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Language as a Factor In Aviation Accidents and Serious Incidents: A Handbook for Accident Investigators ed. 3

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LANGUAGE AS A FACTOR IN AVIATION ACCIDENTS AND SERIOUS INCIDENTS

A HANDBOOK FOR ACCIDENT INVESTIGATORS

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Language as a Human Factor in Aviation Resource Center

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**LANGUAGE AS A FACTOR IN AVIATION ACCIDENTS AND SERIOUS INCIDENTS
A HANDBOOK FOR ACCIDENT INVESTIGATORS**

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Synopsis

In an increasingly multicultural and multilingual aviation industry, it is important that accident investigators understand the complex role of language in maintaining safe operations. This Handbook supports investigators to systematically identify language factors in aviation accidents and serious incidents.

Taxonomy

The Taxonomy of Communication Factors in Aviation is based on research by Elizabeth Mathews in 2012, revised collectively (2013 - 2018) by Angela Albritton, Michael Kay, and Elizabeth Mathews. The final version, included in this Handbook, was based on a linguistic review of the Aviation Safety Network Database conducted in 2018 by Joan Carson, Elizabeth Mathews, Steven Singleton, Enrique “Rick” Valdes, and Dave Williams.

Usage Note

All accident information contained in this Handbook is based on official accident investigation reports, published on the Flight Safety Foundation’s Aviation Safety Network Database, unless otherwise noted. <https://aviation-safety.net>

Reviewers See Appendix E— List of reviewers

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PART ONE: INTRODUCTION

1. PURPOSE

The purpose of this Handbook is to support accident investigators in the identification and consideration of possible language factors in aviation accidents and serious incidents, with a focus on multilingual contexts.

This Handbook provides information and guidance that will support accident investigators in conducting a systematic review of communication factors, specifically language factors.

Support provided in this Handbook include the following:

- **A Taxonomy of Communication Factors in Aviation:** a tool that will support better understanding of possible language factors in aviation as related to but distinct from other communication factors.
- **A Language Environment in Aviation Table:** a table to identify the environments and contexts in which language can affect aviation safety.
- **A Checklist** to guide the documentation of language use and language proficiency.
- **Examples of Accidents** in which language factors were identified in various contexts.

2. ADDRESSING LANGUAGE PROFICIENCY IN AVIATION

Background

From an early focus on improving technology and implementing regulations, the industry approach to improving aviation safety widened in the 1970s to include an understanding of the central role of human factors. Awareness of the importance of communications as central to human factors and to aviation safety is widely accepted. However, the role of language as a component of communications is less well understood. The 1977 runway collision between two jumbo jets at Tenerife, Spain, highlighted not only the importance of human factors but also the role of language in maintaining safe communications.

A series of accidents in the 1990's heightened industry concern over the role of language in aviation and led to the adoption of strengthened ICAO Language Standards and Recommended Practices. These language-related accidents include the following:

1990 Fuel exhaustion near Cove Neck, NY, USA;

1995 Controlled flight into terrain, near Cali, Colombia; and

1996 Mid-air collision over Charkhi Dadri, India.

Each of these accidents occurred in a multi-lingual context, and each involved language factors identifiable in the pilot-controller radiotelephony communications.

ICAO Language Proficiency Requirements

In response to these accidents, India proposed ICAO Assembly Resolution A32-16 (1998) urging ICAO “to take steps to ensure that air traffic control personnel and flight crews involved in flight operations in airspace where the use of the English language is required, are proficient in conducting and comprehending radiotelephony communications in the English language.”

The ICAO Language Standards and Recommended Practices (SARPS) adopted in 2003

- Define oral language proficiency for pilot and air traffic controller radiotelephony communications;
- Require proficiency in the use of both ICAO standard phraseology and in plain (operational) language; and
- Require initial and recurrent language testing of pilots and air traffic controllers.

Generally referred to as the ICAO Language Proficiency Requirements (LPRS), they were and are an important and necessary response to industry understanding of the role of language in aviation at the time they were adopted, ensuring that pilots and controllers have minimum adequate levels of language proficiency for safe and effective radiotelephony communications. (Salient aspects of the ICAO LPRS are provided in Appendix C.)

Additionally, the ICAO Language SARPS have raised global awareness of the role of language in aviation safety. However, the ICAO SARPS do not address all the operational or training contexts in which language impacts aviation safety.

