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# **U.S. Airline Transport Pilot International Flight Language Experiences, Report 4: Non-Native English-Speaking Controllers Communicating With Native English-Speaking Pilots**

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Final Report

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### Technical Report Documentation Page

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| 16. Abstract<br><br>In 1998, the International Civil Aviation Organization (ICAO) took a heightened interest in the role of language in airline accidents. Member states agreed to take steps to ensure air traffic control (ATC) personnel and flight crews involved in flight operations in airspace where the use of the English language is required were proficient in conducting and comprehending radiotelephony communications in English. This report is a compilation of responses and comments by a group of U.S. pilots from American, Continental, Delta, and United Airlines of their difficulties in international operations. In this report, their responses to questions 39-45 are presented as a compiled narrative. We derived six major thrusts: (1) The English language proficiency of non-native English-speaking controllers may be inadequate for high workload conditions; (2) Pilots develop and use different strategies to improve ATC communications once they determine the controller's language proficiency; (3) Pilots describe ATC communications between users of the same and different languages; (4) Language switching distracts pilots and limits understanding, adversely affects situational awareness, leaves them with feelings of uncertainty, and increases their workload; (5) Language barriers most affect situational awareness just prior to top-of- descent and during taxi; and (6) How pilots compensate for reductions in situational awareness. We offer 16 recommendations to improve communication practices ranging from developing standardized and secure English language testing for use by all ICAO member states, to realistic emergency and nonroutine scenarios and simulations demonstrating use of conversational English to enhance datalink for surveillance and communications. |  |                                                      |                                                                                                                                                                                                                  |                                                                                                                                   |  |
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# CONTENTS

|                                                                                                                                                                                                                                                      |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| RESULTS .....                                                                                                                                                                                                                                        | 1  |
| Section 6: Non-Native English-Speaking Controllers Communicating With Native English-Speaking Pilots .....                                                                                                                                           | 1  |
| Q39. How would you characterize voice communications between international non-native English-speaking controllers and native English-speaking pilots? .....                                                                                         | 1  |
| Q39a. When you hear international non-native English-speaking controllers, what tells you whether they are high or low in English language proficiency? .....                                                                                        | 4  |
| Q39b. If you suspect an international non-native English-speaking controller's English language proficiency is low, what do you do to improve understanding? .....                                                                                   | 7  |
| Q40. How might native English-speaking pilots' communications with international non-native English-speaking controllers differ from that of pilots and controllers who speak the same language? .....                                               | 9  |
| Q41. During a typical international flight, about how much time do native English-speaking pilots and international non-native English-speaking controllers spend talking as compared with pilots and controllers who speak the same language? ..... | 11 |
| Q42. Do international non-native English-speaking controllers have to communicate differently with native English-speaking pilots than pilots who speak their local (native) language? .....                                                         | 12 |
| Q43. To what extent has hearing a non-native English-speaking controller switch between languages posed a problem for you? .....                                                                                                                     | 14 |
| Q44. Describe how your situational awareness is affected by changes in your ability to understand the language(s) being spoken over your communications system. ....                                                                                 | 17 |
| Q44a. When do changes in your ability to understand the language(s) being spoken over your communications system most affect your situational awareness? .....                                                                                       | 19 |
| Q45. What do you do to compensate for any reduction in situational awareness? .....                                                                                                                                                                  | 21 |
| DISCUSSION.....                                                                                                                                                                                                                                      | 24 |
| REFERENCES .....                                                                                                                                                                                                                                     | 29 |



## EXECUTIVE SUMMARY

This is the fourth report from a series of reports that presents the findings from in-depth interviews with 48 pilots who fly internationally for major U.S. air carriers. A second series of reports used the same format and questions with pilots who fly for Aeroflot, Alitalia, China Air, and LAN Chile airlines.

English language proficiency is a safety concern as noted by the International Civil Aviation Organization (ICAO 2004). Given that international flight operations are increasing, it is important to know more about the language experiences U.S. pilots encounter when flying into countries where English may or may not be the local or national language among their radio operators, air traffic controllers, and pilots.

Several major U.S. airline companies were asked to solicit volunteers from among their international pilots to serve as paid subject matter experts in a structured interview constructed to assess the language difficulties they encounter during international flights. There were 12 pilots from each airline, representing American, Continental, Delta, and United Airlines, for a total of 48 airline transport pilots (ATPs). These pilots were assumed to be representative of typical U.S. airline pilots flying internationally as to English language proficiency, familiarity with ICAO and aviation procedures, terminology, and standard air traffic phraseology. We limited the size of each interview to include no more than four pilots. There were morning and afternoon sessions that took place over several days at each company's preferred location.

The structured interview was divided into 10 sections: (1) Background Information, (2) Pre-Flight Preparation, (3) Air Traffic Control (ATC) Procedures, (4) Word Meaning and Pronunciation, (5) Language Experiences in Non-Native English-Speaking Airspace/Airports, (6) Non-Native English-Speaking Controllers Communicating With Native English-Speaking Pilots, (7) Language Experiences in Native English-Speaking Airspace/Airports, (8) Native English-Speaking Controllers Communicating With Non-Native English-Speaking Pilots, (9) Communication Problems, and (10) Technological Intervention. A copy of the interview questions appears in Prinzo and Campbell (2008).

The first report summarized the U.S. pilots' oral and written responses to the questions contained in Sections 1-3, the second report continued with Section 4, and the third report summarized the pilots' responses to questions in Section 5. This report continues with the U.S. pilots' responses to questions found in Section 6. It provides a wealth of information related to their flight experiences when communicating with controllers who speak English as a foreign language. It provides an overall description of how these communication exchanges affected their perceptions of safety, communications, workload, and situational awareness.

The pilots' answers to the questions and discussions during the interviews were their perception of the situations they encountered. Many stories were anecdotal and some were relayed in third person. The analyses of those discussions and written responses are summarized and presented as if from one pilot's diary containing a compendium of flight experiences. This was done to preserve the richness and integrity of the information given during the interviews.

The pilots listed 21 different non-native English languages that they heard during their international flights, with Spanish and French listed 22.60% and 19.86%, respectively. When asked about their overall non-native English-speaking language experiences, 21% reported their language experiences with controllers who spoke English as a foreign language could use some changes, and 31% said their experiences were not good enough for extreme conditions such as an emergency or avoiding weather. None of the pilots reported communications as extremely poor.

The pilots' responses had six major thrusts:

(1) Some non-native English-speaking controllers' English language proficiency may be inadequate for high workload conditions. The controller's English language proficiency becomes readily apparent during periods of adverse weather, heavy traffic, or when unexpected circumstances arise. Pilots had difficulty with some tower controllers' inability to understand that either their aircraft or another aircraft required emergency services. Likewise, when faced with adverse weather or volcanic activity, some pilots reported en route controllers could not communicate effectively with native English-speaking pilots (lacked English language skills). The added time-pressure, anxiety, and stressors during these times led some pilots to use Common English in an attempt to be understood. In the absence of complete bilingualism, some controllers' utterances became prone to errors and misunderstandings occurred. This in turn led to requests to have the message retransmitted, which also added more workload.

(2) Pilots develop and use different strategies to improve ATC communications once they determine the controller's language proficiency. They listen to the controllers' pronunciation and fluency to determine how proficient they are in speaking and understanding English. They also consider comprehension, grammar, vocabulary, and the controller's projected confidence (although to a lesser degree). When responding, pilots said they speak slower, more distinctly, clearly, and sometimes louder. All crewmembers listen closely to all messages, and they may turn up the volume. When the message is for them, the crew will say what they thought ATC said. If there is a lack of agreement, they transmit either

“Please repeat” or “Say again.” Rarely do they ask for a confirmation or verification of a specific element.

(3) Pilots describe ATC communications between users of the same and different languages. When pilots and controllers share the same language, communication exchanges seem more relaxed with very little lag time from the end of one message to the onset of a reply. They use shortened call signs, exchange salutations and pleasantries, and you hear occasional laughter. Some pilots thought more information was relayed between speakers of the same language in the same amount of time than between a native and non-native speaker.

Some U.S. pilots perceived non-native English-speaking controllers took longer to answer their questions because they were taking calls from local pilots first. Both the English-speaking pilot and non-native English-speaking controller slowed down their speech rates and kept their transmissions brief and concise, using ICAO phraseology. Radio discipline was the rule, rather than the exception. Controllers might be more inclined to ask local pilots to deviate from their route than foreign pilots. Talking to a foreign pilot in English could take more time and effort, create stress, and still result in miscommunication.

(4) Language switching distracts pilots and limits understanding, adversely affects situational awareness, creates uncertainty, and increases workload. When pilots enter into a foreign country’s airspace, they may hear the controller speaking in English and then communicate with a local pilot in their native language. This language-switching poses a problem for any pilot unfamiliar with the local language – a disadvantage because it is not easy to identify the controller from among the other speakers; when one speaker begins and another ends, it is often difficult to recognize words, phrases, or relevant information. More attention is diverted to listening to the radio than “aviating,” navigating, or performing station-keeping tasks. The pilots need to listen to the radio to understand how the conditions outside their aircraft may affect their flights.

By listening to ATC instructions, clearances, reports, and other information broadcast over their radios, pilots learn about the weather and traffic in their vicinity and develop expectations regarding their own communications with that controller. Failure to understand leads to a feeling of uncertainty. If one pilot is 30 miles in front of another aircraft and reports turbulence at 35,000 feet, then the pilots following may not want to remain at that same altitude. Knowing what is ahead allows them to request adjustments to their flights. Since the pilots do not understand the language, they can neither anticipate the turbulence nor request an altitude change to avoid a rough ride for their passengers.

(5) Language barriers most affect situational awareness just prior to top-of-descent and during taxi.<sup>1</sup> When pilots were asked to rank-order different phases of flight most affected by language barriers, their viewpoint involved threats to safety first and, for some, loss of employment second. It is during the top-of-descent that pilots are most dependent upon timely communications from ATC. It is at this time they receive their clearance and begin planning their arrival to the destination airport. They need to be fully cognizant of events that may impact their arrival, and communicating with controllers whose language skills are inadequate or who provide ATC services in multiple languages may jeopardize their situational awareness. When on the airport surface, in addition to scanning their instruments, completing safety checklists, and observing other aircraft movement, they might be copying a clearance from a heavily accented or less-proficient controller or listening to the controllers as they talk in their native language, both of which add to the workload and limit situational awareness.

(6) How pilots compensate for reductions in situational awareness. When we asked pilots what they do to compensate for any reduction in situational awareness, they said they conduct a complete and thorough ground and pre-flight preparation and review, increase their vigilance and attention, and apply their best practices to operational communication with ATC. All flight crewmembers are expected to draw on their experiences and help disambiguate ATC transmissions and contribute to situational awareness. Traffic collision avoidance system (TCAS) is an enhancement to situational awareness – pilots correlate ATC communications with other aircraft with the targets on their display and alert the controller, should any become a threat.

Finally, we present 15 recommendations derived from the pilots’ responses to the interview questions and discussions. They are: (1) Support standardized, consistent, and secure English language-testing standards for use by ICAO member states; (2) Develop realistic emergency and nonroutine scenarios and simulations that require controllers (and pilots) to demonstrate their use of conversational English. These scenarios and simulations should be added to existing or new instructional and training programs, as well as to refresher training; (3) Provide pilots with the opportunity to listen to ATC messages and conversational English spoken by non-native English-speaking controllers in English. Priming the pilots in the languages they will be hearing over their radios may facilitate decoding

<sup>1</sup> Pilots were asked to determine when changes in their ability to understand the language(s) spoken over their communications system most affected their situational awareness by rank ordering a list of 12 phases of flight from 1 = most affected to 12 = least affected. The list was derived from *Phases of Flight Definitions and Usage Notes* developed by Commercial Aviation Safety Team (CAST)/International Civil Aviation Organization (ICAO, 2006). Although the phrase *top-of-descent* was not included, the phrase *when preparing for descent – from cruise to either initial approach fix or VFR pattern entry* was.

and comprehension; (4) Expand ICAO Emergency ATC vocabulary and phraseology and create datalink messages beyond “PAN-PAN, PAN-PAN, PAN-PAN,” “MAYDAY, MAYDAY, MAYDAY” or “CONDITION RED MAYDAY, MAYDAY, MAYDAY.” When pilots declare emergency situations, they need a set of phraseology to adequately express to controllers what they need for ensuring a safe, efficient, and effective outcome; (5) Publish a common, universally accepted, and comprehensive aviation thesaurus by CAST/ICAO. It would include definitions of standardized concepts, vocabulary, phraseology, and procedures; (6) Provide Notices to Airmen (NOTAMs) in the native language and in English in a standard and consistent format for use by all ICAO member states; (7) Exploit datalink capabilities to provide pilots with enhanced situational awareness. In particular, instructions and clearances conveyed in the native language can be correlated with that aircraft’s flight identifier transmitted by automatic dependent surveillance (ADS) broadcast technology and displayed graphically and in real time using cockpit displays of traffic information (CDTI); (8) Develop a digital datacom message repository that pilots can access to review recent messages sent to other aircraft within a defined distance (to be determined). It would provide the same information currently available over their radiotelephony party-line communications, but it would be presented as text in English. This information could replace the information lost by language switching, help maintain situational awareness, and allow pilots to anticipate future clearances, instructions, weather, turbulence, traffic, and other developing events; (9) Develop new ICAO phraseology for pilot requests for ride reports. Pilot reports (PIREPS)<sup>2</sup> provide ATC with valuable weather information experienced by pilots during their flights that is relayed to ground weather stations. In the U.S., some of this information is shared with pilots who request a “ride report.” Ride reports do not exist in China and may not exist in other countries. Requests for ride reports are common in the U.S. Since there is no required phraseology, non-native English controllers are at a disadvantage understanding what information U.S. pilots are requesting.

Examples of some requests include, “How’s the ride sound today?” and “What kind of ride reports have you had on climb outs?” (10) Develop structured ATC phraseology for providing pilots with ride report information. In response to pilot-requested ride reports, U.S. controllers use a combination of aviation and Common English. Presently, if weather is not a factor, some controllers might convey that information using the following examples, “No complaints,” “Some deviations along your route,” and “It should be okay.” Again, non-native English-speaking pilots would be at a disadvantage understanding what was said over the party line. Any information related to a ride report should have a predictable format and structure; (11) Develop new ICAO phraseology for use when normal operations are disrupted. In particular, controllers need to know what the pilots need during these times. A review of off-nominal events may shed light for crafting standardized pilot requests; (12) Develop a universal dialect for spoken messages. Location names should have one agreed-upon pronunciation; (13) DataCom messages should be non-ambiguous to all pilots and controllers; (14) DataCom spoken and written messages should contain no more than two communication elements; and (15) Research studies are needed to determine whether issues exist in the interpretation and execution of spoken or written clearances and instructions. In particular, the following questions should be answered:

- a) Should pilots and controllers be provided with displays that present ATC messages in English only or English and their primary language?
- b) Should ATC messages be presented orally or visually as text/graphics, or both?
- c) How should ATC messages be presented to best capture the intent of the message to controllers and pilots?
- d) What is the best approach to convey the finesse of a flight operation (e.g., management of flow)?
- e) How do we test messages to ensure the intended action is executed by pilots and controllers who share the same, as compared with different languages, cultures, or both?

<sup>2</sup> PIREPs include reports of strong frontal activity, squall lines, thunderstorms, light-to-severe icing, wind shear and turbulence (including clear air turbulence) of moderate or greater intensity, volcanic eruptions and volcanic ash clouds, and other conditions pertinent to flight safety.



