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English-language Training For Air Traffic Controllers Must Go Beyond Basic ATC Vocabulary

Because miscommunication can have serious consequences, air traffic controllers responsible for international flights must have the skills in English to communicate more broadly than just to repeat learned phrases. The training and testing of controllers in English should require that controllers be able to respond to unusual, as well as routine, situations.

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In ordinary speech situations, we interpret spoken content by processing visual cues, such as gestures, and use these cues to supplement verbal information. As a last resort, we ask questions and obtain further information needed to make the meaning clear.

Context also plays an important role in understanding a speaker's message. Even if we miss a word or two of a speaker's presentation, we can still construct what the speaker said based on the usual context of the situation. Large amounts of spoken communication can be processed while we think about other things nearly simultaneously because context often makes much of the semantic content predictable.

Visual cues and contexts help make ordinary speech adequate for most of the things we do. Because pilots and air traffic controllers are invisible to one another they cannot depend on visual cues to facilitate communication. Furthermore, while communicating with each other, both pilots and controllers also process large amounts of visual information and perform other linguistic tasks — pilots communicating with other crew members, controllers communicating with other flights and both groups monitoring their instruments.

Context can be misinterpreted. In pilot–air traffic control (ATC) radio communication, the term "two five zero" can be an altitude, an airspeed or a heading. Expecting, for example, to receive heading instructions from a controller, and perhaps hearing only the words "two five zero," a pilot might mistake an altitude clearance for a heading.

To compensate for distractions and the ambiguity of context, pilots and controllers use highly formatted exchanges and rely on readback to ensure that the intended meaning of their messages has been understood. Despite using readback, miscommunication can occur, especially when the listener's expectations influence what is heard.

In high-risk situations, such as those that can arise during ATC communication, the result of a miscommunication can be serious.

Steven Cushing presents examples of miscommunication that have caused or contributed to aviation accidents. In these accidents, visual, contextual and other redundant cues were unavailable, and the speakers failed to recognize or resolve the ambiguities in their exchanges.[1]

Cushing cites the March 27, 1977, KLM Royal Dutch Airlines Boeing 747 collision with a Pan American World Airways B-747 in the Canary Islands, which resulted in 583 deaths; 61 survived. A pilot of the KLM aircraft said that he was "at takeoff," which the controller assumed to mean that the pilot was ready for takeoff and was awaiting further instructions. Actually, the KLM aircraft was taking off and was about to collide with the Pan American aircraft, which was taxiing on the runway toward the KLM aircraft.

Dealing with ambiguity in ATC communications is even more complex when flight crews, controllers or both are communicating in non-native English, that is, English that has been acquired as a second language.

The International Civil Aviation Organization (ICAO) does not mandate the use of English internationally for ATC communications, but recommends communication in the language "normally used by the station on the ground." Somewhat equivocally, ICAO recommends the use of English "pending the development and adoption of a more suitable form of speech for universal use in aeronautical radiotelephony communications."[2]

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ICAO further recommends that English-language support should be available from ATC facilities serving designated routes and airports that are used by international flights. This ambiguous situation has resulted in *de facto* use of English as the international language of ATC without a requirement that it serve as such, and without the development of standards for training and testing controller use of English.

Given the challenges of ATC communication and the lack of regulatory specifications for English as the international language of aviation, it is not surprising that a number of aviation accidents have involved non-native English in pilot-controller communications. As Cushing noted concerning the accident in which the KLM pilot informed the controller that the B-747 was "at takeoff," the grammar of the pilot's native language, Dutch, interfered with his ability to construct the English statement "I am taking off," which would have had a different meaning to the controller.[1]

Other accidents involving misinterpretation of meaning have occurred more recently. On Jan. 25, 1990, the first officer of an Avianca airliner failed to translate to the air traffic controller the captain's statement that the aircraft was in an emergency situation, instead saying, "We're running out of fuel." The controller responded to a low-fuel situation, but not to a low-fuel emergency. The plane impacted terrain at Cove Neck, New York, U.S., killing 73 persons aboard the flight; 85 survived.

