pilot

1446036	Flight crew reported an altitude deviation on a STAR into CYYZ and were informed in Canada a 'descend via' clearance only means speeds not the altitudes.	phraseology	new phraseology			Pilot
1446676	B777 flight crew reported several tires were blown during landing rollout.	pronunciation / accent	unclear pronunciation	12611,50		Controller
1447350	Air carrier First Officer reported they received several non-standard clearances on arrival into Barcelona (LEBL).	phraseology	incomplete instruction			Controller
1449785	Air carrier First Officer reported that while on PHX Taxiway F after passing G3 west bound to G2 ATC advised them their wingtip clearance was insufficient.	phraseology	incomplete instruction			Controller
1451269	A Controller issued incomplete holding instructions causing an aircraft to turn in the wrong direction below the Minimum Vectoring Altitude.	phraseology	incomplete instruction		2,50	Controller
1451902	B737-800 flight crew reported receiving an amended approach clearance with non-standard confusing phraseology.	phraseology	non-standard phraseology			Controller
1457016	MLU TRACON Controller used non-standard phraseology and did not confirm that an aircraft they received was climbing to the correct altitude.	phraseology	non-standard phraseology		10,00	Controller
1457523	Air carrier flight crew reported a ground conflict at EHAM after all three pilots misunderstood the Ground Controller's hold short instructions because of rapid, accented speech.	pronunciation / accent	speech rate			Controller
1462487	Charlotte Approach Controller reported stopping an aircraft's descent to prevent a loss of separation with another aircraft.	phraseology	non-standard phraseology		3,00	Pilot

	Controller stated pilot accidentally deleted altitude from the FMS.					
1467031	Business jet flight crew reported they followed HPN Tower's instruction to exit Runway 16 onto Runway 11 while another aircraft was on final approach for Runway 11.	pronunciation / accent	accent			Controller
1471455	CRJ-200 flight crew reported that during descent they misunderstood instructions from ATC.	phraseology	non-standard phraseology			Controller
1472178	PCT Controller and an air carrier Captain reported some confusion with clearances that resulted in the aircraft missing the crossing restriction. As a result conflicting traffic was vectored into the Washington DC Flight Restricted Zone.	phraseology	new phraseology		5,00	Pilot
1472490	S46 TRACON Controller reported an aircraft on final approach for BFI conflicted with VFR aircraft transiting the approach course not in communication with ATC.	phraseology	non-standard phraseology		2,60	Controller
1473165	Corporate jet Captain reported missing a change to the approach clearance by ATC into SBRJ due to expectation bias, changing weather conditions and the Controller's foreign accent.	pronunciation / accent	accent	13258,00		Controller
1475825	OAK Tower Controller and pilot reported that the pilot did not comply with departure instructions causing them to fly into conflict with traffic inbound on an instrument approach.	phraseology	non-standard phraseology	415,00	1,00	Controller

1480119	SR20 flight instructor reported an NMAC with another light aircraft in the pattern at CMA airport.	pronunciation / accent	accent	2700,00		Pilot
1480931	Air taxi pilot reported not flying the full approach into AVL as ATC intended due to a poorly worded clearance.	phraseology	incomplete instruction	5300,00		Controller
1480951	ZMP Center Controller reported that another Controller does not follow procedures, is lazy, and incompetent.	phraseology	no wake turbulence category		8,00	Controller
1482253	B737 Captain reported that there was miscommunication with foreign ATC regarding aircraft speed due to a language barrier.	pronunciation / accent	unclear pronunciation			Controller
1482989	PCT TRACON Controller reported assigning an operational error conducting a flight break up procedure even though they were in compliance with the 7110.65.	phraseology	standard phraseology insufficient		7,00	
1486310	HCF TRACON controllers reported that a Special Operation aircraft was allowed to fly at an altitude below the Minimum Vectoring Altitude.	phraseology	unfamiliarity with phraseology		24,00	Controller
1490310	A Widebody Transport First Officer reported that during a back-taxi on the takeoff runway it was not clear where to make the 180 turn.	pronunciation / accent	difficult to understand			Controller
1490741	Air carrier flight Crew reported a track deviation due to confusion with the departure clearance delivery format.	phraseology	unfamiliarity with phraseology	14353,50		Pilot
1499220	A B737-800 Captain reported while on RAJEE SID, ATC issued numerous amendments to published procedure using non-standard, or nonspecific phraseology. This, along with new Visual Jeppesen SID altitude depictions	phraseology	non-standard phraseology	15000,00		Controller