Language Contexts Not Included in ICAO LPRS

Subsequent research into the role of language in aviation accidents and serious incidents has shown that language as a human factor impacts aviation safety in a multitude of ways not addressed by the ICAO Language Proficiency Requirements.¹

¹ Elizabeth Mathews, Joan Carson, Steven Singleton, Enrique “Rick” Valdes, and E. David Williams. “Investigating Language Factors in Aviation Accidents.” *Aviation Psychology and Applied Human Factors*. 12:2 (2022) Published Online: September 19, 2022 <https://doi.org/10.1027/2192-0923/a000229>

- They do not specify the language proficiency required for safe and effective flight crew communications, for threat and error management communications, or for crew resource management.
- They do not address the language proficiency needed in ground school, simulator, or flight training instruction conducted in an English as a foreign or second language context.
- There are no reading proficiency requirements, even though operational and safety manuals, Quick Reference Handbooks, and checklists are published in English and used by operational personnel who use English as a foreign language.²
- There are no ICAO language requirements that address the demands of written language in aviation, yet the way in which documents are written has been shown to impact the effectiveness of pilot operational training on an aircraft.
- There are no ICAO language requirements that address the range of communication environments and situations faced by other key aviation personnel (maintenance technicians, cabin crew, or aeronautical station operators, etc.), all of which may be implicated in accidents or incidents.

Although the ICAO LPRS only apply to pilot and controller radiotelephony communications, the impact of language on aviation safety is, in fact, much broader. Accident investigators should be aware of the varying demands on language ability in varying situations.

Aviation English Testing

ICAO LPRS are enforced by ICAO Member States each of which is responsible for testing and certifying the level of language proficiency of its pilots and air traffic controllers. It is important that accident investigators know that aviation English language testing (and training) programs are largely unregulated.³ There are no licensing requirements for aviation English testers, and no universal or national language-specialist regulatory oversight of language testing programs. As a result, the reliability of aviation English testing worldwide is uneven.⁴

² Operating manuals, training manuals, and on board documents are typically not written in a style that accommodates the reading proficiency of people who use English as a foreign language.

³ In a research report sponsored by the UK Civil Aviation Authority, Dr. Barbara Clark notes that, in addition to finding that some pilots and controllers had language proficiency below ICAO minimum standards, there were "...grounds to suspect cheating on aviation English exams...[and] grounds to suspect that some non-native English speakers are not being tested, but instead are granted ICAO Level 4 certificates on 'sweetheart' deals (handshakes, via friends, etc.)..." Clark, B. 2017. *Aviation English Research Project: Data analysis findings and best practice recommendations*. Civil Aviation Authority, Aviation House, Gatwick Airport South, West Sussex, RH6 -0YR.

⁴ There are also cases in which poorly trained raters erroneously (without malicious intent) evaluate candidates in accordance with their understanding of the LPR scale. Erroneous judgments much more often result in higher levels rather than lower ones.

PART TWO: UNDERSTANDING LANGUAGE AS A HUMAN FACTOR IN AVIATION

1. COMMUNICATIONS AND LANGUAGE IN AVIATION

Industry understanding of human factors as a relevant variable in aviation accidents has increased dramatically since the 1977 runway collision at Tenerife illustrated the critical importance of human factors and of communication and language factors, in particular.

Operational and safety experts universally acknowledge that communication plays a role in maintaining safe operations. Yet investigating and analyzing communications remains problematic in accident investigations because of the complexity of the various components of communication, including language. Industry understanding of language factors in aviation has not kept pace with the development of understanding of other human performance factors.

All models of human factors in aviation include *communication* as a fundamental aspect of aviation safety. However, what is not made clear in any model or framework of aviation human factors is the relationship of language to communication, and the distinction between language and communication. In many anonymous reporting systems, and in taxonomies of human factors, language factors are simply included under “communication” or “language barrier.” In addition, current models of human factors do not clarify the variety of operational contexts nor the variety of ways in which language affects aviation safety.

Language Factors in Aviation Accident Investigations

Communication can be understood broadly as a process, an exchange of information between people. It can be interrupted or compromised by a number of variables, including but not limited to problems related to language proficiency or language use. Language itself can be understood as a *tool* of communication, focusing on verbal codes, spoken or written.

A review of possible language factors in a number of accident investigation reports has found that even when language factors are identified in accident investigation reports, they are sometimes obscured in a variety of ways.⁵

Sometimes language factors are catalogued as “communication” errors, when in fact, communication is a topic that encompasses more than language. For this reason language must be identified specifically as that part of the communication that was the salient issue in the accident.

Sometimes language factors are identified as “non standard phraseology” when the communication issue was, instead, related to the use—or lack—of plain operational language.