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# UNITED STATES AIRLINE TRANSPORT PILOT INTERNATIONAL FLIGHT LANGUAGE EXPERIENCES

*To effectively communicate, we must realize that we are all different in the way we perceive the world and use this understanding as a guide to our communication with others.*

— Anthony Robbins (American advisor to leaders)

This is the fourth in a series of reports derived from the responses made by 48 U.S. pilots about their international flight experiences during small, structured focus group interviews. It continues with question 39 and ends with question 45. These questions asked pilots about their language experiences with controllers who spoke English as a foreign language. The pilots were asked to imagine flying into a country where a language other than English was the primary language. Although controllers would speak English to them, they might speak to local pilots in their country's primary language. As a result, the U.S. pilots might hear several different languages on any given frequency.

The first report (Prinzo & Campbell, 2008) provided an analysis of the first three sections of the structured interview: 1) Background Information related to the recency of international flight experiences among the pilot-participants; 2) General/Preflight Preparation; and 3) Air Traffic Control (ATC) Procedures. It covered the U.S. pilots' responses and discussions of questions 1-23. The second report (Prinzo, Campbell, Hendrix, & Hendrix, 2010a) continued with U.S. pilots' flight experiences when word meanings and pronunciation became barriers to efficient and effective communication. It covered the pilots' responses and discussions to questions 24-30 in Section 4. The third report (Prinzo, Campbell, Hendrix, & Hendrix, 2010b) involved pilots' responses and discussions of questions 31-38 found in Section 5. It addressed their language experiences in non-native English-speaking airspace and airports.

Some of the questions asked pilots to select from among a list of alternatives that best reflected an aspect of their flight experiences and information to support their selection, while other questions asked them to provide examples or describe a particular event. When possible, the content was tabulated and presented in tables. Likewise, when their discussions of a particular question appeared to address similar topics with a shared issue or concern, we grouped them together and its core issue, or concern, was extracted and labeled. Topics within an issue, or concern, are presented alphabetically, as is the issue or concern.

The pilots' responses were combined, condensed, edited, and presented in the form of a narrative from the perspective of a hypothetical, albeit typical airline pilot with an ATP<sup>1</sup> certificate; redundancies were removed to

improve readability. As various times during the interviews, one or more of the pilots might be asked for additional information or to clarify some point during the discussions. In most cases, the question was asked of an individual pilot, but there were times when all the pilots in a group were asked, and it is duly notated in the text.

## RESULTS

### Section 6: Non-Native English-Speaking Controllers Communicating With Native English-Speaking Pilots

The questions in this section of the interview focused on the English language proficiency of non-native English-speaking controllers and how well they communicated with pilots who were native speakers of English. For example, a controller in Mexico might speak in Spanish to Aero México pilots and English to pilots flying for British Airways or Qantas Airways. We explored how the controllers' communications affected pilots' perceptions of safety, the communication process, and situational awareness.

#### 39. *How would you characterize voice communications between international non-native English-speaking controllers and native English-speaking pilots?*

As shown in Table 1, only 48% of the respondents indicated voice communications were either "excellent" (4%) or "very good" (44%), while 52% perceived it either "could use some minor changes" (21%) or was "not good enough for extreme conditions" (31%) such as an emergency or avoiding weather. None of the pilots reported communications with these controllers as "extremely poor."

#### Communication Is Excellent Explanation

##### *It Depends on the Area*

The controllers I deal with in Europe and in the North Atlantic are excellent. In fact, most non-native English-speaking controllers are excellent; but that can be attributed to the airports our Company flies to.

#### Very Good In Most Respects Explanation

Of the 21 respondents, 62% provided a rationale for their response selection. Those who did not indicated they had nothing new to contribute.

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<sup>1</sup> An Airline Transport Pilot

**Table 1.** Perceptions of Voice Communications Between Non-Native English-Speaking Controllers and Native English-Speaking Pilots

| Voice Communications                   | Number of Pilots | Issues Discussed                                                                                                                                                                                                                        |
|----------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Excellent                              | 2                | It Depends on the Area                                                                                                                                                                                                                  |
| Very good in most respects             | 21               | Controllers Make Effort To Communicate<br>It Depends Upon the Situation – Routine or Unusual<br>Multi-Language Frequencies<br>Some Places Are Better Than Others<br>We Complain, But It's Really Very Good                              |
| Could use some minor changes           | 10               | Different Dialects and Language Proficiency Affect Understanding<br>It Depends Upon the Country and the Situation<br>Universal Phraseology Is Lacking                                                                                   |
| Not good enough for extreme conditions | 15               | Controllers Lack Concept of Avoiding Weather<br>Controller Workload Increases<br>In Heavy Traffic, Forget Smooth Communication<br>Normal Situations Okay – Distress Situations May Not Be Understood<br>Situational Awareness Decreases |
| Extremely poor                         | 0                |                                                                                                                                                                                                                                         |

*Controllers Make Effort to Communicate*

I find that most controllers try hard to speak English intelligibly. I really think they want to do the very best they can and really try to adhere to ICAO phraseology, and it doesn't present a problem. When asked to "say again," the repeat is usually slower and more intelligible.

*It Depends Upon the Situation – Routine or Unusual*

All controllers are very good during routine communications. It's only when nonroutine events occur that we have problems getting controllers to understand that we may have to make a missed approach because our cabin crew is not ready to land, etc. Certainly, they don't deal with these situations every day; we don't deal with them everyday either.

Occasionally, when things get really tense, our excitement level may be higher, and we may lend ourselves to slang or nonstandard terminologies. That's when communication goes out the window. I think sometimes ATC does not understand we need to divert or must declare an emergency, and they'd probably rather hear us say "Mayday."

*Multi-Language Frequencies*

*Radio protocol lost*

An English-speaking pilot can ask a controller a question, and a lot of times another local carrier will interfere – just jumps right in – so we have to wait, and wait, and wait, and finally get an answer. That happens quite a bit; controllers will answer native pilots several times while English-speaking ones go unanswered.

*Everyone gets stepped-on*

The controllers do get "stepped on" a lot; and when there is a lot of conversation going on, that causes a little bit of a problem.

*Some Places Are Better Than Others*

The international controllers are very good in most respects. But how well they understand English depends on where it is – some places are better than others. Going into Canadian and Caribbean airspace is pretty good. Some areas we go through in South and Central America, maybe not quite as much.

*We Complain Although It's Really Very Good*

We fly to about 10 international destinations, use the same routes, and the same pilots tend to fly them, so it tends to be fairly standard. [The] same routes lead to few surprises. Routine communications are very good in most respects. I have never felt in jeopardy due to a language difficulty.

Because we live in a jaded world, we complain. I just don't see any issues in radio communication. We get the job done; we don't declare too many emergencies due to communications problems, and there certainly aren't any accidents most of the time.

*Using datalink for weather deviations*

*Interviewer:* How often in a 6-month period have you heard other crews use, or have you had to think about using emergency authority to get a clearance because of language difficulties?

That is a good question. I talked to a crew last week returning from Beijing that had to do exactly that. And I agree that the Datalink is a non-ambiguous way of communicating; it is in some ways slower.

When you have a weather deviation, you put in a request; and then you're sitting there waiting for something to happen. And if it doesn't happen quickly enough, you have to make a move and hope if you eventually have to declare an emergency, you will. If you're actually speaking with someone, you can say, "I've got to turn now."

*Interviewer:* But you have use of emergency authority, for example; because of communications problems, it's not used all that often.

No, but I would caveat that statement with the fact that the deviation is occurring without a clearance, and the backup is, "I'm going to say I'm using my emergency authority." But you're not using the word, declaring it over the radio, until someone requests, "Why are you where you're at?" Then you explain, "I had an emergency, I was getting too close to dangerous weather."

You don't typically throw the word emergency out when you're deviating from what you're doing without the clearance until you're questioned about it. If procedures were applied by the book properly, pilots would state the fact they are using an emergency authority to deviate from their current flight track. I think it would be documented much more frequently if it was done in that order, where the pilot declares an emergency before starting the deviation.

*Interviewer:* I have a question about using the datalink for weather requests. If there is a weather condition, what is an acceptable delay period for getting that information and what would exceed it?

It depends, probably about a minute. Your radar looks out pretty far, and you're using it to make these kinds of decisions. Sometimes weather changes quickly, or when you get in closer, you realize it is not giving you an accurate painting of the weather<sup>2</sup> – it's worse than you thought.

### **Could Use Some Minor Changes Explanation** *Different Dialects and Language Proficiency* *Affect Understanding*

We're all speaking the same language; we're just speaking different dialects of it and with different levels of proficiency. The degree to which we understand one another is going to determine how effective communications are. If both people are proficient and speak the same dialect, the level of understanding is going to be high; and safety enhanced. If they speak different dialects or a native English-speaking person speaks with a non-native English-speaking person, their dialects are probably different. The chance that they are going to get something wrong or misunderstand something becomes much higher.

#### *It Depends Upon the Country and Situation*

Not all controllers speak English well. We'll be talking to a Panamanian controller who speaks English

as though from the States – it's real clear that he understands us.

Sometimes we hear a controller who just doesn't say [a phrase] right, or has an accent that differs from the one from Panama, and that's okay, but does he understand? It's hard to know until we ask something out of the ordinary and then judge it from the response we get or don't get – we just have to be careful and resolve ambiguity.

But let's face it – when it's time critical or out of the ordinary, I'm not sure the message gets through. If ATC could expand vocabulary outside the ICAO ATC phraseology to include conversational English, then when we ask a question that's outside the norm, controllers might better understand our situation.

### *Universal Phraseology Is Lacking*

There needs to be more of a common universal phraseology in ICAO. Just as Chicago and the Northeast Corridor have their own procedures and way to do things – every country has its own nuances as well. Some use ICAO, some use ICAO with some parts of TERPS,<sup>3</sup> some use PANS-OPS.<sup>4</sup> It would be nice if they all used the same standard.

We need standard phraseology for all communications; terminology needs to be the same. I'd like a fix to be called a "fix." We're after the same thing in all languages. The French way of pronouncing versus the American, which is best? Just tell me how you want it pronounced, and I'll adapt to the standard.

### **Not Good Enough for Extreme Conditions** **Explanation**

#### *Controllers Lack Concept of Deviation for Weather*

I've found that when the operation becomes non-standard or the weather gets bad, some controllers cannot communicate effectively with native English-speaking pilots. Last year, I had a lot of problems trying to get around hurricanes and thunderstorms. The controller did not really understand exactly where we were and that there were other aircraft dealing with the same problem – and at one point I was concerned that maybe he mixed up who was who.

*Interviewer:* How were you getting a sense he was not getting what you needed? What did he do that would be evidence of that?

He was calling another flight back instead of us. And I don't know if he was just misunderstanding or something else; we really got the impression that he did not understand our location. We had just given a position report, and he had us in radar contact; it must have been radar contact because that made it even more a concern for us that he did not understand which aircraft was which. And deviations – in one

<sup>2</sup> The reader should also consider the possibility that inaccuracies may occur when pilots only receive limited instruction on the proper use of weather radar or make faulty inferences (see [www.cad.gov.hk/reports/main3.pdf](http://www.cad.gov.hk/reports/main3.pdf)).

<sup>3</sup> Terminal Instrument Procedures

<sup>4</sup> Flight Procedures (PANS-OPS, Doc 8168; ICAO, 2006) and the Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM, Doc 4444; ICAO, 2007).

minute he would say we couldn't and then the next minute he would clear us; but he would clear us in the opposite direction of where we wanted to go.

That's another case where TCAS is very valuable – to verify that you aren't interfering with offset traffic. Weather issues often are very challenging in foreign airspace.

### *Controller Workload Increases*

When there are only two airplanes it's not a problem. However, if there is a storm or something special going on and the controller is talking in the native language to local aircraft in the approach control corridor and everybody's maneuvering around the weather, it'll be really frustrating not knowing what is being said to the other airplanes. We're out there trying to figure out what's going on, "Am I going to be able to get to the airport? If there's weather, where is everybody else going?" We can't ask because we don't know what's happening and don't speak the local language.

An example is an arrival to Lima, Peru. Their radar was not very good; one aircraft is coming out from Lima on the same airway we're on coming in. They had to wait. ATC kept calling him for DME<sup>5</sup> – "What's your DME from Lima VOR?"<sup>6</sup> And we're coming in – "What's your DME from the Lima VOR?" We're not going to be able to descend until his DME is more than our DME.

That is not a problem if you can understand it in English; but if ATC is speaking Spanish to this guy and we're 68 miles from the airport and still at 33,000 feet – we're in for trouble. We know that because we see this guy on the TCAS.

### *In Heavy Traffic, Forget Smooth Communication*

Significant traffic volume, maintaining an arrival or departure, with significant weather requiring deviations around a standard path, is more than many foreign controllers can handle. The time delay between a request and a response sometimes is unacceptable. So, we declare over the frequency for everybody to hear – "We're coming left heading so and so to go around some weather; and we're at this altitude." The delay from completion of a transmission to comprehension of meaning can be significant during high tempo ops.

### *Unacceptable lag times*

*Interviewer:* When you talk about the time being unacceptable, what timeframe?

It depends, a lot of times it has to do with frequency congestion. The non-radar environment is where it has become necessary to do exactly that. In the Eastern Caribbean and Saint Lucia, where they're non-radar and there are build-ups, airplanes are moving around; ATC has us on a 4½-degree flight path at a steep descent angle to the runway, and we haven't

started the descent. In those types of situations, we're literally being blocked by other transmissions. Or, if we put the request in and have not gotten a response back in a minute or so, then it becomes an issue. We declare what we're doing at that point; we have a legitimate emergency.

### *Normal Situations Okay – Distress Situations May Not Be Understood*

I do not deviate from the flight plan with any non-native English-speaking controller unless it is an urgent situation. In normal situations – and that is 99.9% of the time – everybody's pretty happy; everybody gets what they want.

If we had an emergency and needed certain services, it would be difficult to communicate that in certain parts of the world. I would anticipate tons of trouble because there could be some pieces missing in the communication that could cause a serious problem.

I had an emergency in Mexico and it took 15 minutes to get it explained. We had hot brakes after an abort. A fire truck showed up but didn't see any fire, so it was leaving and we're telling the controller, "No, get them back here." We couldn't get across to him why we needed it to stay. We finally got our company operation personnel to call and explain in Spanish why they had to be there.

*Interviewer:* Was it the ground personnel that didn't understand or the tower controller as well?

The tower controller knew we had an emergency; but we weren't going up in flames so why did we need a fire truck? We couldn't explain the precaution to him.

In extreme conditions where the task loading is such that we have to do what we have to do – listening and trying to decipher communications is going to be low on my priority list. The higher priorities are flying the airplane, what we're going to do, and clearing everybody out of the way.

### *Situational Awareness Decreases*

It's not good enough for extreme conditions; when things break out of the normal ICAO structure non-native English-speaking controllers don't do very well. When they talk in their own language to local aircraft, English-speaking pilots lose the "big picture."

### *39a. When you hear international non-native English-speaking controllers, what tells you whether they are high or low in English language proficiency?*

Two subject matter experts<sup>7</sup> (SMEs) and the first author (Coder 1) independently coded the pilots' responses using *Doc 9835 Manual on the Implementation of ICAO Language Proficiency Requirements* (ICAO, 2004). Key words served to filter pilots' comments and remarks. For

<sup>5</sup> Distance Measuring Equipment

<sup>6</sup> VHF Omnidirectional Range

<sup>7</sup> One SME is an instructor at the FAA International Training Office, and the other provides aviation English training to controllers and flight personnel. All of the coders are very familiar with the language proficiency scales.

example, one pilot reported using how controllers pronounced words, while another pilot considered the verb tense and grammar of the controller's utterance. The key words "pronounced words" was coded Pronunciation, while "verb tense and grammar" was coded Structure. This process was performed on 94 pilot comments.

