Communication in Civil Aviation: Linguistic Analysis for Educational Purposes

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Abstract. Effective communication is a basic human requirement and in the aviation environment an essential pre-requisite to safety. English is the designated language of communication between air traffic controllers and pilots of international flights. Deviations from the usage of standard phraseology and lack of language proficiency had been identified as one of the causal factors in safety occurrences. The research focuses on radiotelephony communication (RTF) between pilots and air traffic controllers in the international controlled airspace as well as face-to-face communication between pilots in the cockpit and between pilots and aerodrome staff. Linguistic analysis of radiotelephony allowed us to prove its discursive nature based on procedural, interactive, and real-time attributes. The RTF discourse is defined as a closed, narrow-professional, institutional and dynamic type. This discourse is intentional and focused on safe operation of flight; conventional, limited by a set of stereotyped phrases enshrined in regulatory documents and obligatory for radiotelephony participants' use, by strict regulation of radiotelephony procedures at all stages of flight. Main speech functions realized in RTF discourse are informative and regulatory. Analysis of linguistic and psycholinguistic features of RTF discourse, nature and causes of RTF communication failures, and psycho-physiological features of pilot in-flight activity (information overloading, high tempo of work due to time limits, work in stressful conditions) allowed to determine types of exercises for ab initio students to meet language requirements of safe, clear and effective communication in Civil Aviation.

Keywords: Communication, radiotelephony, language proficiency.

Introduction

Development of modern science, engineering and technology leads to the emergence of specialized areas of human activity that cause emergence of specialized areas of communication. One of such specialized spheres is communication in Civil Aviation, since "modern flight aviation system operates as a communication process constructed, organized, regulated, and realized through human actions" [1].

In our studies, it was found that professional aviation communication encompasses: 1) specific professional speech communication within the professional community "air traffic controllers (ATCOs) – aircrew" while operating an aircraft flight, and is implemented in the form of Radiotelephony of Civil Aviation (RTF); 2) communication of aircrew and air traffic control (ATC) personnel with ground personnel in order to ensure the organization of the flight and its safety; 3) communication with passengers, which is carried out indirectly as aircrew announcements or directly in certain flights, if there arise situations that require flight crew intervention to ensure flight safety [2].

Air-to-ground communication (that is a radio exchange between ATC and aircrew) is viewed as the key component of flight safety. At the dawn of aviation, communication between pilots and ground services was not possible due to the lack of radio communication means. However, low altitude piloting, low speeds and small number of aircrafts minimized possibility of aircraft collision in flight or at airfields. Nowadays air traffic on many routes is similar to traffic on big freeways, and to ensure safety of its participants it is necessary to observe the rules of professional communication, which is considered as a component of the professional reliability of ATCOs and pilots. The "Air-Ground Communication Safety Study: Causes and Recommendations", made by Eurocontrol, indicates that 64% of all communication problems have some air safety consequences [3].

The ICAO Language Proficiency Requirements apply to achieving and maintaining proficiency in all languages used in radiotelephony communications. However, English is the language most widely used by the global aviation community, and the one language, which is obligatory to provide. Thus, improving levels of spoken English is the aviation community's main focus currently.

Most flights operated by Ukrainian airlines and served by Air Traffic Control in airspace of Ukraine are international. Therefore, the radio exchange language for Ukrainian pilots and air traffic controllers is English, that is, a foreign language that is specially learned by these professionals to become their reliable and efficient instrument of professional activities. Despite the long-standing interest of scientists in the linguistic aspects of Aviation English and RTF phraseology [4; 5; 6; 7; 8], the nature of communicative failures in "air-to-ground" radio exchange [9; 10; 11; 12], Aviation English teaching [2; 13; 14], the problem of ensuring communicative reliability of pilots remains unsolved. In this regard, we consider **the purpose** of the article in exploring linguistic nature of the RTF discourse and on this basis defining a typology of exercises for the radio exchange training of future Civil Aviation pilots.

Methods of the research

The following methods were applied in the research: *descriptive method* that was used to describe communication in Civil Aviation as an institutional professional discourse; *abstract-logical method* that allowed to synthesize theoretical material and covered various techniques: analysis, comparison, hypothetical prediction and analogy; *cognitive, linguistic* and *psycholinguistic analysis* of a selection of excerpts

from investigation documents of aviation accidents, a contributory factor of which was communication failure in the radio exchange process, which were used to clarify the nature of communicative failures in RTF discourse; *observation* of professional and communicative activities of air ATCOs and pilots in the process of RTF communication; *modelling* exercise typology for teaching RTF communication.