⁵ The purpose of the review of accidents in this Handbook (Appendix B) is not to challenge the findings of any accident investigation. Rather, examples of how language may appear as a *valid investigative question* are provided to help raise awareness among accident investigators.

Sometimes language factors are identified, but their relevance as the foundation upon which other errors were allowed to develop is misunderstood, or dismissed. Basic facts about language use and language proficiency in the course of a flight are fundamental to being able to identify and analyze possible language factors.

Understanding the role that language plays in aviation is a key element in accident investigations because investigators need to be able to issue meaningful and actionable recommendations to prevent future accidents and to improve safety.

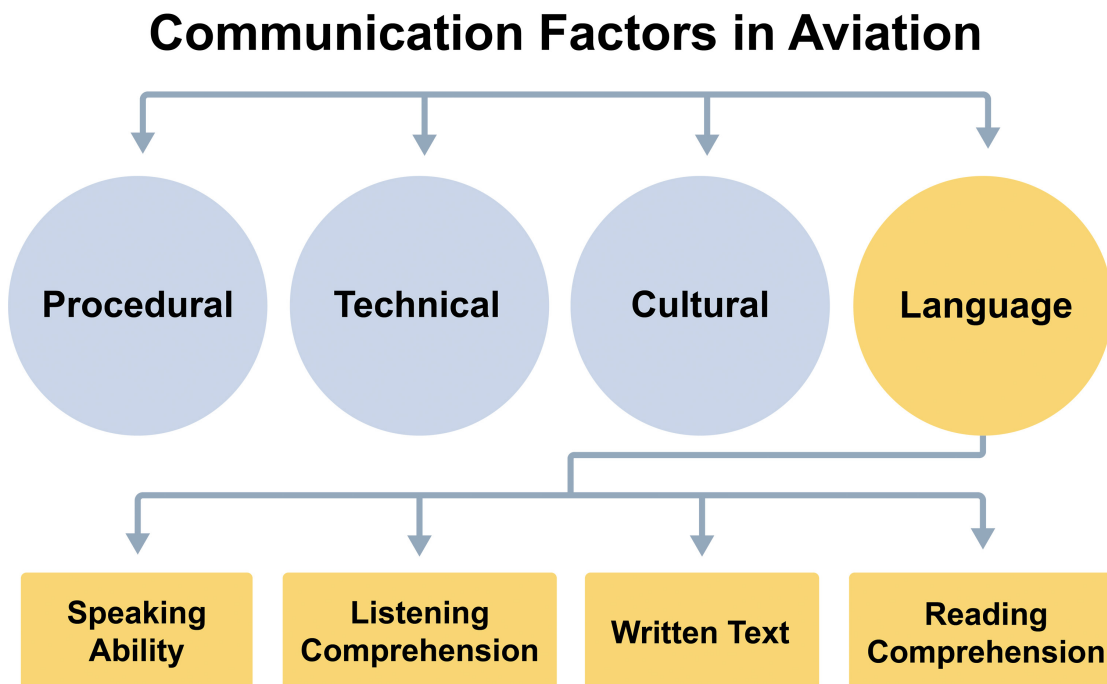
2. A TAXONOMY OF COMMUNICATION FACTORS IN AVIATION

This taxonomy of communication factors in aviation has been developed to support the identification, understanding, and analysis of language as a human factor within the context of other communication factors in aviation.

The purpose of the Taxonomy is:

- To situate and clarify the role of language within the field of human factors;
- To support the identification and analysis of language factors in aviation accidents and incidents;
- To heighten industry awareness and understanding of language in aviation safety.

Standardizing the terminology used to identify and report on language and other communication factors will better clarify the role of language in aviation accident investigations and will enable more meaningful and interpretable Findings and Recommendations related to language issues. Over time, a more standardized approach to the investigation and reporting of language factors will support a comprehensive understanding of the impact of language on aviation safety, beyond pilot and air traffic controller communications.



The Taxonomy of Communication Factors in Aviation distinguishes four types of communication factors: (1) Procedural factors related to communication; (2) Technical factors related to communication; (3) Cultural factors; and (4) Language factors.

- (1) Communication factors related to **procedures** can affect aviation, such as Read Back/Hear Back errors or a failure to share information.
- (2) A communication failure can be the result of **technical issues** that impede communication, such as static or noise on the radio, or an equipment failure.
- (3) Communication can be hindered by **cultural factors** such as group versus individual orientation, issues of power distance, failure to apply principles of Crew Resource Management, or issues within an organization's culture.