Coder 1 was unable to categorize seven of the comments into any of the six categories and added two more categories: Projected Confidence and Language-Switching. Coder 2 was not able to categorize two comments, while Coder 3 categorized all 94 comments. Presented in Table 2 are the percentages of agreement between the coders. Krippendorff's alpha (Hayes & Krippendorff, 2007) was computed to measure the agreement among the coders and it was  $\alpha = .81$ , indicating a high degree of reliability among them.

The eight different ways pilots tell whether a controller is high or low in English language proficiency, along with several examples of key words, are presented in Table 3. A chi-square test of goodness-of-fit revealed Pronunciation and Fluency were cited more often to determine if a controller was high or low in English language Proficiency,  $\chi^2(7) = 80.83$ ,  $p < .05$ .

## ICAO Language Proficiency Categories

### *Comprehension*

When ATC is questioned by an English-speaking pilot, I listen to whether or not the controller continues to repeat the same words and rigidly sticks to ICAO standard terms; if so, I know that we're going to have a problem. Also, how they reply to not-so-usual requests from the pilots and their ability to comprehend nonstandard jargon are indicators.

### *Fluency*

We listen to the cadence of their transmissions as well as the number of pauses in their transmissions, whether there is halting speech. Other aspects include timbre, inflection, emphasis, and speech rate. Typically, they speak very slowly and distinctly.

### *Interaction*

The amount of time it takes for ATC to answer an inquiry or whether we're just handed-off. If he says, "Standby," and asks his buddy what I just said – the time lag in responding is a good way of telling, and

so is how quickly he understands what I just said. If we ask them a question and they can respond very quickly, then I usually know that they know exactly what I'm talking about.

### *Pronunciation*

I can tell by their ability to properly pronounce English names and words, as well as their diction, accent, and the clarity of their spoken word. Another factor is how clearly they communicate their message. If I can understand without having to ask for a repeat, they probably are pretty good English speakers.

### *Structure*

Phraseology is another tip, as are correctness, sentence structure, and the use of proper English.

### *Vocabulary*

Whether or not controllers can change their answer and their ability to communicate outside of a standard clearance – that is, can they deviate from the canned radio calls?

### *What does "next" mean?*

One pilot provided an example using the phrase "next taxiway." In his example, he used the analogy of a calendar. Figure 1 illustrates the ambiguity with the word "next" regarding a meeting next Thursday.

Today is Monday, the 7th. If I tell you I'm going to meet you next Thursday, am I going to meet you on the 10th or the 17th?

Likewise, the same ambiguity can occur with instructions for the pilot to exit a runway. As shown in Figure 2, which taxiway should the pilot use when issued an instruction to exit the runway via the next available taxiway or to turn [right, left] next taxiway? Would it be the nearest taxiway or the one after that – the next one?

## Other Categories of Language Proficiency

### *Projected Confidence Speaking In English*

I listen for the confidence in their voices and the deliberateness of enunciation and pronunciation. Some controllers don't speak as forcefully, are uncomfortable with where they emphasize words,

**Table 2.** Inter-Coder Agreement Classifying Pilot Judgments of Controller Language Proficiency

| ICAO Categories of Language Proficiency | Percent Agreement |             |             |
|-----------------------------------------|-------------------|-------------|-------------|
|                                         | Coder 1 & 2       | Coder 1 & 3 | Coder 2 & 3 |
| Comprehension                           | 50%               | 100%        | 71%         |
| Fluency                                 | 91%               | 96%         | 96%         |
| Interaction                             | 71%               | 43%         | 25%         |
| Pronunciation                           | 94%               | 100%        | 94%         |
| Structure                               | 63%               | 88%         | 67%         |
| Vocabulary                              | 83%               | 100%        | 100%        |

**Table 3.** How Pilots Determine Non-Native English-Speaking Controllers' Language Proficiency

| ICAO Categories of Language Proficiency         | Percentage of Instances | ICAO Descriptors<br>(Level 6, Expert and Level 3 Pre-Operational)                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Comprehension                                   | 6.32%                   | L6 Comprehension is consistently accurate in nearly all contexts and includes comprehension of linguistic and cultural subtleties.<br>L3 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.                        |
| Fluency                                         | 25.26%                  | L6 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.<br>L3 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.                                    |
| Interaction                                     | 7.37%                   | L6 Interacts with ease in nearly all situations. Is sensitive to verbal and non-verbal cues and responds to them appropriately.<br>L3 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.                                                              |
| Pronunciation                                   | 36.84%                  | L6 Pronunciation, stress, rhythm, and intonation, though possibly influenced by the first language or regional variation, almost never interfere with ease of understanding.<br>L3 Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation and frequently interfere with ease of understanding.                                                                                                    |
| Structure                                       | 6.32%                   | L6 Both basic and complex grammatical structures and sentence patterns are consistently well controlled.<br>L3 Basic grammatical structures and sentence patterns associated with predictable situations are not always well controlled. Errors frequently interfere with meaning.                                                                                                                                                                  |
| Vocabulary                                      | 8.42%                   | L6 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.<br>L3 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. |
| <b>Other Categories of Language Proficiency</b> |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Projected Confidence                            | 7.37%                   | Their comfort-level speaking English                                                                                                                                                                                                                                                                                                                                                                                                                |
| Language-switching                              | 2.11%                   | How often they speak their native language                                                                                                                                                                                                                                                                                                                                                                                                          |

Today is Monday, the 7<sup>th</sup>. If I tell you I'm going to meet you next Thursday, am I going to meet you on the 10<sup>th</sup> or the 17<sup>th</sup>?

|          |          |          |          |           |          |          |
|----------|----------|----------|----------|-----------|----------|----------|
| <b>S</b> | <b>M</b> | <b>T</b> | <b>W</b> | <b>TH</b> | <b>F</b> | <b>S</b> |
| 6        | 7        | 8        | 9        | 10        | 11       | 12       |
| 13       | 14       | 15       | 16       | 17        | 18       | 19       |

**Figure 1.** When is Next Thursday?



**Figure 2. Where Is the Next Taxiway?**

and what words they stress. They don't speak loud enough when they are uncomfortable with what they're saying. It is an effort for them to say things, and we know they are working to put their sentences together. We hear anxiety in their voice.

### *Language-Switching*

I also listen to the way the controller is talking to the other aircraft either in English to all of them or in his native tongue. Also, how often they use their native language and hearing them effectively control non-native English-speaking pilots from other countries.

### *39b. If you suspect an international non-native English-speaking controller's English language proficiency is low, what do you do to improve understanding?*

Respondents' responses to interviewers' questions and compiled comments from the written and interview portions of the questionnaire were grouped into four major categories: (1) Message Reception on the Flight Deck, (2) Message Production From the Flight Deck, (3) Resolving Ambiguities/Doubts, Requests (4), and Contributions From Prior Knowledge. One respondent made no comments. The list of pilot actions is presented in Table 4. An examination of these categories revealed 46% of the pilot actions centered on Message Production From the Flight Deck, 22% on Message Reception on the Flight Deck, slightly more than 20% on Resolve Ambiguities/Doubts, and 5.75% each on Requests and Contributions From Prior Knowledge.

### **Message Reception on the Flight Deck**

I make sure everybody's on a headset or an earpiece to begin with, through the departure and the arrival phase. (An earpiece helps me understand better. It

takes out any technical static or anything that might be there.) Then, during the enroute phase, the speaker is always on so the other pilots can hear ATC too. I'll turn the radio up and concentrate on what ATC's saying, make sure we're both listening and hearing and have it repeated if we don't understand.

### **Message Production From the Flight Deck**

It's funny how sometimes we'll actually get louder and speak slower. Speaking louder does not reduce repeats. It's not as if they're deaf; but [everyone] has a tendency to do that, "Well you can't hear me, that's one reason why you can't understand me."

I may say my readbacks slower, more distinctly, and make them more easily understood than might be necessary if I was talking to New York or Boston Center. By saying it that way, I give him the opportunity to detect if I don't understand exactly what it was that he wanted to convey; so we check it on both fronts: I read back what I think he gave me; and if he verifies it, it's okay.

We speak Common English in the States, and everybody understands; so I think, "Okay, speak only in ICAO terms that they will understand because they are limited [in English proficiency]." They know air traffic control and they know ATC English; so speak ATC English slowly, clearly, and make sure they repeat it if there's any doubt at all.

*Interviewer:* You're saying be aware if they only speak very limited Aviation English?

Right, I've found that [non-native English-speaking controllers] know about "cleared for takeoff." They know about "climb and maintain." They may be unsure about "radar contact." They may not be able to speak to us about a unique occurrence. So, I just speak slowly and make sure I enunciate my words. I keep the questions very short and to the point. When

**Table 4.** List and Frequency of Pilot's Actions to Improve Understanding a Non-Native English-Speaking Controller Whose English Language Proficiency is Low

| List of Pilot Actions                                                          | Frequency Reported |
|--------------------------------------------------------------------------------|--------------------|
| Message Reception on the Flight Deck                                           |                    |
| Crew Resource Management                                                       |                    |
| Make sure every crewmember listens attentively                                 | 4                  |
| Confer with pilots on the flight deck about their understanding of the message | 4                  |
| Sensory and Attentional Resources                                              |                    |
| Listen more closely; Pay stronger attention; Listen attentively using headset  | 7                  |
| Turn up the volume                                                             | 5                  |
| Wear an earpiece or headset                                                    | 3                  |
| Message Production From the Flight Deck                                        |                    |
| Speech Production                                                              |                    |
| Enunciate, remove tension from my voice; speak clearly                         | 8                  |
| Speak slowly                                                                   | 13                 |
| Word Production                                                                |                    |
| Spell out fixes, waypoints                                                     | 2                  |
| Use the phonetic alphabet to spell fixes, waypoints, intersection names        | 6                  |
| Phraseology                                                                    |                    |
| Use only ICAO phrases, vocabulary, terms. Avoid slang, jargon                  | 10                 |
| Be succinct                                                                    | 5                  |
| Give full readbacks                                                            | 2                  |
| Readback what he said so his response is only affirmative or negative          | 2                  |
| Resolve Ambiguities/Doubts                                                     |                    |
| Ask for another controller, if necessary                                       | 3                  |
| Ask for clarification or verification                                          | 3                  |
| Make sure ATC repeats slowly fixes, clearances, transmissions                  | 13                 |
| Obtain confirmation of a repeated transmission or clearance                    | 2                  |
| Requests                                                                       |                    |
| Make your requests and questions short, standard, and simple                   | 3                  |
| Do not ask for direct routing, ride reports, or PIREPs <sup>a</sup>            | 3                  |
| Contributions From Prior Knowledge                                             |                    |
| Anticipate the clearance                                                       | 1                  |
| Be aware that they only speak ATC [ICAO] English                               | 1                  |
| Hope there's no emergency                                                      | 1                  |
| Make no assumptions                                                            | 1                  |
| Stay on expected route                                                         | 1                  |
| Try to comply exactly                                                          | 1                  |

<sup>a</sup> Pilot Weather Report. A pilot report to FAA air traffic facilities of meteorological phenomena encountered by aircraft in flight. See the *Aeronautical Information Manual § 7-1-20*, (FAA 2009).

I get an answer then I go to the next point. And then I use only ICAO ATC vocabulary.

### **Resolve Ambiguities/Doubts**

If I think the controller is having a problem, I listen more intently, slow down my speech, speak clearly, concisely, distinctly, and use standard ICAO terminology. I do not use the local name but use the phonetic spelling of the fix. And I don't add any extra information. We stay on the expected routing and accept that we're stuck on that route.

[If I'm not sure] I'll ask the guys sitting next to me what they thought the controller said. We ask for repeats until everybody understands the clearance. Occasionally we'll hear another pilot trying to comment on what the controller is trying to tell us.

*Interviewer:* Does that usually work after a couple of times?

Yes, it does. The controller will either slow down, speak more clearly, or we will. However, the bottom line is we all have to be on the same page about what it is we're supposed to be doing. I repeat his instructions back to him and allow him to interpret his instructions. "Do you want me to go here?" "Yes." "Do you want me to go there from right here, or do you want me to stay on route to go there?" I get to be more exact – "What do you want me to do?"

*Interviewer:* So, you're using conversational English for the clarification phrase?

I ask questions – not very in-depth ones. I try to use ICAO language. I talk slower and try to take any kind of tension out of my voice and ask for repeats, or "say agains," as necessary.

*Interviewer:* Generally, in the U.S., you'll say, "Say again," or "Verify heading," or "Was that ...," and you'll give a particular heading if that's what it is. Do you say the same type of phrase with a non-native English-speaking controller, or do you find a different way to get that point across?

I try to just use two words, like "Please repeat" or "Say again." If we try to elaborate, "Would you please say that again, or I didn't understand that," it is too much Common English.

*Interviewer:* If you read back incorrectly, would they assume, because you are the pilot, that it's okay – or would they correct you?

Domestically, I expect ATC to correct me if it is wrong; but outside the U.S., I wouldn't take that chance. In South America a lot of times, what a pilot says is golden and controllers pretty much let us do what we ask even if it's incorrect. I think some of it is their culture. That has caused a lot of accidents because I think pilots are asking for something sometimes that isn't safe, and ATC is not going to question our judgment.

### **Requests**

I've found it best not to ask for PIREPs or ride reports. That would be the kiss of death trying to say,

"What kind of ride reports do you have southbound on upper amber funkycratz?" Controllers are not going to understand.

### **40. *How might native English-speaking pilots' communications with international non-native English-speaking controllers differ from that of pilots and controllers who speak the same language?***

The responses from 46 pilots to the written questions appear in Table 5. Two pilots left the question blank and had nothing more to offer during the discussions. Approximately 35% reported Radio Communication Protocol Differs in a Multi-Linguistic Environment when compared with the communications between pilots and controllers who speak the same language. Another 20% mentioned differences in Speech Production. The responses of the remaining pilots were equally represented in Cognitive Aspects of Cross-Linguistic Communication (15%), Pilot Controller Interactions (15%), and Verification/Confirmation of Messages (15%).

### **Cognitive Aspects of Cross-Linguistic Communication**

The speed of communication and understanding is probably a comfortable pace for [pilots and controllers in their native language]; but then it seems like they really slow down when they speak English.

*Interviewer:* They have awareness then?

Right, it's fairly noticeable when they switch back from Chinese to English, that they slow down and speak a little bit differently, depending on their skill level.

It's always easier if the controllers are speaking their first language, as opposed to their second language. If two Spanish people are speaking English, they're going to understand each other better because they understand the dialect and accent better than a Spanish person who is speaking English to an English person. Same-language pilots and controllers tend to relax; they rapid-fire spit out the clearances. It takes more time for the non-native speaking controller to convert to English.

### **Pilot Controller Interactions**

Characterizing the difference between me talking to a Chicago controller and a non-native English-speaking controller – I can't freelance, which is very applicable to unusual situations, unusual clearances and requests. I must stick to ICAO communication standards in that situation where communication is difficult.

When pilots and controllers speak the same [non-English] language, we tend to hear shortened call signs. I'll hear the Spanish controllers talking to other Spanish-speaking pilots using jargon just as we do, rather than standard ICAO phraseology, and their tone is more casual and familiar.