Socio-psychological and psychophysiological aspects of aircrew professional activity

Effective vocational training should first and foremost take into account the specifics of ab initio students' future professional and communicative needs. As the research is aimed at improving aircrew language proficiency, sociopsychological and psychophysiological analysis of pilots' professional activity was conducted [2], which enabled us to draw conclusions on future pilots' professional speech training:

– the pilot has a leading, integral role in the system "man – machine – environment", while the interaction between man and machine is based on the principle of active participation of the person, who organizes the whole system and directs it to achieve a definite, predetermined result, i.e. the principle of "active operator";

– flight activity is one of the most complex and dynamic, the aircrew of modern aircraft operates at the limits of human capabilities; flight activity as a profession belongs to the category of "dangerous professions";

– the course of pilot's mental processes in flight is influenced by specific characteristics of flight activity (unusual for a human conditions of lifting-off the ground; rapid movement in space; high pace of activity; simultaneous performing of multidirectional actions at certain stages of flight; risk of dangerous situations, influence of specific physical factors on the body (acceleration, vibrations, etc.);

– modern aircrew manages not the physical object as such, but its information model, so the circulation and processing of information are fundamental in aviation; speed, accuracy and reliability of the whole system "man – machine" depends on the accuracy and timeliness of information processing. Incompleteness, ambiguity, uncertainty of information can not only make worse time and accuracy characteristics of the pilot's activity, but also cause stress and action errors;

– features of the pilot's activity (information overloading, high tempo of work due to time limits, work in stressful conditions) are strengthened by the fact that a human as a link of the complex system "aircraft – pilot –environment" has its limitations, which lead to errors in the work and provoke emergencies;

– the feature of pilot's "professional reliability" is the absence of communication failures in his professional speech activity in the RTF discourse.

Linguistic features of aircrew communication in Civil Aviation

The specificity of the communication field makes particular requirements for the use of lexical and grammatical means, sentence making and structuring the utterance. All

this is subordinated to the one goal – the highest possible meeting communicative needs in this sphere of professional communication. Communication in aviation lays down a number of requirements to the language used by aircrew in flight: the language used employs a specific set of vocabulary, and functions; operational fficiency, rather than linguistic correctness, is the ultimate criterion by which proficiency is evaluated; communication is predominantly oral and most often with no visual contact [15].

Discursive nature of aircrew communication in Civil Aviation

Psycholinguistic analysis of radiotelephony allowed us to prove its discursive nature. In defining the RTF discourse nature, we relied on Ye. Kubriakova's research where discourse is defined as "the form, the use of the language in real time (on-line), that reflects a certain type of human social activity" [16]. In terms of a social context, professional space acquires an important value, as it points out the environment in which discursive activity takes place and allows defining RTF as a narrow-professional type of discourse. The narrow-focused professional orientation of the RTF discourse characterizes it as a closed type [5]. The dynamic nature of the RTF discourse is associated with the components of dynamism – procedurality of activity that is related to interaction and is expressed in real-time binding (on-line discourse). In this connection, we view the RTF discourse not as the result of communication, but rather as the speech behaviour itself.

Discourse "Radiotelephony of Civil Aviation"

As a closed, narrow-professional, institutional dynamic type, the RTF discourse is characterized by a) the intentional character and focus on safe flight performance, herewith all communication in the RTF discourse is reduced to provide this guideline; b) communicators of the RTF discourse as representatives of a certain professional space realize themselves in a limited set of role characteristics; c) communication process "ATC – aircrew" is built on "circular model", since one-way communication is not provided in this type of the discourse (this feature distinguishes the interactive character of communication and allows to refer RTF to discursive space); d) "status-role" relations of RTF participants are mostly realized by means of binary opposition "a message initiator" – "an executor / non-executor of the requested action".

Realization of the RTF discourse by its communicators can be represented schematically (see Fig. 1 and 2).