There is generally broad industry awareness and understanding of these three categories of communication factors, and accident investigators bring expertise to the analysis of technical, procedural, and cultural factors in aviation accidents and serious incidents.

- (4) Communication failures can also be the result of **Language factors**, a critical component of communication. Within the category of Language, four specific components of language are identified: Speaking, Listening, Reading, and Writing. Each of these components affects aviation safety.

Although the Taxonomy identifies four types of communication factors (Procedural, Technical, Cultural, Language), this Handbook focuses primarily on Language to clarify its role within Communication. In addition, the Taxonomy provides the industry with standardized terms to describe language factors. This will support the identification of meaningful and interpretable language issues, which, over time, will provide a clearer picture of the impact of language on aviation safety.

The Taxonomy is explained more fully in Appendix A.

See Appendix B for examples of language factors in accident reports.

PART THREE: INVESTIGATING LANGUAGE FACTORS

Introduction

ICAO Circular 298 (2003) states that “No accident investigation can be complete without a thorough consideration of Human Factors issues involved” (Paragraph 4.1.21.) As industry understanding and awareness of the scope of human factors has increased, so too has the investigation of human factors in aviation accidents improved. Today, frameworks and models describe human factors in aviation; protocols and checklists support the investigation of human factors in aviation accidents.

The International Society of Air Safety Investigators (ISASI) suggests that accident investigation “findings” be defined as “all significant conditions and events, causal and non-causal, found in the investigation.”⁶ ICAO Annex 13, 1-2, defines an accident **Cause** as “Actions, omissions, events, or conditions, or a combination thereof which led to the accident or incident.”

Contributing factors are defined as those “Actions, omissions, events, or conditions or a combination thereof which, if eliminated, avoided, or absent, would have reduced the probability of the accident or incident or mitigated the severity of the consequences of the accident.”⁷

Using this Handbook

The Taxonomy and information in this Handbook are intended to support a more systematic and thorough investigation of language factors. The next section outlines the steps to follow to ensure language factors are considered and documented.

1. DEVELOP BACKGROUND KNOWLEDGE RELATED TO LANGUAGE IN AVIATION

The first step in investigating language and other communication factors in aviation is to become aware of the contexts of language in aviation, specifically:

- The distinction between Language Factors and other Communication Factors, as outlined in the Taxonomy of Communication Factors in Aviation (*Appendix A*);
- The range of contexts in which language affects aviation safety. (*See Table in Section 2 below and Appendix B: Example of Language Factors in Accidents and Serious Incidents*);

⁶ Wood, Richard H., and Sweginnis, Robert W. *Aircraft Accident Investigation*, ed. 2. Endeavor Books, p. 8.

⁷ ICAO Annex 13, 1-2, defines an accident Cause as “Actions, omissions, events, or conditions, or a combination thereof which led to the accident or incident.” Contributing factors are defined as those “Actions, omissions, events, or conditions or a combination thereof which, if eliminated, avoided, or absent, would have reduced the probability of the accident or incident or mitigated the severity of the consequences of the accident.”

- The scope of the ICAO Language Standards (*Appendix C*); and
- The state of aviation English testing (page 6).

2. REVIEW THE CONTEXTS OF LANGUAGE USE IN AVIATION OPERATIONS AND TRAINING

The second step is to consider all of the contexts in the chain of events in which language (spoken and written) may have affected flight safety.

The table below illustrates the contexts in which language (spoken and written) may appear as a factor. Each of these contexts should be considered for their potential to provide relevant information to the investigative team.

Contexts of Language Use in Aviation Operations and Training

	Speaking / Listening	Reading	Writing
Pilots	<ul style="list-style-type: none"> • <u>Pilot-controller</u> • Pilot-pilot, CRM, flight deck communication, instruction • Pilot-aeronautical station manager 	<ul style="list-style-type: none"> • Aircraft and Operating Manuals • Quick Reference Handbooks • Safety updates and briefings • Training materials • Datalink • Flight Management Systems 	<ul style="list-style-type: none"> • Datalink • Maintenance reports • Safety incident reports
Maintenance Technicians	<ul style="list-style-type: none"> • Instructors 	<ul style="list-style-type: none"> • Aircraft manuals • Safety updates and briefings • Training materials • Safety materials 	<ul style="list-style-type: none"> • Records and reports
Controllers	<ul style="list-style-type: none"> • <u>Controller-pilot</u> • <u>Controller-controller</u> • Ground staff • Emergency services 	<ul style="list-style-type: none"> • Training materials • Safety updates and briefings • Datalink • Charts 	<ul style="list-style-type: none"> • Reports • Datalink
Cabin crew	<ul style="list-style-type: none"> • Passengers • Pilots • Other crew members 	<ul style="list-style-type: none"> • Manuals and learning materials • Equipment instructions • Safety updates 	<ul style="list-style-type: none"> • Reports
<p>Note: Only the communication situations that are <u>underlined</u> are governed by the ICAO Language Proficiency Requirements.</p>			