If accent and terminology are the same – and some assumptions are understood such as, if a pilot and

**Table 5.** Perceived Differences in Communication Between Native and Non-Native English-Speaking Pilots and Controllers

| Categorical Differences                                                   | Items                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cognitive Aspects of Cross-Linguistic Communication (7)                   | Awareness and attention. Speed of communication and understanding. Easier for controllers to speak in their native language. Easier when both speak the same language and the level of understanding between them is better. It's much easier to get their points across with minimal transmission time.                                                                                                                                                                                                                                                                                          |
| Pilot Controller Interactions (7)                                         | More formal. Less nonessential communications. Extraneous conversations don't exist with different languages. Can't freelance in unusual situations/clearances/requests. There may be some reluctance to ask for clearances that may be hard to understand. Tone more casual and familiar in the same non-native English environment – lots of chatter and some laughing – I don't understand it, but it seems casual.                                                                                                                                                                            |
| Radio Communication Protocol Differs In Multi-Linguistic Environments(16) | Native speakers [of English] will normally speak more slowly and try to enunciate clearly any transmissions, eliminating jargon foreign to non-native English-speaking controllers. Speak in ICAO standard terminology, in a clear, concise tone without additional comments, short and to the point. Less use of slang, off the cuff remarks, no pleasantries. Most languages do not translate exactly word-for-word. Subtle differences in meaning can creep in. Same-language pilots and controllers will use "slang," but others will use standard. Shortened call signs, more use of jargon. |
| Speech Production (9)                                                     | Difference in accents and phraseology used. Speaking rate is slower. Speak more clearly and deliberately. Say each number – Delta one two three vs. Delta one twenty-three.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Verification/Confirmation Of Messages (7)                                 | We ask short and precise questions. More frequent repeats, speak more slowly. Don't make out of normal requests. More need for repeat and clarification. We, as native English-speaking pilots, can cause the same difficulties for controllers/pilots as they do for us.                                                                                                                                                                                                                                                                                                                         |

controller speak the same language, they're probably from the same culture and from their upbringing, will know culturally what is meant. I think the assumptions sometimes [between pilots and controllers] from countries are really different; it can be kind of a barrier.

### Radio Communication Protocol Differs in Multi-Language Environments

Radio discipline is maintained more with mixed languages, while pilots and controllers who speak the same language will add greetings like, "Good morning," or "So long." They will use slang and off-the-cuff remarks like, "Hey, who's winning the World Cup?" If we say, "Bon jour" in France, controllers will come back and say something in French. The more you say, the more there is a chance for error.

#### *There's Trouble Outside of Standard Phraseology*

How much trouble do you want to create for yourself? If we're getting a few bumps at our altitude, we'll probably wait it out. We'll keep nonstandard or non-required communications to an absolute minimum. In the U.S., we tend towards slang sometimes; and that cannot enter into the arena when everybody speaks a different language. We really need to use

the standard terms, the standard phraseology, give them in the same order, and speak slowly and clearly to make the communications work.

#### *Jargon, Slang, and Buzz Words*

We're warned against using slang or jargon in any country. When communicating with international controllers, we're told to carefully choose our wording; use nothing that can be misconstrued, avoid words like "emergency" and "burn." Watch our speech rate; don't use slang or nonstandard ICAO terms; don't say "oh" for "zero" or "point" for "decimal." Use standard ICAO terms (something they are trained in; and, hopefully, the U.S. will be [ICAO] someday).

### Speech Production

An example – we hear "American ten sixty-four" call-in to a U.S. controller, but it is "American one zero six four" to the Mexican controller. We hear Aero Mexico call-in as "Aero Mexico eight sixty-four" to the same controller. So obviously, it's easier for those who are native to the same language, and it takes more time if one is a non-native English-speaker because they use more words and speak slower.

**Table 6.** Pilots' Perceptions of Time on Frequency Communicating Between Native and Non-Native English-Speaking Pilots and Controllers

| Time Spent Communicating | Number of Pilots | Issues                                                                                                                                               |
|--------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Considerably more time   | 1                | No Comment                                                                                                                                           |
| More time                | 16               | Repeats and Slowed Cadence<br>Same Language-Many Transmissions/Native English-One Transmission                                                       |
| About the same           | 8                | Radio Traffic Too Heavy for Chatting With Anyone                                                                                                     |
| Less time                | 16               | Native English-Speaking Pilots Make More "Say Agains"<br>One Language May Require More Words Than Another<br>Same-Language Speakers Communicate More |
| Considerably less time   | 7                | Native English Speakers Check-In, Check-Out<br>Same-Language Speakers Communicate More                                                               |

### Verification/Confirmation of Messages

*Interviewer:* You said it's easier for controllers to speak their native language than English; but in terms of how you handle it, you speak in a slow, clear, standard manner. Is that more or less what you do?

That's more or less what we do. I always ask a question if I'm not completely sure of what he wants; I always ask, "What do you want, where?"

#### 41. *During a typical international flight, about how much time do native English-speaking pilots and international non-native English-speaking controllers spend talking as compared with pilots and controllers who speak the same language?*

Respondents' compiled comments from the written and interview portions of the questionnaire are included below. As shown in Table 6, only one pilot reported English-speaking pilots spent "considerably more time" communicating with non-native English-speaking controllers, compared with pilots and controllers who spoke the same language. Another 33% reported that "more time" was spent, 33% reported it as "less time," and 15% as "considerably less time." The remaining 17% reported the time to be "about the same" regardless of language pairing.

### More Time Spent Communicating Explanation

Twelve of the 16 respondents (75%) provided comments, of which four either misunderstood or misread the question. One pilot reported he was not sure what they talk about, and another said that although he did not time them, it seems more time occurred between non-native and native.

#### *Repeats and Slowed Cadence*

It takes more time between the native English-speaking pilot and the non-native English-speaking controllers than between the pilots and controllers of the same language because the native English speakers are constantly asking them to say again and

repeat. The frequent requests for repeated transmissions and complex clearances take probably twice as much time. Short clearances with one instruction – an altitude assignment or heading – take about the same amount of time for all.

#### *Same Language-Many Transmissions/ Native English-One Transmission*

When I'm hearing Spanish-to-Spanish clearances, voice communications tend to be multiple clearances or multiple transmissions in the same amount of time that it takes us to make one transmission and receive one transmission. They might have two, three, or four go back and fourth to our one, because it's easier for them to talk in the same language. And then we have all the repeated radio calls to clarify a transmission; that's just the nature of the beast.

We do not fly into high-traffic environments. I could be on a frequency with only one or two other airplanes, and it's not uncommon to hear them speaking in Spanish. There are times when we'd like to get a word in but can't get on the frequency.

### About the Same Time Spent Communicating Explanation

Of the eight respondents who selected this response, 87.5% commented.

#### *Radio Traffic Too Heavy for Chatting With Anyone*

It's just too busy up there and too much going on, so the chitchat among two native speakers versus a non-native speaker and an English-speaking controller has diminished over the years to more or less pure business communications. There are the same number of regular transmissions going from a Continental flight inbound as for a Lufthansa flight inbound. As long as they're speaking English to other foreign carriers, whether it's Lufthansa or United, they spend about the same amount of time talking to each airplane. It is about the same as long as the transmission is understood. If there is a long pause after a transmission, then it's going to take some time.

### **Less Time Spent Communicating Explanation**

Approximately 81.25% of the 16 respondents offered explanations for their selections.

#### ***Native-English Speaking Pilots Make More “Say Agains”***

It probably takes more time with native English-speaking pilots to non-native English controllers because we’re asking for repeats and trying to be accurate. I’ll typically hear non-native English-speaking controllers carry on conversations with native non-English speaking pilots and will have no idea what they’re talking about.

#### ***One Language May Require More Words Than Another***

Maybe their language uses more words to express the same thought. Long running conversations with pilots and controllers speaking the same language is not common with English-speaking pilots. With us, non-native English-speaking controllers mainly stick to canned and necessary communications for air traffic control.

#### ***Same-Language Speakers May Communicate More***

If [a controller] gives what I think might be the same clearance given to us to a local pilot, it seems to last about three times longer. I don’t know if they are more verbose or more nonstandard. I can’t really tell, but it’s just the time the transmitter is keyed sounds like less time is spent with me than with him.

It appears that there are more communications among native-language speaking [controllers] to their native language cohorts. They speak to each other in their native language maybe about the nuances of the weather and may be more inclined to add a greeting, a goodbye, or a comment – “Is Joe working the other sector today?”

Non-native English-speaking controllers have to really keep it simple [with us]. We do not usually discuss complex nuances of weather, etc. There is less jargon, greetings, and “chit-chat” when I’m talking to them.

### **Considerably Less Time Spent Communicating Explanation**

Of the seven respondents who thought non-native English-speaking controllers spent considerably less time communicating with native English-speaking pilots, 71% provided comments.

#### ***Native English Speakers Check In, Check Out***

I check in, check out – end of story. I make my point quickly and receive my clearances. It’s less fatiguing for me. No “chit-chat” means less fatigue.

#### ***Same-Language Speakers May Communicate More***

When language is a barrier, I interact less with the

non-native English-speaking controllers and rely more on weather radar, company dispatch, or ear-to-ear with other aircraft. I’m not able to get the same type of information as I do from native English-speaking controllers. I think when they’re speaking with their own pilots, they have a familiar way of speaking and may add some colloquialisms.

If I speak the local language, many times I add something to break the ice. I’ll say, “Bon jour [Air Carrier] zero eight six one level three seven zero.” And they’ll come back with “Merci.” Maybe it’s not a good thing to do; but it seems like they talk more to their own pilots and very little with us. If language proficiency is minimal, extraneous conversation adds confusion.

Flying over the Arabian Peninsula, we hear one of the PATCO<sup>8</sup> guys on the radio, so we relax and can communicate more with him. There’s no misunderstanding. That’s not the case when we’re talking with a non-native English-speaking controller.

#### ***42. Do international non-native English-speaking controllers have to communicate differently with native English-speaking pilots than pilots who speak their local (native) language?***

As shown in Table 7, 48% of the pilots reported “yes,” there were differences in how international non-native English-speaking controllers communicated based on the language spoken by the pilot, 6% agreed but limited their responses to “sometimes” differences occur. Another 23% were either “uncertain” or said “no,” they did not believe there were differences. The remaining 23%, although they left the question blank, from their discussions it appeared that they agreed with the pilots who reported differences.

#### **Yes, International Non-Native English-Speaking Controllers Have to Communicate Differently**

Twenty-three pilots reported differences occurred at least sometimes in the communication process.

#### ***Brief and Concise to Us – Longer and Faster to Natives***

I think controllers use slang, accents, and speed when speaking to local pilots in their native language. It would be easier for the pilots to understand. I think communicating is different because of the length of their communication and the amount of time they talk.

I found that controllers do not answer our questions. They must speak more slowly, concisely and deliberately to an international group that is flying through their country just as we do with them. The communication process is different between what you’re accustomed to hearing and saying, versus being able to converse in a foreign language.

<sup>8</sup> Professional Air Traffic Controllers Organization – The Union representing U.S. air traffic controllers during the 1981 strike from which President Reagan fired the striking controllers who failed to return to work – many went to work for non-U.S. air traffic services.

**Table 7.** Pilots' Perceptions of Communications Between Native and Non-Native English-Speaking Pilots and Controllers

| Response            | Number of Pilots | Differences in Communication Practices                                                                                                                                                                     |
|---------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Yes                 | 23               | Brief and Concise to Us – Longer and Faster to Natives<br>No Common Accent, Dialect, Slang or Jargon<br>Slower Speech Rate<br>They Can Speak Their Common Language<br>They Put Us on Different Frequencies |
| Sometimes           | 3                | It Depends on the Local Pilot's English Skills                                                                                                                                                             |
| Uncertain           | 6                | I Think They Limit Communication to Essentials Only                                                                                                                                                        |
| No                  | 5                | It Should be the Same as What They Say to Us, Just Easier                                                                                                                                                  |
| No Written Response | 11               | Comfort In Your Native Language<br>Higher Workload Requires More Effort<br>Speech Rate Slower<br>Translation Takes Time                                                                                    |

*No Common Accent, Dialect, Slang, or Jargon*

A controller cannot use local slang or jargon with native English-speaking pilots because we won't understand what the controller said. Also, since we don't share a common accent or dialect, I don't understand a word I just heard quite as clearly as from a controller who says that word the same way as me.

*Slower Speech Rate*

I find that controllers whose speech rate is slower understand that to speak fast to us will lend itself to confusion. They want it done right the first time, so they speak slower to me in English than they would to a native pilot in their own language. Controllers who speak more slowly and enunciate will not have to make repeated radio calls and be challenged with pilots who ask, "What did you just tell me?"

*They Can Speak Their Common Language*

I can tell a Chicago controller, "The captain tells me I have 10 minutes and we're going to have to proceed elsewhere; am I going to make it by then?" If we ask that question to Magadan control,<sup>9</sup> we're not going to get the same kind of answer. So, if a French pilot is talking to a French controller, I would guess the same off-the-page type of communication can occur that I have in Chicago. Then the French controller would have to use ICAO standard terminology for me to understand, but the fine details will not be communicated.

*They Put Us on Different Frequencies*

Going to Europe, I think they actually put non-native English-speaking pilots on different frequencies than the English-speaking pilots. We're all going to one frequency, and we're all going to hear each other. I think they do that for a reason, and I'm not sure what that reason is.

**Sometimes International Non-Native English-Speaking Controllers Communicate Differently**

Three respondents reported Sometimes. All of them provided comments during the interviews.

*It Depends on the Local Pilot's English Skills*

Sometimes there are differences that we need to clear up, but it's not something that's a real problem. When English is a problem [for a local pilot], controllers revert to their native language. It seems like they speak quickly to get it done, but they have to communicate in English with us.

**I'm Uncertain Whether International Non-Native English-Speaking Controllers Communicate Differently**

Three respondents reported that the controllers probably communicated differently with pilots who spoke their language compared with how they communicated with native English-speaking pilots. Although initially unsure, during the discussions they also identified differences.

*I Think They Limit Communications to Essentials Only*

The reason that I was kind of wishy-washy about my response was because I do not know what they're saying to each other, since it's not in English. But I would assume it's about the same [as between an English-speaking controller and pilot].

When speaking to us, it does change to just essential communications. They probably would be less inclined to ask me, as a non-native language pilot in their country, to deviate, or to go out of my way with a nonstandard clearance, than they would with pilots they knew could communicate clearly with them. They would have to think about how to say it perfectly to us, versus to a pilot who speaks their language.

<sup>9</sup> Magadan is located in Northeastern Siberia.

## **No, Do Not Believe International Non-Native English-Speaking Controllers Communicate Differently**

Of the five respondents who did not believe there were differences, two said we should ask the controller, while the others did not know what their languages entailed or what they were saying in their native languages. Although it appeared to be easier for them to communicate in their native language, the pilots did not believe there should be anything different in how they communicate.

## **No Written Response to the Question**

Although 11 respondents did not provide a written response, they did discuss their experiences. Based on their discussions, it would appear they perceived differences in the communication practices between international non-native English-speaking controllers and native English-speaking pilots, as compared with pilots who spoke the local language.

### *Comfort in Your Native Language*

Non-native English-speaking controllers ask us [questions] if they have to; and I would say that if they don't have to, they won't. It's just a matter of comfort using one's own language.