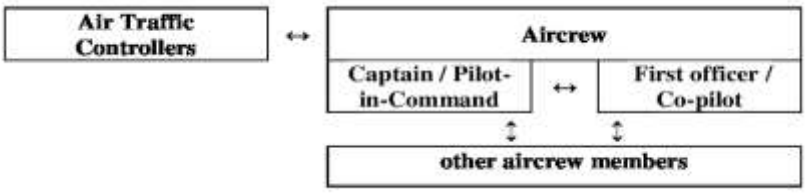

Fig. 1. Realization of the RTF discourse in the mode "Air Traffic Controllers – Aircrew"

As we see from Fig. 1, it is possible to distinguish two varieties of the RTF discourse regarding the aircraft crew. The RTF discourse is *external* when realized in air-to-ground communication (between a pilot and an air traffic controller). In case the RTF discourse is used in communication among the aircrew members inside the aircraft, it is defined as internal.

In some cases, the RTF discourse becomes three-membered.

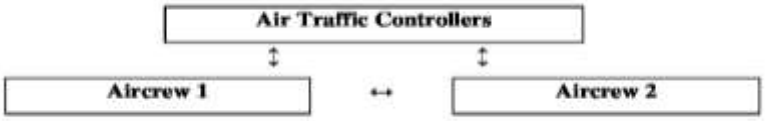

Fig. 2. Realization of the RTF discourse in the mode
"Air Traffic Controllers – Aircrew 1 – Aircrew 2"

As we can see in fig. 2, for Aircrew 1 there are two sources of external information: from Air Traffic Controllers and from another aircraft (Aircrew 2).

External information from ATC bodies is essential for the aircraft crew in the standard flight course and absence of emergencies. The flight program and connected with it aircrew activity depends on this information. Flight operation in standard conditions is related to the implementation of the decision. In the case of a non-standard situation, the role of cockpit communication in the process of gathering, processing information and decision-making increases. Decision-making is the main point of the aircrew activity under stress conditions.

Functional aspects of the RTF discourse

From the functional standpoint, the RTF discourse is viewed as hierarchically organized speech acts, combined into a dialogic utterance. Specific features of dialogues in the RTF discourse are their purposefulness and fast pace, which are connected with a limit of time for communication. The longer the communication process lasts (considering flight speeds), the less time it left to perform aircraft control operations, as a result, some of the operations are either not performed or are performed with errors, which can lead to aviation accidents. The RTF discourse (as a variety of oral colloquial speech) is realized in accordance with the principle of economy. Consequently, the specific feature of utterances in the RTF discourse is conciseness. The RTF dialogue does not foresee the visual perception of the communicants, that is, it lacks the perception of facial expressions and gestures. Possible radio interferences do not always allow perceiving the intonation pattern of the utterance. The result of this is a special attention to the text and to the word as its unit.

The main speech functions, implemented in the RTF discourse, are informative and regulatory. The RTF discourse performs its informative function if information on the aircraft condition and location, airfield condition, functioning of communication facilities, emergencies, etc. is transmitted. The informative function is implemented in such speech genres as request, controller's information, clarification, confirmation, etc. (e.g. Borispil Ground: WRC 7061***, taxi with caution, taxiways are slippery***. –

WRC 7061: Roger, WRC 7061). The regulatory function of the RTF is carried out mainly by the air traffic controller and is manifested in the control of the aircraft crew activities: setting the mode of flight, its heading, flight route for descending before landing and climbing after take-off, at levelling aimed at preventing dangerous approaches and collisions of aircraft and other obstacles. The main genres of speech utterances that implement the regulatory function of the RTF discourse are instructions, controller's orders and recommendations (e.g.: Pilot: *Borispil Ground, WRC 7061, request taxi.* – Controller: *WRC 7061,* ***taxi to holding point RWY 36R via taxiways D4, B****.* – Pilot: *Holding point RWY 36R via taxiways D4, B, WRC 7061).*

In flight, the aircrew interacts with various ATC services. For instance, at the first and final stages of the flight, the interaction "aerodrome control – aircraft" is carried out. Communication covers the following topics: departure information and engine starting procedures, push-back, taxi instructions, take-off procedures, airport traffic circuit, final approach and landing, go around, after landing [17].

RTF discourse as a "language code"

The RTF discourse is based on lexical and terminological "boilerplates", speech clichés, the use of which is obligatory in accordance with the requirements of radio communications. The rules and standard phraseology are intended to shorten the duration, to regulate and enhance the reliability of the RTF communication in radio networks and over terrestrial channels of connections of ATC bodies.