In December 1995, the American Airlines Flight 965 accident near Cali, Colombia, might have been prevented if the Colombian controller had been fluent in English.[3] The Colombian government has officially determined flight crew error as the probable cause of the accident. Nevertheless, the Cali controller said that he did not have adequate English skills to ask questions when the crew made illogical statements about the plane's location. The Boeing 757 aircraft flew into a mountain and 160 were killed; four survived.

Problems arising from lack of fluency in English received considerable attention at a three-day Communicating for Safety Conference, sponsored by a number of major aviation professional groups, held May 15–17, 1997, near Phoenix, Arizona, U.S.

Speaking at the conference, Capt. John Cox of US Airways said, "Ours is a lexicon of abbreviations, acronyms and jargon, and just consider how many different versions of English we have. Often our language can be confusing — we have problems with oxymorons, slang, homonyms (to, too, two) and so forth."[4]

At the same conference, Frank Price, manager of Air Traffic International Staff of the U.S. Federal Aviation Administration (FAA), said, "Unlike [in] the past, international traffic is now flying into the [U.S.] heartland. Every [FAA Air Route Traffic Control] Center now works international traffic."[4] Outside the United States, air routes — such as those over Russia and China — that were severely restricted or prohibited from use by western air carriers during the Cold War have been opened, increasing the potential for pilot-ATC language problems.

At the special aviation safety conference convened by the U.S. Secretary of Transportation in early 1995 following several highly publicized accidents in the last five months of 1994, proposals were made to require all airline transport pilots to pass a test of English-speaking proficiency. This led to the drafting of a standardized test, which included three parts: written, listening and speaking, and using model airplanes to demonstrate understanding of flight-maneuver terminology. The FAA has reportedly not taken action to require such testing of non-U.S. pilots who fly to the United States, although one private company that teaches "aviation English" uses testing in its own proficiency assessments of non-U.S. pilots that it trains.[5]

At the recommendation of the U.S. National Transportation Safety Board (NTSB), the FAA in April 1997 sent ICAO a letter proposing the establishment of English standards, and ICAO is expected to respond before the end of 1997. The U.S. Congress has also expressed concern about the issue. In connection with appropriations for the FAA, the House of Representatives Transportation Appropriations Subcommittee urged the FAA to work with the NTSB and ICAO to standardize training and evaluation procedures for English proficiency in the worldwide aviation system and approved funding for such a program. A House-Senate conference committee has recently approved a US$500,000 set-aside as part of the FAA budget for fiscal year 1998.

Several U.S.-based air carriers took the initiative to foster training of controllers, despite the absence of an international standard addressing skill levels. United Airlines, Northwest Airlines, Delta Air Lines, Alaska Airlines and FedEx supported English-proficiency programs for Russian and Chinese controllers at U.S. universities.[5]

Training programs to improve controller English skills face a variety of challenges. Because skill-level requirements have never been defined, training has emphasized mastery of standardized terminology. Nevertheless, the acquisition and use of language skill is complex and involves learning grammar, pronunciation, intonation and usage. Developing functionality in a foreign language is a difficult task.

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Effective pilot-controller communication depends on the ability of the speakers to avoid ambiguity, at best, or at least to resolve ambiguous situations when they occur. If controllers lack adequate English skills, they cannot resolve ambiguous situations by requesting clarification or verification of details, as happened at Cali. Therefore, English proficiency needs to exceed the level required to reproduce memorized phrases and terms. The mastery of specialized terminology is insufficient.

Contrary to the method used in many countries, ATC terminology should be taught not to beginners, but only to students who have at least a relatively advanced knowledge of English. Jack C. Richards suggests that special terminology is best learned in the context of the general language in which it is used.[6]

ATC terminology is highly specialized and occurs infrequently in the general language, so mastery of ATC terminology alone does not produce functional proficiency in English. A fairly high level of functional proficiency is needed to master ATC terminology, because as Richards says, knowing a word includes:

- Knowing the probability of encountering that word in speech or print;
- For many words, knowing the type of words most likely to be associated with the word;
- Knowing the limitations imposed on the use of the word according to variations in function and situation; and,
- Knowing the syntax associated with the word.[6]

Knowledge of specialized terms is also easier to acquire when aspects of the language have been mastered first, such as principles of word formation and sentence structure. Teaching and testing knowledge of ATC terminology with lists of terms turns controllers into parrots, who are handicapped in unusual or stressful ATC situations, rather than skilled users of English who can apply the language in a range of contexts.