### *Higher Workload Requires More Effort*

I've found that it is harder for non-native English-speaking controllers to communicate in English, especially during times of higher workloads because they have to concentrate on slowing down their rate of speech and making sure that we understand. Their pilots would have the same problem coming into our airspace as we do going into theirs. We do try to make sure we understand and do what they expect us to do. I think it is hard for them to deal with us.

I think non-native English-speaking controllers communicate in their native language when they deem it to be appropriate. But in most of the high-density international arrivals and departures, they try to speak the same [to us as they do local pilots]. If I can't understand the language being used, it's a safety of flight issue.

### *Speech Rate Slower*

Well, now that I think about it, maybe they do tend to speak English slower and more clearly to the non-English speaking pilots. The differences are real subtle, but they exist. Maybe it's more of an effort for them to speak English, since it is their second language. We've got to realize that they're speaking English now, but may not be used to it. We need to slow it down, and make sure the pronunciation is there.

### *Translation Takes Time*

I tend to think non-native English speakers have to talk more slowly and think about the clearances because now they have to think, translate, and speak in English and then hear, translate, and understand what we said. So, I think it takes more time to do that. If they are disciplined, they will attempt English with all the pilots. If not, the only English spoken will be to English-speaking pilots.

## **43. To what extent has hearing a non-native English-speaking controller switch between languages posed a problem for you?**

As seen in Table 8, only 6% of the pilots reported language-switching as not being a problem for them, while 40% reported it as a problem to a "moderate" or "greater extent." The remaining 54% said it was a problem "to a limited extent." Their discussions focused on issues ranging from "it's annoying" to reductions in situation awareness where safety degrades.

## **To a Great Extent Explanation**

I consider the situation more severe than my colleagues do. I think it really decreases situational awareness.

## **To a Considerable Extent Explanation** *Radio Protocol Lost*

The fact that we don't know when [pilots and controllers who speak the same non-English language] are done with a conversation can result in everybody stepping on each other.

### *Reduces Situational Awareness*

When I hear non-native English-speaking controllers speaking in their native language, it reduces my situational awareness because I don't know when the communication begins and when it ends. I know when they say, "[Air Carrier] one two three" that they're talking to me and when they say, "[Othership] one two three" that they're talking to someone else. But, if I hear a non-English language being spoken, I don't know what they're saying, so I must listen because it may come back to me.

## **To a Moderate Extent Explanation**

Of the 16 respondents, 94% participated in the discussions.

### *Mixed Languages – Spanglish*

When controllers start switching between languages, it's hard for them to make the change completely because many times, I hear what comes out as "Spanglish."<sup>10</sup> Then I have to guess. Is he talking to me? If he switched to his native language due to stress – that is not good.

<sup>10</sup> Spanglish is the transformation of English words into Spanish ones among bilinguals. For example, "norsa" for "nurse," instead of the standard Spanish "enfermera."

**Table 8.** The Extent to Which Language-Switching Poses a Problem for Pilots

| Alternative              | Number of Pilots | Issues                                                                                                                                                                                                                                  |
|--------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| To a great extent        | 1                | Really Decreases Situational Awareness                                                                                                                                                                                                  |
| To a considerable extent | 2                | Radio Protocol Lost<br>Reduces Situational Awareness                                                                                                                                                                                    |
| To a moderate extent     | 16               | Mixed Languages – Spanglish<br>Situational Awareness Lessened<br>The Frankfurt Incident<br>There Is a Communication Barrier                                                                                                             |
| To a limited extent      | 26               | It's Annoying<br>Knowing a Little of the Language Helps<br>Languages You Don't Know Are Distracting<br>Low English Proficiency May Impact ATC Duties<br>Reduced Situational Awareness – Degraded Safety<br>Requires Increased Attention |
| Not at all               | 3                | It's a Minimal Impact Proficiency<br>Know the Language or Blank It Out<br>Linguistic Ability Equals ATC                                                                                                                                 |

### *Situational Awareness Lessened*

When controllers speak to pilots in their native language, they're not offering us an important piece of the equation when they switch back and forth between languages. When they issue a clearance in their own language, we don't know if they just issued a heading or an altitude, and I cannot use what I've heard for traffic avoidance and traffic awareness. Our situational awareness is degraded, or may be compromised. It's not a comfortable feeling – I like to know where everybody is and how our flight is situated.

I don't think it makes my job any less safe, but we can't get an inference from what they're doing to know how they're going to handle us, especially if they're speaking in their native language to the aircraft that's in front of us, behind us, or next to us.

### *The Frankfurt Incident*

I originally said "not at all," but because of something that transpired the other day, I realized that [language switching] did cause a problem when controllers spoke English to us and their native language to another carrier. Coming into Frankfurt the other morning, we were cleared to intercept the localizer at 8,000 feet. The controller was talking to everybody in English and cleared another aircraft to 4,000 feet before glide slope intercept. I'm watching the glide slope come down and we're not getting cleared to 4,000. All of a sudden, he's talking to Lufthansa air cargo in German – they're not speaking English. I look at the TCAS and realize that he is talking in German because I've got an MD11<sup>11</sup> underneath me.

The pilot was supposed to go to the right runway, but he overshot to the left runway. The controller came back and asked us if we were able to get down

from there because the MD11 is below us. So, it's gear and flaps for us to slow down; he's speeding up and sliding over, back to the right runway. Had the controller continued to speak in English to that pilot instead of switching to German, we'd have known the position we were in earlier and could have been better prepared.

In fact I'm unhappy and wondering why they aren't letting me down. So that did cause us a problem, at 8,000 feet, throwing out gear, flaps, and slowing down to 160 knots to try to keep the separation. The runways in Frankfurt are close together, so aircraft can't be wingtip-to-wingtip on parallel approaches. I think you've got to have aircraft staggered by three miles. It happens rarely but that's why when they switch from English to speaking in their native tongue to somebody; I'm looking for somebody who did something wrong.

*Interviewer:* At 8,000 feet, did you intentionally slow down to 160 knots, or were you told to slow?

We were told to slow. ATC wanted more separation. If we couldn't slow, since he was lower, he would get to land, and we would go around. So we slowed to 160 knots, and then they came back and said we could accelerate back to 170 knots. So we went from flaps 20 to flaps five – less drag on the airplane at that point. But, it was at that point we not only had to slow down, we still had to get down to 4,000 feet to catch the glide slope, which had already gone by.

*Interviewer:* And that added to your workload at the same time?

Yes, everybody was really working together, and the cargo guy was trying to do what he could do. The controller was trying, too. If he had continued to speak in English, we would have known about the traffic. If the guy had said, "Okay cleared to intercept

<sup>11</sup> Type aircraft.

runway seven left,” I could have said, “I thought you cleared him to seven right” – and it’s “oops.” But by that time, he’d already gotten over there – because I didn’t understand what they were saying in German – he had either overshot or misread the instructions and the controller thought he said left when he said right, or vice versa. But he was where he shouldn’t have been.

*Interviewer:* And without TCAS would you have stayed at 8,000 feet?

Yes, they would not have cleared us. They did not clear us until we intercepted the glide slope; and they had cleared us to intercept the localizer, which was the horizontal path, but not the vertical path. They hadn’t cleared us for the approach, only to intercept. Had they cleared us for the approach, we would have started down and been on top of the other aircraft. If I misinterpreted what he said as cleared for the approach, we would have armed the glide slope. When it locks in, we would have started down – which would have caused a big problem. And a lot of times, they clear pilots for the ILS<sup>12</sup> approach in two separate transmissions. First, we intercept the localizer then they clear us to intercept the glide slope – as opposed to how we do it in the States. Under these circumstances, it could have gotten nasty. Without the TCAS, we wouldn’t have known he was out there. We had lost contact with the other aircraft; we heard it report ahead of us, but once he spoke German, we didn’t know where he was going.

### *There Is a Communication Barrier*

It’s not a problem, per se, that he’s speaking in two different languages, but it is a concern that I’m not aware of clearances given to other aircraft regarding altitudes, aircraft ride reports for turbulence, and frequency changes. It’s a communication barrier. I’m not even sure they will understand if I ask for a ride report. Pilots generally ask other pilots for ride reports, but it eventually lessens situational awareness.

### **To a Limited Extent Explanation**

Approximately 77% of the 26 pilots discussed their responses.

#### *Accents*

I’ve noticed that the controllers’ accents become thicker when switching back to English after they’ve spoken their native language to somebody else.

#### *It’s Annoying*

From a communication standpoint, I find it annoying, but not really a significant factor.

#### *Knowing a Little of the Language Helps*

There was one incident I was involved in while in the Air Force. We were dumping fuel in an emergency, and the controller cleared a Spanish airline into our airspace and our altitude – in Spanish. I caught it

and said, “Hey, do you realize that we’re over here?” “Oh yeah, we’ll go somewhere else.” So that was a case where, with my limited Spanish, I understood what he was saying and stopped an incident. Not understanding what a controller says in his native language could be a hazard to flight.

### *Languages You Don’t Know Are Distracting*

It’s moderately distracting since I do have to listen to that conversation even though I do not understand. If he’s talking, I’ve got to listen or I could miss a call that is actually for us because it’s the same voice, same pitch, and accent. But in a high workload environment, it might cause us to not pay attention to the checklist, the configuration, or the FMC<sup>13</sup> programming.

### *Low English Proficiency May Impact ATC Duties*

Controllers who switch from their own language to English and back again have to switch gears, and a lot of times they have to start thinking about what they’re going to say if they’re not terribly proficient in English. So there might be a delay in a clearance, an assignment of heading, or something like that. Generally, it is not too much of a problem in a normal traffic flow.

### *Reduced Situational Awareness – Degraded Safety*

Being left out of the loop gives me an uncomfortable feeling, especially in terminal areas. We need to understand what’s in front, around, and behind us in English. So, it does decrease situational awareness in regards to other aircraft – their clearances and requests. When controllers and pilots talk to each other in their own language, it can cause a breakdown in communication and in the safety net because if there was a mistake in their conversation, I would not know if it affects us.

I heard a story of a guy catching something where there would have been a conflict. It’s pretty rare now with TCAS; however, an increase of situational awareness is a good thing any way you look at it. Without TCAS, it gives you less situational awareness and that can degrade safety.

### *Requires Increased Attention*

I find that I use a little more attention if controllers talk in their own language and then skip right away to our call sign. Sometimes we might actually think a different controller is talking as he switches languages or that it is two non-English speaking pilots talking to each other over the radio. It can be hard for us to identify who’s actually speaking.

### **Not at All Explanation**

#### *Linguistic Ability Equals ATC Proficiency*

I’m just in awe of anybody who can think that fast. It helps with situational awareness in the terminal area, especially if he’s talking to [a pilot] who can pick out a particular altitude or fix that they are at. So it helps if the controller can shift back and forth.

<sup>12</sup> Instrument Landing System

<sup>13</sup> Flight Management Computer

It gives me confidence in his level of proficiency if he can think and speak that quickly.

#### ***Know the Language or Blank It Out***

Because of my language ability, I understand almost all the controllers everywhere I go; it doesn't present a problem for me. But by the same token, if they start speaking in a language I don't know, I blank it out because I know I can't understand what he's saying and I don't care, because it doesn't apply to me. Actually, it presents more of a problem for me when I understand what he's telling the other guy because it just automatically registers, but when they switch to a language I don't understand, it is not a problem at all.

#### ***Minimal Impact***

It doesn't really impact me. I can't understand what he says. He just finished speaking to a pilot in the native language, and now he's speaking English to me. Do I need to be let in on their conversation? The only question is – where's the other aircraft?

#### ***44. Describe how your situational awareness is affected by changes in your ability to understand the language(s) being spoken over your communications system.***

The pilots' responses from the written and interview portions of the questionnaire are summarized below. As shown in Table 9, their contributions were organized into 10 different, albeit related, themes, ranging from it being a non-issue to a hazard to flight.

#### ***Decrease in Normal Operation***

When we don't understand, there is a decrease in the normal operation of the airplane because we have to take time to make repeated radio calls – "I call you back." We sit there waiting when we should have begun our descent 10 miles ago. Now our airspace is compressed, and we're getting into a problem. These types of difficulties take time away from duties that help maintain our situational awareness, especially during descent to landing when we need to brief approaches and calculate descent profiles.

#### ***Hazard to Flight Reported in Local Language Instead of in English***

A pilot may report a hazard to flight in a foreign language, and the controller may not pass it on in English. That is information that I'm not privy to. I could be missing important data relative to the location of that aircraft or reports by other pilots that might be nice to know but I can't understand – such as a plane slid off the runway. We all incorporate that information to build the bubble of airspace around the airplane we're operating. Things like that should definitely be stated in a manner where everyone can understand exactly what's being said.

#### ***High Workload Times Affects Situational Awareness the Most***

It's been my experience that it is a considerable distraction. Sometimes the pilot not flying can't understand the controller, so the pilot flying has to answer for him, and that increases workload. Situational awareness goes down because we're spending more time concentrating on when they're going to switch from speaking their native language to English.

It's obviously the high-workload environment where more communication problems are taking place than need to take place. For me, it's when we're taxiing out and taxiing in because both the pilot and controller have a high workload. There's more aircraft on the frequency and more direct contact with the controller than during preflight, so there's a higher chance of error.

The times most affecting our situational awareness are the high-workload times that crowd out the time to deliberately listen to any controller – and that would be takeoff and departure for me. It takes my attention away from my primary duties of what I want to do, and I have to focus it all on what they're trying to say.

It seems to me that the highest chance for error in communications is when I'm starting with my descent through approach. There's so much going on during that time such as having to make more responses and having direct contact with the controller. Also, there is more traffic and that causes more communication on the frequency.

**Table 9. Changes in Pilot Situational Awareness Due to Changes in Language Understanding**

| <b>Ways Situational Awareness Is Affected by Changes in Language Understanding</b> |
|------------------------------------------------------------------------------------|
| Decrease in Normal Operation                                                       |
| Hazard to Flight Reported in Local Language Instead of in English                  |
| High Workload Times Affect Situational Awareness the Most                          |
| It's Not a Problem                                                                 |
| Loss of Clarity of Language                                                        |
| Multi-Language ATC Is Confusing                                                    |
| Multi-Language Crewmember Can Help or Hinder                                       |
| Situational Awareness and Cockpit Duties                                           |
| Taxiing Amid Airplanes Without Knowing Where They're Going                         |
| TCAS and Technology Aid Situational Awareness                                      |

### *It Is Not a Problem*

It would be huge distraction if we heard somebody was cleared across our runway. It is not affected so long as we ascertain that the communication was correct. In other words, if we're comfortable with what we just heard, it's generally not a problem. If we doubt what we heard, we need to have it clarified.

*Interviewer:* If the instruction was spoken in a different language, you wouldn't know anyway.

Right, and quite honestly, at that point we're not really listening to the controller. We are flaring and unless we hear the words *go around* or *overshoot*, nothing is going to change what we're about to do at that point. Landing is a relatively low workload time; there's really not that much to do except physically manipulate the controls and land the airplane.

### *Loss of Clarity of Language*

I am much less complacent overseas due to language comprehension problems and getting a consensus in the cockpit as to what the controller said. Situational awareness is directly proportional to the clarity of the language – all the languages spoken on the frequency. If we can hear it and understand it, our situational awareness is great; and if we can't, [it may be nonexistent].

### *Multi-Language ATC Confusing*

To get the proper separation in [name city], sometimes controllers give short vectors on a tight turn to runway zero five. We don't know if that is what he's doing to the guy in front of us or not. If controllers are talking to a local aircraft in their own language, we have no idea if it is on the ground, in the air, or departing. Where is the weather? So, multi-language ATC is a very dangerous situation, and I think it should be outlawed.