3. DOCUMENT LANGUAGE INFORMATION WITH A CHECKLIST

The third step is to use the **Language Information Checklist** to systematically investigate language-related information in multilingual contexts.

Language Information Checklist

1. Document the first language of relevant personnel.
2. Document the English language proficiency level of relevant personnel with reference to language proficiency test results.
3. Document the language(s) used in oral (speaking/listening) situations. [Refer to Language Context table above.]
4. Document the language(s) used for written (reading/writing) materials. [Refer to Language Context table above.]
5. Document the language used in training of relevant personnel, when possible.

The US National Transportation Safety Bureau (NTSB) accident investigation protocols include checklists for, *inter alia*, **Operations**, which collect flight crew information such as training, certificates/ratings held and dates acquired, as well as **Human Factors** which collect personal and operational information such as education, family information, sleeping habits, and general and specific training.

Collecting this information does not mean that any of the operations or human factors information thus noted was necessarily relevant to a particular accident/incident. Rather, the information helps the investigators to (a) bring into focus any one piece of information that may deviate from expected norms, and (b) access these pieces of information should they become significant in the course of the ongoing investigation.

In the same way, collecting fundamental information about language use and language proficiency of personnel involved in the accident is a necessary step in any accident investigation.

4. IDENTIFY LANGUAGE FACTORS

The fourth step is to use the Taxonomy of Communication Factors (Appendix A) to identify language factors that played a role in the accident.

Language affects aviation safety in many ways (see Appendix B). At times, language use or language proficiency is a clearly discernible factor in an accident or incident and is identified by accident investigators as a contributory factor. This is especially true in the case of radiotelephony communication.

At other times, language can be a factor in the complex chain of events that is harder to detect. For example, language is the foundation upon which crew resource communication are based. Limited language proficiency has also been shown to hamper operational understanding of the

aircraft. Language proficiency is essential to effective operations, with a potential chain of causality going back as far as its effect on initial or recurrent training and a subsequent negative impact on operational proficiency.

Sometimes inadequate language proficiency may be evident but not found to be a contributing or latent factor. Even if language factors are not determined to be causal, contributory, or a latent factor in the accident, when inadequate language proficiency is identified, it should be noted as a safety deficiency.

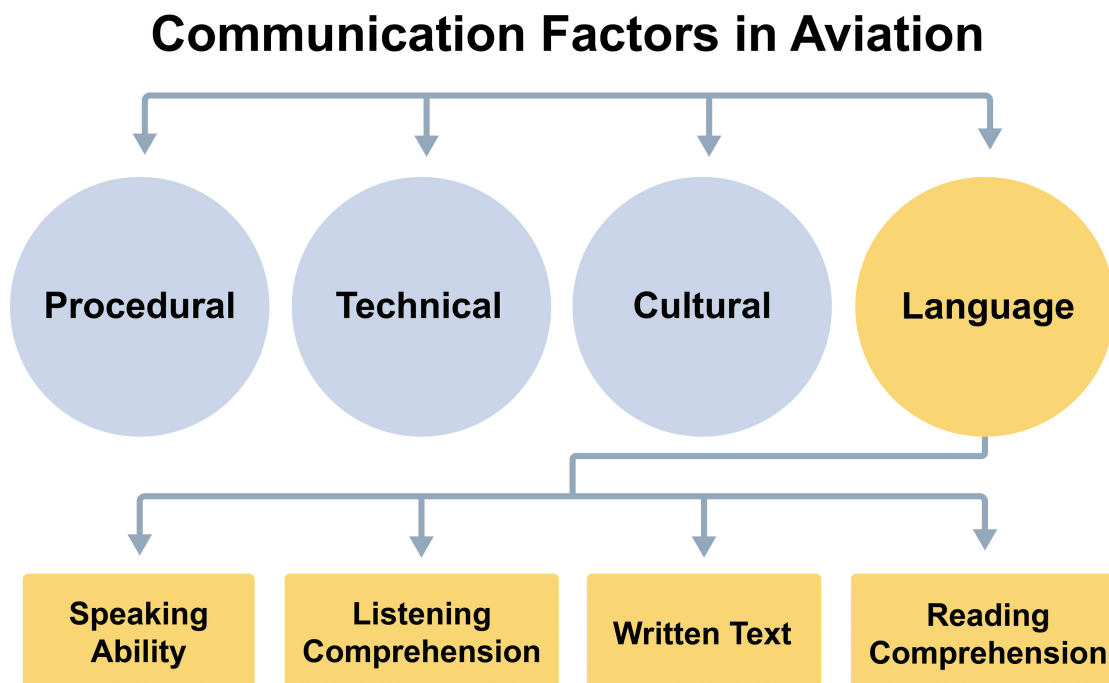
The role of language in an accident can be subtle. In some cases, accident investigators may identify a need for external linguistic expertise. In these cases, the linguistic expert must have “Best Qualifications” according to ICAO Guidance Document 9835. The qualifications are, specifically, a Master’s or Ph.D. degree in Applied Linguistics AND experience in aviation communication.