	contributed to altitude deviation.					
1506913	Boeing 737 Captain reported Departure Control climb clearance confusion due to ATC incorrect clearance phraseology.	phraseology	non-standard phraseology			Controller
1507142	Air carrier Captain reported they routinely encounter aircraft with similar sounding call signs.	phraseology	similar-sounding call-signs			
1509471	A319 Captain reported confusion on approach to SFO regarding an altitude assignment after NORCAL TRACON issued an ambiguous clearance.	phraseology	ambiguous instruction			Controller
1510957	Air taxi flight crew reported executing a go-around after experiencing a NMAC in the pattern at RNM airport. The crew cited Tower technique as contributing.	phraseology	non-standard phraseology			Controller
1511378	Air carrier pilot reported being confused by the 'Climb via SID' phraseology used by ATC when departing BWI.	phraseology	unfamiliarity with phraseology			Controller
1515432	BE-55 pilot reported taking off without clearance after misunderstanding Tower phraseology.	phraseology	unfamiliarity with phraseology	11000,00		Pilot

Abstract

The purpose of this thesis is to highlight the critical factor of language-related miscommunication in radiotelephony communication between pilots and air traffic controllers. The specialized language variety that is used in this international environment, aviation English, is identified to be a manifestation of English as a lingua franca and an example of English for specific purposes. This characterization not only allows for a better understanding of the linguistic characteristics of aviation English, but also informs findings in the analytical part of the paper. Regarding the latter, an analysis of a set of anonymous incident reports was conducted using the online database of NASA's Aviation Safety Reporting System. Following a manual filtering process, each report was assigned a category and a label based on the type of incident described in the report's narrative. The resulting data revealed that the use of non-standard phraseology and difficult-to-understand pronunciation were the most frequent contributory factors with regard to language-related miscommunication. It is thus suggested that while a standardized language system such as aviation English facilitates effective communication, the international aviation community is encouraged to constantly work towards improving the language system as well as the communicative abilities of its language users. The latter suggestion in particular means that it is not merely non-native speakers of English who are required to improve their linguistic competences, but native speakers of English as well, who might have to become attuned to the specialized setting of radiotelephony communication through training which focuses on the effective use of communicative strategies.

Deutsche Zusammenfassung

Ziel dieser Diplomarbeit ist die Thematisierung sprachlich bedingter fehlerhafter Kommunikation in der Kommunikation über Sprechfunk zwischen Piloten und Fluglotsen. Aviation English, d.h. jene spezialisierte Sprache, die in einem solchen internationalen Umfeld zum Einsatz kommt, wird dabei als eine Ausprägung von English as a lingua franca und als ein Beispiel von English for specific purposes identifiziert. Diese Charakterisierung ermöglicht neben einem besseren Verständnis der linguistischen Eigenschaften von aviation English auch eine detailliertere Diskussion der Ergebnisse aus dem analytischen Teil der Arbeit. Dieser empirische Teil wurde mithilfe der Online-Datenbank des Aviation Safety Reporting System der NASA durchgeführt, wobei eine Auswahl von anonym übermittelten Vorfallsberichten untersucht wurde. Nach dem manuellen Filtern der Datenabfrage wurden, abhängig von der Art des jeweils beschriebenen Ereignisses, jedem Bericht eine Kategorie und eine Bezeichnung vergeben. Die gewonnenen Daten zeigten, dass die Verwendung nicht-normgerechter Phrasen und eine schwer verständliche Aussprache die häufigsten Faktoren in Bezug auf sprachlich bedingte fehlerhafte Kommunikation waren. Um dem entgegenzuwirken, bedarf es vonseiten der internationalen Luftfahrtgemeinschaft neben der Optimierung des sprachlichen Systems auch einer Verbesserung der kommunikativen Fähigkeiten des Luftfahrtpersonals. Insbesondere letztere Anregung zielt dabei gleichermaßen auf alle Sprachbenutzer ab: während nicht-Muttersprachler der englischen Sprache von einem Ausbau ihrer sprachlichen Kompetenzen profitieren, können ‚native speakers' durch gezieltes Training von kommunikativen Strategien mit jenem spezialisierten Umfeld besser vertraut gemacht werden, in dem der Sprechfunk zwischen Piloten und Fluglotsen stattfindet.