### *Multi-Language Crewmembers Can Help or Hinder*

If we're the only English-speaking airplane and there are a whole bunch of airplanes out there, situational awareness can deteriorate to almost zero when we don't understand what's going on. If we're lucky, we might pick up some local language or have a multi-language co-pilot who can interpret for us. There is a benefit if one of us has even a limited knowledge of the local language – it augments our situational awareness. Going into Mexico once, a controller gave holding instructions to me in English and to an Avianca in Spanish – to the same fix at the same altitude. I was able to pick that out.

The problem with that is there is only one pilot interpreting the clearance instead of two pilots. I don't want my co-pilot speaking the local language for that reason.

### *Situational Awareness and Cockpit Duties*

It's as if we're in a dark room and having somebody turn on a light. If we understand where the other people are, what they're doing, or where they're expected to be, that's the answer to the test. Being in the dark, we only get bits and pieces instead of the full picture of the situation that we need [to maintain a safe flight].

For example, an aircraft is on the same frequency as me, doing the same approach, coming into the same airport except I'm not going to know what he is doing because I don't understand the language. Whereas if it's in English, I know the call signs of the two guys in front of me because I just heard that guy get doglegged, and this guy's on base, and I'm right behind him. So, I have more situational awareness of aircraft that are around me that could be a factor for our flight.

Also, somebody might report in seeing volcanic smoke and we could fly right through that area unless that information is broadcast in English. So, I have to concentrate more on listening, which can certainly distract me from doing my cockpit duties. We all like to think ahead and anticipate what the next thing is going to be so we can be ready for it. When we don't know, it increases our nervousness; it's just a little less comfortable.

### *Taxiing Amid Airplanes Without Knowing Where They're Going*

Ground operations can be very confusing; everybody's speaking the local language except us. I have no idea if another airplane is sitting there waiting for me or where he's going, and that's a very frustrating [situation] to be in – and dangerous.

I'm a first officer on a narrow-body aircraft; that is a busy seat. In the Caribbean, when we're taxiing, ATC issues us a new clearance and we're trying to start engines, and get everything done. We either have to stop and decide whether to copy the clearance now or complete our airplane stuff.

During these times, the captain's more focused on what the controller is saying, as opposed to a first officer who's moving switches and starting engines when clearances are being issued. That might be a little bit of an overload for me. But along the same lines, part of the reason my situational awareness is greatly affected is because I tend not to listen as intently since I don't understand what is being said in non-English. Since I can't tell the beginning and the ending [of the transmission], I don't know when ATC will come back to me because I don't know the flow sequence that they're going through.

### *TCAS and Technology Aid Situational Awareness*

When a pilot and controller are speaking in a foreign language, it doesn't give us the ability to be aware of whether they're talking about weather, airport conditions, clearances, or whatever. I tend to

**Table 10.** Effects of Language Understanding on Situational Awareness by Phase of Flight

| Rank                | Phase of Flight                                                                                                                                        |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                   | When preparing for descent – from cruise to either initial approach fix or VFR pattern entry.                                                          |
| 1                   | When preparing for final approach – from the final approach fix to the beginning of the landing flare.                                                 |
| 2                   | When taxiing – the aircraft is moving under its own power and terminates upon reaching the runway.                                                     |
| 2                   | When taxiing – the aircraft has exited the landing runway moving to the gate, ramp, or parking area.                                                   |
| 4                   | When preparing for take-off – aircraft is on the runway surface in take-off position.                                                                  |
| 5                   | When in climb to cruise – from completion of initial climb to initial assigned cruise altitude.                                                        |
| 6 & 10 <sub>b</sub> | When in the en route phase in international airspace.                                                                                                  |
| 7                   | When in the en route phase under the control of en route centers.                                                                                      |
| 9                   | When take-off power is applied, through rotation and to an altitude of 35 feet above the runway elevation or gear-up selection, whichever comes first. |
| 10                  | When preparing for landing - transition from nose-low to nose-up attitude just before landing touchdown.                                               |
| 11                  | When moving in the gate, ramp, or parking area - assisted by a tow vehicle (tug) moving to the taxiway.                                                |
| 12                  | When preparing for departure - aircraft is stationary.                                                                                                 |

<sub>b</sub> This phase of flight was ranked 6<sup>th</sup> and 10<sup>th</sup> by the same number of pilots.

depend on my instincts concerning who's in my immediate area, and we have technology on our planes that help us be aware of other airplanes' positions, terrain considerations, things of that nature; but I also like to hear what is being said between the pilot and controller. TCAS helps us maintain situational awareness. We try to figure out what controllers are having other airplanes do. We can watch them on our cockpit display. I think I lose situational awareness to some extent, but I'd be really worried if we didn't have TCAS. That would be a nightmare.

*Interviewer:* I have a question on situational awareness. Do you visualize traffic climbing and descending and speeding up and slowing down, relative to yourself, under most situations?

I have a picture in my head based on the transmissions being given. Basically, I visualize the airplanes that are the highest threat, closest to us, in front of us, and behind us. When the weather, thunderstorms, etc. develop and they are deviating around weather, I get a feel for it, and a lot of times I can transpose that onto the TCAS; and based on our TCAS picture, I know where they are.

**44a. When do changes in your ability to understand the language(s) being spoken over your communications system most affect your situational awareness?**

The pilots were provided with a list of 12 phases of flight to rank order. The list was derived from *Phases of Flight Definitions and Usage Notes* (CAST/ICAO Common Taxonomy Team,<sup>14</sup> 2006). The pilots' assigned values for each phase of flight were tabulated by frequency of occurrence. The results are presented in Table 10, followed by the philosophy the pilots used when assigning values to

each phase of flight, and discussions of their two highest ranks. Two phases of flight were tied for being most affected by language barriers (Rank 1): Preparing for descent and preparing for final approach. Tied for being the next most affected phase of flight (Rank 2): Aircraft taxiing on the airport surface either to the runway or to the gate, ramp, or parking area. The phases of flight least affected generally involved tasks in which the pilot had little to no direct involvement with tower controllers.

**Rank 1**

*When Preparing for the Descent – From Cruise to Either Initial Approach Fix or VFR Pattern*  
*Ranking philosophy*

My overall philosophy for selecting the priority was the speed of the aircraft, the danger of the environment it is in, and the sterility of the environment in which I'm communicating. If I'm the only aircraft being controlled as a primary for that controller, it's usually less of a problem. The impact of situations as they threaten our aircraft is proportional to the complexity of the phase of flight. The threats seem to follow workload – where we are the busiest and preparing for the busiest time [is] when it would be the most distracting to hear clearances that I can't understand.

*Constricted airspace*

The point where ATC is taking many airplanes and putting them into a confined space versus taking many airplanes and taking them out of a confined space – it's a higher risk factor going in than it is going out. When flying, we want our situational awareness to be the best when we're in the most congested area. We have to descend on time, and then, as we get in the lower altitude structure, there

<sup>14</sup> Commercial Aviation Safety Team (CAST)/International Civil Aviation Organization (ICAO)

is another set of problems – can ATC fit us into the flow? The native language can throw everything out of whack. If there is weather in the area, it changes everyday operations.

#### *Increased workload*

In preparation for descent, there are a lot of things happening, obviously, with the aircraft, checklists, ATC, and other aircraft. It is a very busy time when we are trying to get a lot of communications completed. If the amount of communications is increased, the amount of workload is increased. The amount of awareness during these phases of flight is also increased. To me, that's where the most problems in communications occur.

#### *Multiple languages on frequency*

Usually, communications are rapid-fire, especially going into a real busy airport. We do not want to miss one [transmission]. Hearing a different language that's being spoken is a distraction. The hardest thing to prepare for is when we first receive our clearance at initial descent. That is when we are figuring out exactly what the approach is, the arrival; and that's when communication barriers can get problematic – subtle miscommunications can be life-threatening. Controllers speak in their native language to the guy ahead of us. If I knew what he was given, I could prepare to maybe slow down or speed up.

#### ***When Preparing for Final Approach – From the Final Approach Fix to the Beginning of the Landing Flare***

*Aviating and navigating can be complicated  
by language barriers*

The arrivals and descents are our highest concerns and priorities. Getting around to the final and being vectored in can be difficult. We're low on fuel coming in, trying to get on the localizer, making sure that we're on the correct runway. We could be dealing with weather. We're tired and it is vital that we understand what controllers are saying.

#### *Broken English is a distraction*

The hardest time is when we're concentrating very intently on what we're going to do, and, suddenly, somebody comes up in broken English and now it is much more difficult.

#### *Lack of understanding is uncomfortable during off-nominal situations*

If something happens when the airplane is in a critical phase, a light comes on, or an abort procedure is pronounced; that's when we don't want to hear a foreign language or have difficulty understanding exactly what the controller wants us to do. I want to be able to say – "Hey [Air Carrier] seven one's aborting on three five." I want to feel comfortable knowing that they know what I'm saying too.

#### *Multi-linguistic communications detracts situational awareness*

What airplanes are on approach, are landing, are being cleared for takeoff on that runway, or opposing runways – I need to have the big picture. But I don't have information that is being conveyed in [another language] and things are moving along. That would be most distracting.

#### **Rank 2**

#### ***When Taxiing: The Aircraft Is Moving Under Its Own Power and Terminates Upon Reaching the Runway/ The Aircraft Has Exited the Landing Runway Moving to the Gate, Ramp***

#### *Ranking philosophy*

The overall philosophy for my ranking of the situations was asking the question, "Are they a threat to our aircraft?" The threats seem to follow workload. In terminal areas, there are more radio transmissions and if there is a language barrier, it's going to be a lot harder to follow. Where we are the busiest is when it would be the most distracting to hear clearances that I can't understand.

I compartmentalized the items to areas where I could lose my job and on [the] likelihood of a change occurring. I looked for the ticket item for me and went to number 2 and 3. Then I looked for the least threat times, and put those next to the bottom.

#### *Divided attention*

Ground operations are definitely high on the list because we are either going to ding something pretty quickly or get on the wrong runway or taxiway if we are not really paying attention. In my mind's eye, a heavily accented controller giving us instructions, a little bit of weather and traffic involved, and we're trying to make it to the end of the runway while copying a clearance accurately. Either we are going to listen to the clearance or going to taxi – we are not able to do both at the same time.

#### *Domestic compared with international operations*

Domestically, we know what we're going to get and where we're going to go; but internationally, I invariably have to use a lot more mental capacity to figure out where we're going and what we're doing. Sometimes, to be honest, I assume that the guy in the left seat knows where he's going and what he's doing.

#### *Ground operations are less predictable*

I find my situational awareness is definitely the lowest on the ground – taxiing around, getting taxi clearances, understanding the taxi clearances. Taxiing out is difficult sometimes because there is less time to develop a plan because we don't always know what runway we're going to get until the controller

**Table 11.** What Pilots Do to Compensate for Reductions in Situational Awareness

| <b>Ways to Counteract Reductions in Situational Awareness</b> |
|---------------------------------------------------------------|
| Be Prepared                                                   |
| Challenge Unclear Clearances                                  |
| Clarify                                                       |
| Check the NOTAMs                                              |
| Cockpit Resource Management (CRM)                             |
| Employ Aircraft Equipment and CRM                             |
| Increase Attention and Listen Intently                        |
| Know Your Clearance and Fly Your Own Airplane                 |
| Local Language NOTAMs <sub>c</sub> can Be Difficult           |
| Recognize There Is Reduced Situational Awareness              |
| Request Slower Speech                                         |
| Slow Down and Use Standard Communication                      |
| TCAS as a Tool to Compensate                                  |
| Use Headset                                                   |

<sub>c</sub> Notice to Airmen

says taxi to this runway. Sometimes the communications really affect us because there's ambiguity about where we're going. And then, as we move toward the runway, we can have problems with communications, where we're not sure about what needs to happen. We're changing controllers and the levels of proficiency change, depending on where we are from the departure runway. We get most of the taxi incursions taxiing out to the runway. It's a high-workload environment.

#### *Increased activity level on the ground and on frequency*

Mainly on taxiing in a non-English speaking arena – whether it's after departing the runway upon landing or after push-back trying to get to the departure runway. ATC could be talking to somebody on the other side of the field and we wouldn't know, because we don't have full situational awareness. There are a lot of ground vehicles and other airplanes moving through the same aircraft movement area in close proximity to each other with the possibility of a runway incursion. Runway incursions are an important thing and if that information is not given in English, it is a problem.

#### *Unusual clearances*

The most affected was taxiing around and getting unusual clearances, which weren't necessarily critical but were sometimes hard to understand. If we're having trouble understanding the taxi directions, our workload goes up; we can sit there and say, "Well we're probably going to turn off this way and go to this location." There are more nonstandard things that happen on the ground than when enroute.

#### *45. What do you do to compensate for any reduction in situational awareness?*

The pilots' oral and written responses were grouped into 13 common themes, as shown in Table 11. Each theme follows, and, in some cases, the interviewer asked additional questions. Their responses ranged from individual preparedness to the use of aircraft equipment.

#### *Be Prepared*

As pilots, we really need to be prepared for what we're going to do. I study ahead of time, which is much more of a player in the international arena than it is in domestic operations. I review the STARs,<sup>15</sup> SIDs,<sup>16</sup> approach plates, airport diagrams, and possible taxi routes. Mountains are here; water is here; routes are here; fixes are this; planned is this; optional is this. I focus on what's going on both on the ground and in the air, how we might be cleared, what we can expect the route will be on the ground and in the air – the arrival and the departure we can expect to be given.

If I am going somewhere that I've been to before, I talk to the co-pilot about all the possible things I've ever experienced. Usually, somebody has been there a number of times, and that can make all the difference. If we lose situational awareness, we've got to do something pretty quick. Experienced pilots know what's coming and do more ground or pre-flight preparation. Pay attention to what's being said on the radio, and monitor the instruments for what is going on.

#### *Challenge Unclear Clearances*

Challenge dubious clearances. A dubious clearance is one that is not accurate or not clear. We do

<sup>15</sup> Standard Terminal Arrival Route

<sup>16</sup> Standard Instrument Departure

have situations where we get different phraseology for *cleared for the approach*. The controller may clear us to an altitude and then clear us to intercept the localizer; and here comes the glide slope, and it's time to descend, but we don't think we have a clearance to descend. We can't get a word in because ATC is talking in the local language, and all of sudden, we have to throw it all out and get back to the glide slope.

Somewhere, in some statement, we may have been cleared for the approach, but the words did not click with us, so we did not descend on the glide slope because we didn't think we got the approach clearance. That happens in Russia and South Poland a lot. The best maneuver the airlines teach is a properly executed go around.

We increase our vigilance of what is going on out there and review the procedures before we get there. We stop if we're on the ground, ask ATC to repeat what's going on, or tell the controller that we don't understand the clearance. We may have to ask for a vector to get us going to where we need to be.

#### *Check the NOTAMs*

I check the NOTAMs and accomplish briefings during times of low workload – such as in-cruise flight, where my situational awareness is not as needed. Last year in Santiago, Chile, they closed one of the runways they normally use. It was only NOTAM'd in Spanish and I was the only one [of our flight crew] that understood it because I spoke Spanish. I thought that to be bizarre because half of the NOTAMs are in Spanish, and half are in English. The ones that we needed (all of them in English) were in Spanish.

*Interviewer:* You mean it was not translated?

No [it was not translated].