I. Prokhozhai notes that the RTF discourse is a "code language" since only members of the aviation community understand the information it provides [5]. Under the term "code language", we mean a system of signs or combinations of signs with certain meaning, presented to the recipient in an encoded form, and which need immediate decoding in the process of radio exchange. Encoding of information in the RTF discourse involves transforming information into a form that meets the requirements of this type of discourse – non-ambiguity, conciseness and clarity of the formulated thought. From this point of view, all the information in the RTF discourse is precise. The decoding process is considered as a mental processing of information, which results in the adequate activation of the sign encoded by the speaker.

The encoding of information in the RTF discourse is found at different levels of the language system. phonetic / phonological (e.g.: a) replacement of the sound [θ] with the sound [t]: [θri: – tri:] and [θauzend – tauzend]; b) complete replacement of the sound [v] with the sound [f]: [faiv́ – faif], etc.); lexical (e.g.: a) RTF terminology: *flight level*, *ILS approach*, *wind shear*; b) discursive lexical markers: *affirm* (yes), *break* (a pause between parts of the message), *negative* (no), *roger* (understood), *wilco* (understood, will be performed); c) terminologisation of literary language words: *start-up* – in the RTF discourse – start of the engine, in literary language – start of activity; *backtrack* – in the RTF discourse – to steer backwards, in literary language – to break a promise, to refuse, etc.); grammatical (e.g.: a) discursive syntactic markers: *read back* – repeat all or part of the message as it was received, *words twice* – convey each word or group of words twice; b) elliptical structures (e.g.: Pilot: *Borispil Approach,* ***request*** *ILS approach Runway 36R*); c) absence of

interrogative sentences (pilots and ATCOs use discursive formula to request information: *confirm* – confirm if I understand correctly, *advise* – report, etc.).

Standard and non-standard phraseology of RTF communication

Of the many factors involved in the process of communication in Civil Aviation, *phraseology* is perhaps the most important, because it enables aircrew and ATCOs to communicate quickly and effectively despite differences in language and reduces the opportunity for misunderstanding. Phraseology has evolved over time and has been carefully developed to provide maximum clarity and brevity in communications while ensuring that phrases are unambiguous. *Standard phraseology* reduces the risk that a message will be misunderstood and aids the read-back/hear-back process so that any error is quickly detected. Ambiguous or non-standard phraseology is a frequent causal or contributory factor in aircraft accidents and incidents. International standards of phraseology are laid down in ICAO Annex 10 [18] and in ICAO Doc 9432 – Manual of Radiotelephony [17]. Failure to use standard phraseology can lead to misunderstanding and breakdown of the communication process. *Non-standard phraseology*, which is sometimes adopted unilaterally by national or local air traffic services, can make a positive contribution to flight safety; however, this must be balanced with the possibility of confusion for pilots or ATCOs not familiar with the phraseology used.

Plain English in RTF communication

Although standardized ICAO phraseologies [19] have been developed to cover many circumstances (essentially routine events, but also including some predictable emergencies or non-routine events), no set of phraseologies can fully describe all possible circumstances and responses. RTF users should be prepared to use *plain language* when necessary following the principle of keeping phrases clear and concise. Plain English proficiency is the ability to communicate in non-routine and emergency situations during flight – for example, when a passenger suffers a medical problem on board. It is crucial that pilots can convey these sorts of messages clearly and effectively and that they are received and understood by air traffic control so the appropriate actions can be taken. Therefore, plain English in aeronautical communications needs to be clear, unambiguous, free of colloquialisms, slang and idiomatic speech, and accessible to the international community of users [20].

Communicative failure in RTF communication

The main requirement for any communication is orientation towards mutual understanding. Communication is considered successful if the recipient correctly understands the speaker's intentions and responds appropriately. Communicative failure in the RTF discourse is understood as a violation of the communication process, which results in a mismatch of the content of the encoded message to the content of the decoded message. Communicative failure in the process of radio exchange can occur due to the influence of various factors [2; 5; 6]:

– factors of informative nature: complexity of information that leads to misunderstanding; excessive brevity of information; vague information that logically implies a repeated request from the addressee;

– psycholinguistic factors: a) inadequate anticipation of the situational model; b) inadequate evaluation of the prototype communication situation;