Note that there are many academic fields related to communication, such as Speech Therapy, Communications, literature-based degrees in English or other languages, and theoretical linguistics. These are not appropriate fields to support aviation accident investigations, as they do not provide the necessary training or expertise in the kinds of approaches to language usage and practice that are needed here.

5. REPORT LANGUAGE FACTORS

Include “Communications” as a separate section of the accident investigation report in which all factors of communication are addressed, in turn: Technical, Procedural, Cultural, and Language Factors. The Language data should include not only language use relevant to the accident itself, but also basic information regarding the language proficiency of personnel involved in the accident that has been documented in the Language Information Checklist.

APPENDIX A—TAXONOMY OF COMMUNICATION FACTORS IN AVIATION



Note: When using this taxonomy, it is important to remember that language skills, in particular, apply to both native and non-native English speakers. While a lack of English language proficiency may be, at times, more easily identifiable for non-native English speakers, the use of inappropriate language by native English speakers also contributes to communication problems.

1. PROCEDURAL FACTORS

Note: the Taxonomy does not include procedural factors unrelated to communication, such as failing to properly check for ice. That is an example of a procedural failure but is not a procedural failure related to communication.

Examples of procedural factors that can affect communication include the following, *inter alia*.⁸

1. Blocked transmission
2. Incorrect or an omitted call sign
3. Two languages in use in same operational environment
4. Failure to relay information
5. Failure to apply checklist or to apply it properly

⁸ Aviation safety experts and accident investigators are most readily familiar, by their background training and experience, with technical and procedural factors that affect communication. The categories here are representative not inclusive, intended to highlight some technical and procedural factors that have been identified in accident investigation reports as contributing to communication problems.

2. TECHNICAL FACTORS

Note: the Taxonomy does not include technical factors unrelated to communication, such as an engine failure, which is a technical failure but is not a technical failure related to communication.

Examples of technical factors that can affect communication include the following: *inter alia*:⁹

1. Noise or static
2. Equipment failures related to communication, such as
 - 2.1. Transponder
 - 2.2. Radio equipment
 - 2.3. Datalink equipment
 - 2.4. Headsets

3. CULTURAL FACTORS

Examples of cultural factors that can affect communication include the following, *inter alia*:¹⁰

1. National Culture
 - Individualism versus collectivism
 - Power distance gradient
 - Politeness norms
2. Organizational Culture
 - Safety culture
 - Crew Resource Management (CRM) and Threat and Error Management (TEM) training
3. Professional culture¹¹
 - Pride in the profession
 - A commitment to the safety culture
 - Sense of invulnerability
4. Individual Culture
 - Cultural and linguistic awareness
 - Personal attributes

⁹ See preceding footnote.

¹⁰ Because the topic of cultural factors in aviation has been relatively well covered in the literature on human factors in aviation, the categories here are representative, not inclusive. Accident investigators and safety experts will be aware of other aspects of culture that affect communications.

¹¹ Helmreich, R.L., “Building Safety on the Three Cultures of Aviation.” *Proceedings of the IATA Human Factors Seminar*. 39-43. Bangkok, Thailand. 12 August 1998. And, ICAO Doc 9859—Safety Management Manual; para 2.6.10.

4. LANGUAGE

1. Speaking

Elements of SPEAKING that can affect communication:

1.1. Accent or Pronunciation

1.2. Structure or Grammar

- Imprecise grammar may impede the transmission of an intended message.
- Speaker's use of complex grammar can impede listener comprehension.