#### *Clarify*

We ask for clarifications as necessary with the controller and will repeat our request as often as required. We also confirm instructions with the captain before it is read back. We will use the phonetic alphabet to clarify and cross-reference maps or publications.

#### *Cockpit Resource Management (CRM)*

I make sure all crewmembers are listening and get everybody involved. I read someplace that 72% of all runway incursions happen on the first day and on the first leg, because crewmembers are afraid to call out stuff. So that's part of my briefing – Does everybody have their airport pages out? We review procedures and taxi diagrams ahead of time. I want progressive taxi instructions from everybody.

We use all the tools that we've been trained to use, which is use CRM resources and make sure everybody's briefed on being totally aware of radios and clearances. And sometimes I embarrass the guys. They think I'm an old guy who can't hear. But I will ask a guy about what the clearance was or what our descent is.

#### *Employ Aircraft Equipment and CRM*

I will ask for a repeat of any clearance or altitude – anything I have a question on – and I will use other pilots in the cockpit. We use our aircraft's equipment, and an example of that would be TCAS. We really spend a lot more time looking at the TCAS display and range, trying to identify the competition, per se, especially in the arrival area where everyone is converging and where the sequences are coming in. With TCAS, we almost become backup controllers. We can guess what they're doing and what to expect, based on what we're seeing with altitudes and turns, headings from other aircraft. If we cannot get through the language barrier, we still see the picture that's developing on the TCAS.

#### *Increase Attention and Listen Intently*

I use all my pilots, so there are no assets being wasted. We listen intently, eliminate some tasks, and ensure the cockpit light is on to limit the distractions in the cockpit. We heighten our awareness and really pay closer attention than we probably would domestically. We wear our headsets so that we're able to hear what's being said. And then finally, if there are any questions, we'll verify them as to what we've been instructed to do. It's very cheap insurance.

#### *Know Your Clearance and Fly Your Own Airplane*

All we can do is take care of what we can control – knowing our own clearance and flying our own airplane. I've learned a lesson early on – I don't have to know everything, so I don't pretend to. I'll ask.

We always have three people in the cockpit, and I make sure everybody knows what the plan is. When we're taxiing, my situational awareness is the lowest; I'll be looking around, checking the taxi diagrams. It comes down mainly to resolving ambiguity – having charts available while utilizing my relief pilots, not overloading them to the point that I'm the only one taxiing the airplane, and no one else is monitoring me.

#### *Recognize There Is Reduced Situational Awareness*

The very first thing I have to do is recognize that I have a reduction of situational awareness and then customize the resolution to what's causing the problem. To do that, I try to discover why it has been reduced. It could be a simple thing such as I'm fatigued and need coffee to wake me up. It could be a variety of things.

I'll alert the other pilots on duty to increase their situational awareness as well. We do a thorough brief again, especially for both the departure and the arrival. We'll think about our situational awareness because a pilot never really knows it is lost until it is back. Never forget what we've always been taught – aviate, navigate, communicate.

### *Request Slower Speech*

When I can't understand, I ask the controller to go a little bit slower. I verify everything including opinions until I am sure I understand. We agree this is the altitude we are going to, we agree we are going to this fix. I verify a match for everything before it goes into the computer.

### *Slow Down and Use Standard Communication*

We slow down our normal operation to be a lot more deliberate in what we are doing because we're trying to pay attention to what could be a threat. We are trying to do everything we can to increase our situational awareness and compensate for not understanding the language being spoken. We stick to standard communication.

Even when controllers and pilots are speaking in their native tongue, frequently we can understand their call signs. We may not know where they're going, but at least we know who's out there. We just have to listen very intently and try to correlate TCAS data to what the controllers are saying.

### *TCAS as a Tool to Compensate*

During the enroute phases, TCAS is golden. The route knowledge, knowing what to expect, and why we are expecting that, and what a possible Change 1 or Change 2 might be – that's spectacular. We find that kind of knowledge to be valuable from the guy who has been there before.

*Interviewer:*<sup>17</sup> Do any of you use your TCAS to compensate?

Absolutely, that's one reason why it's a piece of required equipment going into South America.

*Interviewer:* Can you use it to get a sense of where a plane is and where it is going?

Absolutely. I just said, we can question the controller and find out what we don't know [when we don't know what they are saying in their own language]. That's the only recourse we have.

### *Use Headset*

Everybody is listening to what's going on using their headsets because, hopefully, somebody will catch what everybody else misses.

*Interviewer:* In what environment do you normally wear headsets?

Headsets are required below 18,000 feet. I wear them all the time when I'm operating in European airspace. It helps me to understand what's being said. We sit there and wear it for two and a half hours, so you're happy to take the thing off.

## DISCUSSION

This report focuses on the communication between non-native English-speaking controllers and how well they communicate with native English-speaking pilots. It provides an overall perception among 48 U.S. ATP pilots of how these communication exchanges affect safety, the communication process, workload, and situational awareness. The interviewers took the pilots' comments and opinions at face value and occasionally asked additional questions but did not challenge any of their statements or comments.

Language production is generally thought to involve four steps: first, you have an idea of what you want to say; second, you organize that idea into an acceptable linguistic form containing a grammar, vocabulary, cadence, and phonetic segments (Fromkin, 1971); third, you develop a set of motor commands in your brain that are sent to the respiratory, laryngeal, and articulatory systems necessary for speech production (e.g., MacNeilage & Ladefoged, 1976); and fourth, you execute these motor commands (e.g., Broca's area for articulation, Dronkers, Plaisant, Iba-Zizen, & Cabanis, 2007).

For listeners, speech perception occurs when a spoken message is heard and understood (Wernicke's area for understanding receptive language, Beeman, 2005). It entails four general levels of language processing. First, speech sounds are identified and categorized (sensory and phonological encoding processes); second, the lexical representations of words are retrieved from the mental lexicon (lexical processes); third, the syntactic structure of the sentence is determined, and the gist of the sentence is stored in working memory (sentential processes); and fourth, contextual cues are used to integrate the gist of the sentence with the context in which it is embedded (discourse processes).

When the listener is proficient in the language, discourse processes serve to facilitate speech perception, allowing the listener to generate strong expectations as to what words will be spoken next. For example, English grammar follows a subject–verb–object (S-V-O) sentence structure, where both the subject (S) and object (O) are nouns. Thus, the listener comes to expect a verb (V) will follow the subject of the utterance prior to the object.

When a language uses a different grammar structure, such as subject – object – verb (S-O-V, e.g., Japanese and Hungarian), a listener unfamiliar with that sentence structure will not be able to use discourse processes to the same extent as the person proficient in that language and may have difficulty extracting the meaning of the sentence. As an example, languages with an S-O-V structure generally place a person's title (e.g., Jane Captain) after their name, while S-V-O languages place it before the name (e.g., Captain Jane). In air traffic control, when "descend and maintain twelve thousand" was put into an on-line translator, it appeared as "Lower 12,000, maintain" in Japanese and "The drop maintains 12,000" in

<sup>17</sup> This question was asked of a group that had not mentioned TCAS as a compensatory tool.

Korean. In an S-V-O translation from English to Arabic (Modern Standard), the same instruction was translated as “Descended and kept 12 thousand.”

Although Aviation English involves making statements, asking questions, issuing commands, giving reports, and warnings, it does not follow the conventional grammar structure or rules of ordinary English languages. Generally, it does not pose a problem for pilots and controllers when they follow the rules contained in documents such as *Order 7110.65 The Handbook of Air Traffic Control* (FAA, 2010) or *Procedures for Air Navigation Services - Air Traffic Management Doc4444* (ICAO, 2007).

However, problems can arise when pilots and controllers stray from the phraseology developed specifically for aviation and replace it with Common (or plain) English. For example, “Can you accept runway 05” is the equivalent for “Expect runway 05.” The unsuspecting, non-native English-speaking pilots receiving the request, “Can you accept runway 05?” may not understand it since that phrase is not found in either Order 7110.65 or Doc4444. If pilots and controllers limit themselves to the approved phraseology, communication problems might diminish (Prinzo, Hendrix, & Hendrix, 2008).

Unfortunately, absent from these documents is phraseology beyond that used to declare an emergency. Non-native English-speaking pilots and controllers are at a disadvantage when faced with a possible emergency because they must rely on their Common (or plain) English skills. Pilots must adequately convey the nature of their emergency, their intentions, and requests for any assistance. Likewise, controllers must be able to interpret the information and decide the best course of action. Being able to communicate effectively during an emergency is difficult using a native language and can become completely unmanageable if it must occur in a language where proficiency is limited.

As pointed out by Prinzo et al. (e.g., Report 3, 2010b), pilots’ perceptions regarding the English language proficiency of international controllers often is dependent upon where they fly, with some places perceived as better than other places. For example, Canadian, Cuban, and German controllers who provide ATC services in their respective airspaces were perceived as being very good, whereas the Chinese, Russian, and South American controllers had greater difficulty understanding requests made by pilots in English. In fact, many of the U.S. pilots reported that all controllers were very good communicators during routine and expected situations. Another important factor was experience – there may be fewer surprises among pilots who repeatedly fly the same routes than pilots less familiar with these routes.

### **Inadequacies in Controllers’ English Language Proficiency During High Workload Conditions**

How proficient a bilingual controller is in English becomes apparent as they encounter problems. During these times, pilots may be faced with time-critical events

requiring quick decisions, actions, and responses from ATC. Although ICAO phraseology exists for distress calls (MAYDAY, MAYDAY, MAYDAY) and urgency messages (PAN-PAN, PAN-PAN, PAN-PAN), no phraseology currently exists to convey the pilot’s precise circumstances or to tell the controller what is needed. In fact, phrases such as “fuel emergency” and “fuel priority” are not recognized terms after making a distress call or transmitting an urgency message. Flight crews short of fuel must declare a Pan or Mayday to be sure of being given the appropriate priority (Eurocontrol, 2007).

It may be that representatives from the aviation community who develop aviation phraseologies assume pilots’ and controllers’ English skills are sufficiently adequate for emergency, unusual, or unanticipated operations. Should these events occur, the pilot and controller would simply communicate in conversational English to reach a common ground of understanding of the situation as it unfolds. Controllers would provide the needed services and obtain any specialized assistance for the pilot. Hence, there was no need to build phraseologies to explain the situation or convey what services were needed.

Unfortunately, this assumption is false, as documented in Doc 9835 (ICAO, 2004) regarding the implementation of English language proficiency requirements and confirmed by several pilots who participated in these interviews. They told of their difficulties with some tower controllers who were unable to understand that either their aircraft or another aircraft was distressed (e.g., hot brakes, disabled aircraft on the runway) and required emergency vehicle services. Likewise, when faced with adverse weather such as hurricanes, thunderstorms, or volcanic activity, some pilots reported some en route controllers could not communicate properly with native English-speaking pilots. During these circumstances, it can become cognitively challenging for less proficient controllers to decode, translate, interpret, and understand from English to their native language and back again to English. The added pressure, anxiety, and stressors pilots experience during these times may find them using Common English or even slang in an attempt to be understood.

Unfortunately, it is at this precise moment that the controllers’ command of the English language may be inadequate. They may not grasp completely the complexities of the situation from the English spoken by the pilots. For controllers to correctly infer an accurate understanding of the situation as told to them by the pilots requires a successful mapping of the pilots’ words and concepts with theirs. In the absence of complete bilingualism, their utterances may become prone to errors and misunderstandings (Varela, 2006). This also holds true for pilots who attempt to apply their best guesses.

For example, although birds exist in most countries, and a robin is a very typical bird in the United States, there are no robins in Poland. Consequently, talking to a native of Poland about robins would be baffling for that person. Likewise, explaining the concept of watching a

movie to members of rural nomadic tribes living in the Middle East will result in puzzled expressions.<sup>18</sup> The point is, just as there are some words and concepts that are comparable across languages and cultures (e.g., birds) some words and concepts have no equivalence in another language or culture (e.g., watching a movie). Thus, effective communication results from the extent to which pilots and controllers can construct a common ground of understanding – a shared mental representation of the events of the moment. Incomplete understanding diminishes situational awareness, can threaten safety, and adds another layer of complexity to an already stressful situation.

During adverse weather, heavy traffic, and unexpected circumstances, several U.S. pilots reported hearing some pilots and controllers revert to their native language during the course of their interactions. Consequently, pilots who are unfamiliar with the local language experience frustration and uncertainty since they no longer can anticipate unfolding events. If they ask the controller what is happening, there may be unacceptably long delays between the end of their questions and the onset of a response as the cognitive demands placed on controllers become unmanageable. As noted by a pilot “Significant traffic volume, maintaining both arrival/departure [traffic flow], with significant weather that requires deviations around a standard path, is more than many foreign controllers can handle.” And by another, “They need to use the standard phraseology with me for me to understand. If I can’t understand the language, it’s a safety of flight issue.”

### **Strategies Pilots Use to Improve ATC Communication**

While monitoring their radios, pilots listen to how well controllers talk to other pilots. The pilots in our study tended to rely primarily on the controllers’ pronunciation and fluency to determine how proficient they were in speaking and understanding English. The pilots also considered comprehension, grammar, vocabulary, and interactions with other pilots as well as the controller’s projected confidence, although to a lesser degree.

Once pilots decided a particular controller exhibited low-level skills, they altered the way they spoke to that controller and listened more attentively to what was said. In particular, pilots said they deliberately spoke slower, more distinctly, clearly enunciated words, and sometimes spoke louder. If on the ground, sometimes they stopped their aircraft and only moved once the problem was resolved.

When anticipating a call from ATC, their strategies revolved around having all crewmembers listen closely to all the messages and possibly turning up the radio volume. Some crews wear headsets. Likewise, they listened closely to messages designated for them and compared what each one thought they heard. If there was a lack of consensus among the flight crew, then a request for

repeat occurred either in the form of “Please repeat”<sup>19</sup> or “Say again.” This is unlike their communications with U.S. en route controllers where pilots may say, “Confirm heading two four zero” or ask, “Was that down to one eight oh?” (Prinzo et al., 2008).

### **A Description of Same-Language Pilot Controller Communications**

When pilots and controllers share the same language, the speed of communication and understanding is effortless and unconscious (same-language participants generally do not think about what processes are active because understanding appears to be automatic, rather than controlled). They apply top-down higher-order language processes in anticipation of each other’s utterances. Consequently, they are probably more relaxed, and communication progresses at a comfortable pace; likewise with speech production. Generally, speech progresses automatically, requiring very little forethought, thus allowing the controllers to formulate and produce their clearances rapidly.

The pilots’ perceptions of the information flow between speakers of the same native language seemed more casual and relaxed. It contained occasional laughter, lots of chatter, shortened call signs, and some jargon – with less reliance on ICAO phraseology. There appeared to be a degree of familiarity between the pilot and controller, possibly due to a shared dialect, accent, grammar, vocabulary, and probably culture, all of which contribute to the ease of understanding (Al-Hasnawi, 2007). There might be salutations during initial call-up and again when handed-off, as is done in the U.S. Local slang and jargon is understood, but only by those who share (or understand) these socio-linguistic-cultural features.

Some pilots thought controllers and pilots who shared the same language spent more total time on frequency. Controllers could chain together several instructions at a time, offer multiple clearances, or make several transmissions in the same amount of time it took them to complete a transaction with a native English-speaking pilot. Thus, more information could be relayed between speakers of the same, as opposed to different languages, in about the same amount of time.

### **A Description of Different-Language Pilot Controller Communications**

Unlike communication between speakers and listeners of the same language, the English-speaking pilots perceived non-native English-speaking controllers answered questions from local pilots promptly, while they often had to wait. While waiting they heard the controller take calls from other local pilots.