– factors of professional nature: poor knowledge of ICAO phraseology (e.g. misinterpretation of the phrase *Go ahead* as “Move forward” instead of “Continue”); non-compliance with the established by ICAO communication rules and procedures; unjustifiably high speed of an air traffic controller speech when issuing instructions and clearances to aircraft pilots, etc.);

– psychophysiological factors: a) lack of attention; b) violation of the spatial organization of perception and movement, manifested in the inability to quickly differentiate right and left sides, parts of the world on a geographical map, etc.; c) stress / affective state while recognizing the emergency of the situation;

– linguistic factors: existence of a bilingual environment in ATC; grammatical, lexical and stylistic mistakes in the speech of communicators (e.g.: inadequate replacement of lexemes (*'zero' with 'o', 'say again'* with *'repeat, please'*; substitution of grammatical structure (*What's the heading?* instead of *Report heading*)); unclear or incorrect pronunciation of English words; strong accent of the speaker; inadequate homophones decoding (e.g., numeral *'two'* and preposition *'to'* in the air traffic controller’s instruction *Climb to two five zero* instead of *Climb to flight level 250*) etc.

– factors of technical nature: technical communication problems that cause interference and poor broadcasting.

Language teaching for communication in Civil Aviation

ICAO Language Proficiency Requirements

The introduction of the ICAO Language Proficiency Requirements in 2003 and the subsequent steps to assist their implementation have significantly altered the environment in which Aviation English training is carried out. Previously, the training was an optional and irregular activity on the periphery of professional training. Now, Aviation English training is a subject driven by specific objectives: attaining and maintaining the language proficiency defined as ICAO Operational Level 4 [21].

Basic principles of teaching English for communication in Civil Aviation

Experts in Aviation English training differentiate principles of language teaching for aviation: appropriate content-based language training is a more efficient, motivating and cost-effective form of Aviation English training; the content used for language acquisition should be relevant to the population being trained; training should have a communicative focus (communicative approach to language learning). The goal is successful communication, rather than grammatical correctness. The training should use learner-centered classrooms rather than teacher-centered; much student conversation

practice and relatively less teacher lecture; minimal error correction of errors which do not affect comprehension, and; materials which attract learners' attention.

It is generally accepted that the closer the content matter of a course is to the actual situations, activities, functions and subjects encountered in the students' professional life, the more effective and motivating this courseware will be. Professional relevance is a combination of two factors: content and function. Content may include subjects such as approach, delays, bad weather conditions, sick passengers, a hydraulic failure and runway incursions. No less relevant for aviation professionals are the specific language functions required to deal with these situations, such as describing, requesting, clarifying and confirming [14]. The key role in language teaching for communication in Civil Aviation plays the system of exercises.

Modelling typology of exercises for teaching communication in Civil Aviation

In modelling the typology of exercises for the effective mastering of RTF communication by ab initio students, we took into account psycholinguistic features of the RTF discourse (real-time running, focus on safe flight operation, importance of anticipation, information saturation and sense precision, etc.), psychophysiological features of pilots activity in flight (information overload, forced high pace of work due to time limits, stressful working conditions), dependence of pilots on extralinguistic factors that affect quality of RTF communication (lack of current information, poor communication quality), causes of communication failures.

Modelling of exercises of this type provides possibility of training on simulator, which allows visualizing all controlled objects, setting them the desired characteristics (speed, direction, etc.) and simultaneously developing necessary professional speech skills. However, due to a number of organizational and technical reasons, Aviation English teachers often have to prepare ab initio students for successful communication in language classrooms using traditional and multimedia training tools. The suggested typology of exercises will be effective under such conditions.

Type 1. Exercises for the formation of extra-curricular skills of operative memory development (memorization and reproduction of word groups, text fragments, "snow ball", etc.). Work with such exercises is built on the principle of increasing difficulties. Students are suggested to memorize and reproduce a series of words, numbers, word combinations with numerals, geographical names, call signs, headings, flight levels, meteorological conditions. The number of words can vary (with tendency to increasing), although it is reasonable to follow the principle of 7 ± 2. Words can be selected by a theme or randomly. Exercises can be complicated by the tasks of switching from one language code to another. This mode of accomplishment corresponds to the mode of pilot's work, when he perceives flight information in English, but internally processes it in Ukrainian.

Type 2. Exercises for clear accent development, speech fluency (practice in pronunciation of tongue twisters, reproduction of patterns in RTF communication, etc.). Attention should be paid to speech speed, correct word stress, clarity of diction.