1.3. Vocabulary

- Inaccurate use of ICAO or other Civil Aviation Authority (CAA) approved phraseology
- Failure to use ICAO phraseology
- Use of slang or idiomatic expressions
- Inadequate plain language ability
- Homophony (e.g., "to" vs. "two")
- Ambiguity (e.g., uncertain references to "him," "it," "things").

1.4. Fluency

- Speech rate too fast
- Speech rate too slow
- Hesitations interfere with comprehensibility

1.5. Failure to communicate required information/silence

1.6. Speaker's language level not appropriate for varying levels of listeners.

Usage Notes

- Numbers can be particularly difficult for non-native English speakers to use fluently, and are a frequent cause of incorrect hearback/callback and call sign errors. Numbers are often problematic for native English speakers in the same contexts.
- Responsibility for fluent communication in aviation is not placed just on nonnative English speakers, but on all participants.
- Native English speakers often do not have to undergo tests of their knowledge of ICAO/CAA language phraseology. As a result, lack of standard phraseology may be an issue in communication.
- FAA phraseology is different from ICAO phraseology in some instances.
- Ground staff uses of non-standard communication can be problematic when communicating with ATC or pilots.
- Non-routine radiotelephony messages often rely on speaker's plain language knowledge and proficiency, which can be particularly elusive for non-native English speakers in high stress situations.

- Speaker’s use of passive verbs can cause confusion between listener’s understanding of the agent of the action vs. the object of the action.
- Pronunciation/accent may interfere with listener comprehension of text in cases where a non-native speaker must read aloud from a QRH (or other manuals) written in English.
- A failure to use a checklist among crew members who do not share a common language or who must read the checklist aloud in English as a foreign language may be an indication of a language issue.
- Prolonged loss of communication (PLOC) can be confused with radio silence in which communication ceases for language reasons.
- Pilots or controllers who speak English as a foreign language can experience *language apprehension* and may subconsciously seek to avoid actions that would require additional or non-standard communication in English. This can become evident as “radio silence;” a failure to convey important information; or a failure to clarify or confirm ambiguous information or communications.

2. Listening

Elements of LISTENING that can affect communication:

- 2.1. Failure to respond appropriately to verbal communication
 - Failure to respond verbally, i.e., silence
 - Failure to perform instructed actions, or inappropriate action
 - Inappropriate verbal response
- 2.2. Inaccurate readback
- 2.3. Inaccurate call sign
- 2.4. No communication/silence.

Usage Notes

- Research has found that lack of adherence to ICAO phraseology, including the phonetic alphabet, is a significant reported condition causing confusion among pilots.¹²
- Numbers are used in handovers, call signs, flight level, and can interact with message complexity and speech rate to affect comprehension.
- Since auditory short-term memory performance declines rapidly at about 15 seconds from the onset of new information, lengthy messages containing several instructions contribute to pilots’ cognitive workload and can interfere with comprehension of the message.
- Grammatically complex messages can be more difficult to understand.

¹² Clark, B., op. cit., p. 57.

- English used in training may not be at the level of the trainee's competence at the time of training.
- Pilots may have difficulty understanding each other on a bilingual flight deck.

3. Writing

Elements of WRITING that can affect communication.

- 3.1. Level of writing not adjusted for varying abilities of readers.
- 3.2. Sentence structure obscures meaning.
- 3.3. Technical vocabulary not used appropriately.
- 3.4. Lack of familiarity with format (e.g., reports).

Usage Notes

- Grammatically complex texts can obscure meaning and interfere with comprehension and learning.
- Many writing demands (e.g., reports, logbooks) must adhere to specific format to be comprehensible.
- Safety and technical bulletins may not be written in language adjusted for varying abilities of readers.
- Linguistically complex training materials may result in student's not learning at the level necessary to perform required tasks safely.

4. Reading

Elements of READING that can affect communication.

- Following written instructions.
- Learning from written text.

Usage Notes

- Reading comprehension is important for all categories of aviation personnel: pilots, ATC, cabin crew, maintenance technicians, ground staff, and aeronautical station operators.
- Because of the ubiquity of reading materials in training and operations, the effects of lack of or inadequate reading comprehension can be subtle, but always underlie aviation personnel behaviors.
- Reading comprehension is at the heart of much computer-based training.
- Inadequate language proficiency during training may result in inadequate operational proficiency.

APPENDIX B—EXAMPLES OF LANGUAGE FACTORS IN ACCIDENTS AND SERIOUS INCIDENTS

The following are examples of language factors documented in official aviation accident investigation reports.