The pilots noted that controllers slowed down their speech rate when switching from their primary language

<sup>18</sup> Personal communication from an Army chaplain serving U.S. troops in Iraq, Kuwait, Afghanistan, and Qatar.

<sup>19</sup> Although the pilot used the word “please,” discussions with several controllers indicated they had never heard any pilot use “please” during radio communications.

to English. Clearly, it takes longer to mentally translate from one language to that of another, especially if less proficient in one of those languages.

When communicating with non-native speakers, radio discipline was maintained to a higher degree in a multilingual environment, with nonessential communication kept to a minimum. In particular, informal communication and the exchange of pleasantries were avoided. Pilots thought the controllers might be less inclined to ask a native English-speaking pilot to deviate from their route than a local pilot with whom they could communicate more easily. Trying to explain to a native English-speaking pilot would take more time, could result in miscommunication, more effort, and stress than calling up a pilot who spoke their language.

Pilots also limited their utterances to ICAO standard terms and phraseology, said them in the same order, and spoke more slowly than they would if talking to a native English-speaking controller. Just as the S-V-O sentence structure facilitates lexical access among English languages, knowing that a pilot's readback is recited in the order in which instructions were given may help the controller process and confirm the accuracy of the readback more quickly. Slower readbacks provide controllers with more time to execute bottom-up language processes to extract and identify meaningful syllables from the speech stream, combine them into words, phrases, clauses, etc. until the meaning of the utterance is determined. Although it is common for pilots in the U.S. to substitute "oh" for "zero" or "point" for "decimal," substituting one word with that of another could result in confusion among less proficient non-native English-speaking controllers. Therefore, common U.S. word usage was avoided among pilots who knew it was important to choose their words carefully to prevent possible misunderstandings. If pilots needed clarification, their questions were concise and well controlled.

Some pilots thought more time was spent communicating between native English-speaking pilots and non-native English-speaking controllers, but others expressed the opposite opinion. The perceptions of the former group were that the added time on frequency resulted from more requests by pilots speaking English to have either the entire message or part of it repeated, confirmed, or verified. These additional transmissions would increase the total time on frequency. Also, during the communication process, native English-speaking pilots and non-native English-speaking controllers may slow down their speech rate to make it easier for the listener to understand them.

For the U.S. pilots with the opposing viewpoint, they thought less time was spent communicating between native English-speaking pilots and non-native English-speaking controllers because controllers' transmissions were limited to simple ATC clearances and instructions devoid of pleasantries, and the pilots also were brief and to the point. Shorter messages with limited words take less time to transmit.

## **Human Factors Considerations in Language Switching**

At some time or another, many of us have participated in a conference call and attempted to identify who the speaker of the moment was from among the many people participating in that call. If we try to identify who the speaker is, we might miss some of what is being said, as more of our attention is dedicated to bottom-up processing of acoustic information. We listen in on these party line conversations to obtain information and also provide some when it is our turn to talk. We listen for our name to be called before we enter the conversation. We also listen for a drop in pitch and longer pauses to signal the end of an utterance and possibly a dialogue (Ford & Thompson, 1996).

When pilots enter into a foreign country's airspace, they may hear the controller speaking in English and then in the local language. This language switching poses a problem for any pilot unfamiliar with the language.

### ***Language-Switching Distracts Pilots and Limits Understanding***

Hearing non-native English-speaking controllers switch between languages serves as a distraction to pilots as they give more of their attention to listening to other pilots talk than to performing station-keeping tasks (e.g., completing a checklist, configuring the aircraft, programming the FMC). Identifying and then isolating the controller's voice from that of other pilots is not a trivial task, especially when pilots cannot use the content of the transmissions to distinguish between a controller issuing an instruction and the pilot reading it back. Pilots, like others who are proficient in English-only (monolingual), are at a disadvantage when hearing foreign languages because they cannot use these same signaling cues to identify turn-taking, speaker identification, word recognition, or relevant information (Marian & Spivey, 2003; Weber & Cutler, 2004). At best, they may be able to map some familiar sound patterns and guess at what is being said.

### ***Language Switching Adversely Affects Situation Awareness***

Party line communications present an anomaly to flight operations. Interview data gathered by Pritchett and Hansman (1993), like the interview data presented here, suggest party line communication provides pilots with useful weather and traffic information that affects their situational awareness. However, a simulation study conducted by Hodgetts et al. (2005) suggest party line communication increased the perceived workload among the pilots in their study, as well as the time pilots took to complete their descent checklist, when compared with the absence of a party line. Like the pilots in the Hodgetts et al. study, our interview data also indicated perceived increases in workload, but the increases were attributed to focused attention on non-English communications.

### *Language Switching Leaves Pilots With Feelings of Uncertainty*

The more relevant and accessible the information, the better pilots can do their job. There are two sources of auditory-presented information – direct communication between the pilot and controller and indirect information obtained by listening to the communications between a controller and all other pilots on the same frequency via the party line. When all communications are in English, pilots know how their flights are situated as events unfold around them. So, they listen for traffic avoidance and traffic awareness, clearances and requests, and ride reports for turbulence. The clearances and instructions issued to other aircraft may have a direct impact on their flight path.

However, when multiple languages are spoken, pilots unfamiliar with these languages do not know what is occurring. It limits their situational awareness about the big picture and the status of the protected zone around them. Pilots want to know who is in front of them, what they may be flying into (e.g., weather, volcanic ash), as well as what is behind them. Without complete and accurate information, they cannot develop useful strategies, contingency plans, or expectations. This, in turn, can restrict situational awareness, degrade safety, and leave them feeling uncomfortable – especially in busy terminal areas.

An example provided by a bilingual pilot illustrates the problem well. He was given the same holding instructions in English that another pilot received in Spanish. Both pilots were given the same fix and altitude. Had the U.S. pilot not understood Spanish and queried the controller, the outcome could have been catastrophic.

### *Language-Switching Increases Pilot Workload*

Difficulties in understanding take time away from performing other duties that help pilots maintain situational awareness, especially during the descent to landing phase of flight. It is during this time when they calculate their descent profiles and begin their approach briefings. This is supported by Hodgetts et al. (2005), who reported the pilots in their study only took longer to complete their descent checklists. Having to factor in additional cognitive demands due to language barriers may increase the workloads of both the pilot flying and non-flying pilot.

As pilots enter terminal airspace, there is more traffic and communication, a decrease in separation minima, and less time to initiate and execute procedures. Language-switching adds another layer of complexity to communications, especially among pilots unfamiliar with the languages spoken over their communications system. The added wait times by controllers who are slow in responding to pilot requests and questions can result in pilots rushing to perform tasks and maneuvers at a faster pace to maintain their descent profile. Failure to maintain the descent profile may result in having to execute a missed approach.

### **Language Barriers Most Affect Situational Awareness Just Prior to Top-of-Descent and Taxiing**

When pilots were asked to rank-order 12 phases of flight from most to least affected by language barriers, their philosophy involved threats to safety first and loss of employment second. Having a high workload, more radio communications, and low second-language proficiency can overburden working memory and lead to distractions, lapses in attention, interference, and disruptions (see Resnick, 2006).

As noted by the Flight Safety Foundation (Flight Safety Digest, 2000), “Incorrect management of the descent-and-approach profile and/or aircraft energy condition may result in a loss in situational awareness; and/or an unstable approach” (p. 71). Although the Flight Safety Foundation recommends that pilots complete the descent preparation and approach briefing 10 minutes before reaching the top-of-descent point, whether pilots can do so is dependent upon how well they can communicate with controllers who are less proficient in English.

As noted by several pilots, they may be at a disadvantage if ATC delays providing them with the information necessary to complete these tasks. It is during this phase of flight that pilots receive their clearance and begin to plan their arrival. Failure to provide English-speaking pilots with the same information provided to other pilots in their native language may create an incomplete or inaccurate assessment of the situation. Not being fully cognizant of the situation may impose a threat to safety.

While on the airport surface, pilots again face uncertainty while performing a range of tasks – scanning their instruments, taxiing the aircraft to/from the runway, monitoring the radio, scanning out the window, completing checklists, and so on. They also might be copying their clearance instructions from heavily accented or less proficient controllers or listening to them as they talk in their native language, both of which add to workload, and limit situational awareness. Pilots may find themselves either landing on or taking off from the wrong runway.

Unlike domestic operations, U.S. pilots indicated higher cognitive workloads during international operations. What caused the added workload? All the pilots were ATP certificated and knew how to operate their aircraft, as demonstrated by their pilot ratings and certificates. A review of their discussions revealed that uncertainty with local procedures, language barriers, incomplete information, and feelings of isolation made the upcoming events less predictable and contributed to their sense of diminished situational awareness or loss of the “big picture.”

### **Compensating for Reductions in Situational Awareness**

When we asked pilots about what they do to compensate for any reduction in situational awareness, they said they conduct a complete and thorough ground and pre-flight preparation and review. Also, during their flights, they increase their vigilance and attention, and apply their

best practices to operational communication with ATC. That is, they listen attentively, use standard phraseology, apply a proper delivery technique (speak clearly, slowly, deliberately, concisely, and pause momentarily between each element in a readback), and if uncertainty presents itself, they clarify, verify, challenge, or restate the problem until any remaining ambiguity is resolved.

They also rely on their own past experiences and that of other crewmembers, especially when situation awareness is limited or sketchy. That is, all members of the crew are active participants – from the moment they arrive in the cockpit until they leave the aircraft at its destination. Each crewmember is vital and expected to help disambiguate ATC transmissions and contribute to situational awareness.

In fact, some pilots viewed TCAS as an additional crewmember that was responsible for traffic awareness. Some pilots attempt to correlate what ATC is saying to other pilots with the targets displayed on TCAS. Using the other aircraft's call signs, they develop expectancies involving the other aircraft's locations, and possible maneuvers (changes in altitude, heading, speed, etc.). Pilots who watch other aircraft on their TCAS display can see if an aircraft may encroach into their protected zone and alert ATC about a potential conflict.

In summary, the pilots provided much discussion about their experiences flying into non-native English-speaking countries and how communicating with the controllers there affected their situational awareness and workload. The differences in the pilots' opinions resulted from where they generally flew and their experiences flying to particular areas of the world. Pilots flying into an area for the first time might have different opinions than a pilot who has been there many times before. Also, a pilot new to international flying would have a different opinion than a pilot with many years of diverse international flight experiences.

Generally, non-native English-speaking controllers did their jobs well, and language was not reported to be an issue during routine, non-eventful situations. However, during periods of high workload, heavy traffic, and weather, many of the pilots did not believe the controllers' English was adequate. Also, when controllers reverted to their native languages, pilots who did not know these languages experienced discomfort and uncertainty as their situational awareness eroded. During times of uncertainty, pilots use their established strategies to compensate and mitigate against losses in situational awareness brought on by language switching. For example, some pilots attempted to infer what was said by ATC with changes made to aircraft targets on their TCAS displays.

We offer the following eight recommendations. They were derived from the information provided by the pilots during the interviews.

## Recommendations

1. Support standardized, consistent, and secure English language-testing standards for use by ICAO member states.
2. Develop realistic emergency and nonroutine scenarios and simulations that require controllers (and pilots) to demonstrate their use of conversational English. These scenarios and simulations should be added to existing or new instructional and training programs, as well as to refresher training.
3. Provide pilots with the opportunity to listen to ATC messages and conversational English spoken by non-native English-speaking controllers in English. Priming the pilots in the languages they will be hearing over their radios may facilitate decoding and comprehension.
4. Expand ICAO Emergency ATC vocabulary and phraseology and create datalink messages beyond "PAN-PAN, PAN-PAN, PAN-PAN," "MAYDAY, MAYDAY, MAYDAY" or "CONDITION RED MAYDAY, MAYDAY, MAYDAY." When pilots declare emergency situations, they need a set of phraseology to adequately express to controllers what they need for ensuring a safe, efficient, and effective outcome.
5. Publish a common, universally accepted, and comprehensive aviation thesaurus by CAST/ICAO. It would include definitions of standardized concepts, vocabulary, phraseology, and procedures.
6. Provide NOTAMs in the native language and in English in a standard and consistent format for use by all ICAO member states.
7. Exploit datalink capabilities to provide pilots with enhanced situational awareness. In particular, instructions and clearances conveyed in non-English can be correlated with that aircraft's flight identifier transmitted by automatic dependent (ADS) broadcast technology, displayed graphically and in real time using cockpit displays of traffic information (CDTI).
8. Develop a digital datacom message repository that pilots can access to review recent messages sent to other aircraft within a defined distance (to be determined). It would provide the same information currently available over their radiotelephony party-line communications, but it would be presented as text in English. This information could replace the information lost by language-switching, help maintain situational awareness, and allow pilots to anticipate future clearances, instructions, weather, turbulence, traffic, and other developing events.
9. Develop new ICAO phraseology for pilot requests for "ride reports." Pilot reports (PIREPS)<sup>20</sup> provide ATC with valuable weather information experienced by pilots during their flights that is relayed to ground weather stations. In the U.S., some of this information is shared with pilots who request a ride report. Ride reports do not exist

<sup>20</sup> PIREPs include reports of strong frontal activity, squall lines, thunderstorms, light to severe icing, wind shear and turbulence (including clear air turbulence) of moderate or greater intensity, volcanic eruptions and volcanic ash clouds, and other conditions pertinent to flight safety.

in China and may not exist in other countries. Requests for ride reports are common in the U.S. Since there is no required phraseology, non-native English controllers are at a disadvantage understanding what information U.S. pilots are requesting. Examples of some requests include, "How's the ride sound today?" and "What kind of ride reports have you had on climb outs?"

10. Develop structured ATC phraseology for providing pilots with ride report information. In response to pilot-requested ride reports, U.S. controllers use a combination of aviation and Common English. Presently, if weather is not a factor, some controllers might convey that information using the following examples, "No complaints," "Some deviations along your route," and "It should be okay." Again, non-native English-speaking pilots would be at a disadvantage understanding what was said over the party line. Any information related to a ride report should have a predictable format and structure, possibility in the form presented in the following examples.

{Light Turbulence} THROUGH Flight Level {three one five}

{Light Chop} AT Flight Level {three one zero} 'TIL {Location} AREA THEN {Smooth}

11. Develop new ICAO phraseology for use when normal operations are disrupted. In particular, controllers need to know what pilots need during these times. A review of off-nominal events may shed light for crafting standardized pilot requests. Some examples are provided below for illustrative purposes only.

REQUEST {Fire Rescue} {Smoke in Cabin}

REQUEST {Ambulance} {Medical Emergency}

REQUEST {Alternate airport} {Weather, Closest Hospital, Aircraft Malfunction}

REQUEST {Police} {Unruly Passenger}

13. Develop a universal dialect for spoken messages. Location names should have one agreed-upon pronunciation.

14. DataCom messages should be non-ambiguous to all pilots and controllers.

15. DataCom spoken and written messages should contain no more than two communication elements.

16. Research studies are needed to determine whether issues exist in the interpretation and execution of spoken or written clearances and instructions. In particular, the following questions should be answered:

a) Should pilots and controllers be provided with displays that present ATC messages in English only or English and their primary language?

b) Should ATC messages be presented orally or visually as text/graphics, or both?

c) How should ATC messages be presented to best capture the intent of the message to controllers and pilots?

d) What is the best approach to convey the finesse of a flight operation (e.g., management of flow)?

e) How do we test messages to ensure the intended action is executed by pilots and controllers who share the same, as compared with different languages, cultures, or both?

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