Type 3. Exercises for the development of skills to perceive information under unfavourable conditions: (simultaneous listening and counting down, simultaneous

listening to two texts in different languages, perception of information in English, and its processing in Ukrainian, etc.). Barriers in the material perception may vary.

Type 4. Exercises for the development of skills to perceive the RTF discourse (listening to the RTF discourse samples and filling in missed words, determining the basic data on the flight run, understanding of RTF messages in the context of complicated reception conditions, detection of inaccuracies in RTF communication, memorizing and reproduction of RTF samples, etc.). These exercises require entire perception and complete (100%) understanding of the standard RTF phraseology.

Type 5. Exercises for the formation of skills to analyse perceived information in the form of the RTF discourse. The exercises involve listening to RTF samples, analysing and finding the communicative failures that became concomitant factors of aviation accidents. Mastering skills in finding errors in the RTF discourse and their analysis contributes to readiness of future pilots to strictly follow radio communication procedures in their professional activities.

Type 6. Exercises for mastering skills to carry out RTF communication (listening to ATC clearances and reading back, carrying out RTF communication on position reporting / final approach and landing, etc.). Such exercises can be complicated by incomplete information, which requires not only speech skills, but professional intuition, analysis. Such exercises make educational activities closer to the professional ones.

Type 7. Exercises for reflexive and evaluative skills formation in RTF communication (case-study). To cope with these tasks students should apply skills formed at the previous training stages. The inability to cope correctly and quickly with the tasks (efficiency index is taken into account) shows a necessity of further work on formation, adjustment or skills improvement to conduct RTF communication. Self-reflection and evaluation become powerful factors of students' motivation.

Types of the suggested exercises can vary depending on certain goals of a particular stage of training. However, it is possible to distinguish some general principles of work with each exercise:

1. Performance of each exercise should be based on the principle of activity and students motivation to find the correct answer.

2. Control of exercises' performance has to be subordinated to the international requirements to communication in aviation, which in accordance with Doc 9835 "Manual on the Implementation of ICAO Language Proficiency Requirements" are as follows: a) the language used should be clear, concise and unambiguous; b) the need for the use of plain language should in no way be interpreted as permission to chat or otherwise ignore the formal and informal protocols that govern the use of standardized phraseology [21]. So, Aviation English teachers should control students' practices in RTF communication and decide if they meet the ICAO requirements.

3. Exercises must be based on real RTF communication [22-25].

4. The composition of each exercise is determined by considering principles of accessibility and gradual build-up of difficulties. The same type of exercise may vary according to: the number of information elements (only altitude; altitude and heading; altitude, heading and pressure, etc.); quality of communication (channel failure:

disturbances to the transmission of a sound-stream coming from garbling, background noise, signal strength), individual features of air traffic controller's speech), etc.

The practice of using such exercises demonstrates that the suggested approach to their modelling allows facilitating of future pilots training, prepares them for the real difficulties of professional communication in the RTF discourse [26-29].

Conclusion

Aviation is a fast developing branch of international transportation. Safety experts are constantly seeking to identify means of improving safety in order to reduce accident rates. With mechanical failures featuring less prominently in aircraft accidents, more attention has been focused in recent years on human factors that contribute to accidents. Communication is one human element that is receiving renewed attention.

The RTF discourse makes the core of communication in Civil Aviation. Linguistic analysis of radiotelephony allowed us to prove its discursive nature based on procedural, interactive, and real-time attributes. The RTF discourse is defined as a closed, narrow-professional, institutional and dynamic type. This discourse is intentional and focused on safe operation of flight. Main speech functions realized in RTF discourse are informative and regulatory.

The RTF discourse is a "language code", since information transmitted in it is understandable only to the actors of aviation community. Non-compliance with norms of this language code use, as well as a number of psycholinguistic, psycho-physiological, and extra-linguistic factors lead to disruption of information coding / decoding processes, cause communicative failures, become concomitant factors of aviation accidents.

Language training in aviation has specific objectives; the content, criteria of proficiency, conditions of use and professional and personal stakes distinguish the instruction goals from the teaching of language for other areas of human activity. Analysis of linguistic features of the RTF discourse, nature and causes of RTF communication failures, and psycho-physiological features of pilot in-flight activity allowed to determine types of exercises facilitating the process of future pilots training to cope with real difficulties of professional communication in aviation.

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