One solution to English-proficiency and other communication problems suggested by Cushing is an "intelligent voice interface," which would provide some callouts automatically; monitor voice transmissions for accuracy, completeness, plausibility and similar factors; and question the speaker as needed before transmitting communications. But, as Cushing acknowledges, we lack the technology and a complete understanding of how language is interpreted by the brain. For the present, he recommends development of other visual back-up systems to voice.

Although many advocate the use of datalink to avoid the complexities of voice communication, datalink might be a questionable replacement of voice communication for controlled approaches and other nonroutine situations. Reading and typing English language exchanges in free text, if required for datalink systems, will be a time-consuming and challenging linguistic task for non-native speakers. Moreover, datalink and voice interface systems might discourage active monitoring of other flight crews' and controllers' voice communication, which often provides additional information. The resulting atrophy of verbal skills may impede the ability of controllers and pilots to respond to verbal information, especially when they are communicating in non-native English.

Although technical solutions have their appeal, the solution for the moment should be training that will give every pilot and controller the skills to serve as his or her own "intelligent voice interface." Technical systems should be used for back-up and augmentation, and should replace voice communication only for routine ATC exchanges.

For air traffic controllers, international English performance requirements need to be more clearly defined, and then re-evaluated as new technology is introduced that will change the use of natural language for communication between pilots and controllers. Because international standards have not been

developed, countries presently train and certify controllers according to their own standards, so different kinds of programs produce varying results.

For example, Russia and China, two countries training large numbers of controllers in English, face development of their own national standards for training and proficiency certification. In some Latin American countries, standards exist but should be reviewed. Without international policy and guidance, however, there is nothing to direct that various national standards should be similar.

Despite the lack of an international standard, Russian aviation authorities are working to develop the necessary standardization, testing and training programs to improve and maintain the English skill levels of Russian controllers. The same process may be used by other countries to establish local and eventually regional standardization, and these standards could ultimately provide the basis for a unified international standard for controllers' general English skills.

One of the first questions that Russian authorities have had to address is how much English air traffic controllers need to know. Here the Cali accident is instructive, because the controller's technical language proficiency was not adequate to meet the requirements of his job, although he was apparently fully trained. A controller who knows 200 or 300 English ATC terms may have very little functional ability to communicate in English, and therefore the requirement for general language skills must be defined clearly.

Communication broke down most often when Russian controllers moved from strictly formatted exchanges to discuss weather, airport conditions and other topics that require skill in generating sentences.

Results of surveys of U.S. flight crews who fly in Russia indicated that communication broke down most often when Russian controllers moved from strictly formatted exchanges to discuss weather, airport conditions and other topics that require skill in generating sentences. Some Russian textbooks introduce ATC language to controllers with only the most rudimentary English skills, or none at all,[7] so it is not surprising that a Russian controller would know terminology in English but not have a wider command of the language.

As part of an initiative to measure Russian controller English proficiency and to design training to raise skill levels, Russian authorities have used standardized English testing to determine controllers' baseline scores. This process involves testing large numbers of controllers in different regions and observing controller performance to establish a minimum proficiency standard that can be applied to all controllers or selected groups of controllers based on job requirements.

This testing program, the first step toward development of a national standard, will enable the Russian authorities to identify weaknesses in training, select and prioritize personnel for training, measure the impact of training in terms of cost, and guarantee the capabilities of personnel to perform job duties using English.

This process will ensure that controllers can respond to a variety of nonroutine and emergency scenarios using English — for instance, to respond to questionable transmissions from the cockpit, to identify ambiguous situations and causes of ambiguity, and to provide the flight crews with appropriate instructions when these situations occur. In other words, job proficiency should provide a basis for the standard, and testing should be accomplished with respect to operational scenarios that a controller might encounter.

English courses that the Russian controllers attended in the past were primarily oriented toward development of conversational skills, because of the importance of speaking skills for job performance. Not surprisingly, Russian controller test scores have been higher for listening skills than reading skills.

Nevertheless, although speaking and listening skills might be used most by air traffic controllers, reading and writing skills must also be developed in training, even if to a lesser degree. For language learning, all these skills reinforce each other. Some controllers, for example, learn general and technical vocabularies best with visual reinforcement from reading and writing. To acquire general English proficiency as well as a knowledge of ATC applications, controllers must also acquire and use the full range of language skills.

Another language-training problem of special importance to Russia is attrition caused by lack of practice, which has its greatest influence on listening and speaking skills. Most people who have studied a foreign language are aware of how quickly skills are lost if not used regularly. For Russian controllers in particularly remote locations such as the Far East, the rarity of occasions to use English on the job may not be adequate to maintain their skills, and soon proficiency becomes reduced.

The English training program in these parts of Russia, like programs in other countries where English use is limited, will need to include mechanisms such as regular testing to identify skill attrition, with maintenance and refresher programs to counteract attrition. The value of costly training for controllers is lost when language skills atrophy and the training system does not respond by restoring proficiencies.

Examples from Russia show that the English problem is not easy to solve, but that the problem is solvable. Large-scale baseline testing is planned, as is the development of standards, training and testing to produce, measure, maintain and certify language skills. Such a comprehensive and systematic approach will provide the basis for a program that can be easily managed and evaluated for cost-effectiveness.

Even the best-managed English training will not eliminate inherent ambiguities in language, and such training will not compensate for poor discipline, fatigue and other problems in the workplace. But training will improve the ability of air traffic controllers to perform their jobs and greatly reduce the risk that controllers and pilots will communicate with, but not understand, one another.

Like the controllers and pilots who use English language for ATC communications, the aviation industry needs to be more aware of language issues so that it can design training systems to produce and maintain the necessary language skills.

This will ensure that English training will be provided to controllers as thoroughly and systematically as the other training that they receive, and that continued international use of English for pilot-controller communications will support, rather than undermine, the safety of flight.♦

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2. International Civil Aviation Organization (ICAO). Annex 10 — Aeronautical Telecommunications, Volume II, "Communication Procedures," paragraphs 5.2.1.1.1 and 5.2.1.1.2. Montreal, Quebec, Canada: ICAO, 1995.

3. Phillips, D. "Pilots' Confusion Revealed in Tapes from Cali Crash." *The Washington Post*, April 17, 1996. Phillips wrote: "The Cali air traffic controller handling the flight told investigators that he realized that the crew's replies to some of the instructions 'made no sense' and were 'illogical,' but he lacked proficiency in colloquial English to confront the crew. So he merely repeated his instructions, never believing the plane was in danger ... . [The controller] said that he spoke good 'technical' English necessary for international air traffic control, [but that] ... his language capabilities did not allow him to ask questions of the crew then or when they began asking for a new route that confused him."

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7. For example, *Uchebnik anglijskogo yazyka dlya letnogo I dispetcherskogo sostava mezhdunarodnykh avialinij*, Moskva, Voennoe izdatel'stvo Ministerstva oborony SSSR, 1972. This textbook for Russian air traffic controllers introduces English pronunciation in the same initial chapters that contain aviation vocabulary such as "airplane," "map," "flight plan," "apron" and "to taxi." It is intended for use in a 300-hour course to prepare controllers to be certified to provide air traffic control in English.

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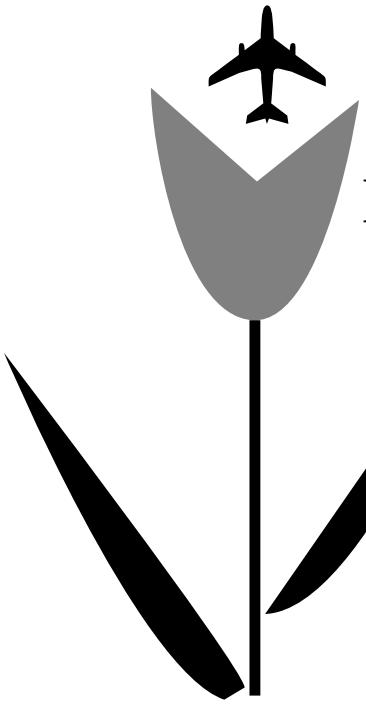

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