This list documents Language Factors specifically, but does not claim that the language factors identified in the reports contributed to the accident or serious incident. Rather, this list illustrates how language factors appear in accident investigation reports and, thus, is intended to raise awareness of the ways that language factors affect aviation safety.

1. SPEAKING AND LISTENING

RADIOTELEPHONY COMMUNICATION

Incorrect phraseology

1973	March 5	Midair collision	France	DC-9 / Convair CV-990
1977	March 27	Runway Collision	Tenerife, Spain	Boeing 747 / Boeing 747

Issuing or interpreting ambiguous ATC instructions

1980	April 25	CFIT	Tenerife, Spain	Boeing 727
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Difficulty comprehending ATC communication

1996	Nov 12	Midair collision	India	Boeing 747 & Ilyushin 76
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Inadequate plain language proficiency to clarify instructions, communicate intent, or manage non-routine situations

1990	Jan 25	Fuel exhaustion	New York	Boeing 707-321B
1996	Aug 29	Crash on approach	Norway	TU 154M
1995	Dec 20	CFIT	Cali, Colombia	B 757-223
1997	Dec 17	CFIT	Greece	Yakovlev Yak-42
2000	Mar 24	Fuel exhaustion	Sri Lanka	Antonov 128K
2002	Apr 15	CFIT	Korea	B767-200ER
2006	Sept 29	Midair collision	Brazil	B 737 / Legacy 600
2007	Jun 4	Serious Incident	London	B 737-500

TWO LANGUAGES USED IN A SINGLE OPERATING ENVIRONMENT

The use of two languages in a single operating environment may contribute to loss of situational awareness.

1960	Feb 25	Midair collision	Brazil	DC3 / DC6
1976	Sept 10	Midair collision	Croatia	Trident Three / DC-9
2000	May 25	Runway collision	Paris, France	Shorts 330-200 / MD83
2001	Oct 8	Runway collision	Milan, Italy	Cessna Citation / MD-87

Note: Limited English language proficiency can result in flight crew being unable to request, direct, or assist emergency services. Emergency rescue personnel who did not understand directions in English from the First Officer on how to access accident victims still on the aircraft, was reported (personal communication) in the following accident.

2000	Oct 31	Crash on take off	Taiwan	B747-41
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CREW RESOURCE MANAGEMENT

Bilingual flight deck communications in English as a foreign language may impede Crew Resource Management. Poor CRM among flight crew who do not share a common first language may be a result of language factors.

2000	Jan 10	Loss of control	Switzerland	Saab 340-B
2005	Aug 14	Crew incapacitation	Greece	B737-31S

2. READING

Low levels of reading proficiency can affect the operational understanding of the aircraft or of procedures when manuals, safety updates, or procedures are written in complex technical English. The impact of limited English proficiency during training that was conducted using operational and training manuals written in English has been linked to inadequate operational proficiency in some accidents. It should also be noted that the operational manuals are usually written in a style not specifically intended for non-native English readers.

1994	Apr 26	CFIT	Japan	Airbus A300
2008	Sept 14	Crash on approach	Russia	B737-505
2012	Apr 2	Ice on wings	Russia	ATR 72
2013	Nov 17	CFIT	Russia	Boeing 737

3. WRITING

Operational or maintenance manuals written in, or translated into, non-standard or unclear English can cause comprehension difficulties.

2002	May 25	Loss of control	Taiwan	B747-209B
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2011	May 7	CFIT	Indonesia	Xian MA60
2011	July 13	Loss of control	Brazil	Let 41OU-VP

APPENDIX C—SALIENT FEATURES OF THE ICAO LANGUAGE SARPS

ICAO LPRS are contained in the following ICAO Documents, (and are excerpted in ICAO Document 9835—*Manual on the Implementation of the ICAO Language Proficiency Requirements, Appendix A*):

Annex 1—*Personnel Licensing* (Chapter 1.2.9 and Appendix 1)

Annex 6—*Operation of Aircraft* (Part 1, chapter 3.1.8)

Annex 10—*Aeronautical Telecommunications, Volume II* (Chapter 5.1 and 5.2)

Annex 11—*Air Traffic Services* (Chapter 2.29)

Doc 4444—*PANS-ATM* (Chapter 12.2.1)

From the point of view of the accident investigator, the salient aspects of the ICAO LPRs are as follows:

- It is the responsibility of the Civil Aviation Authorities (CAAs) to provide oversight of national English language testing.
 - CAAs may provide national testing, either in-house or contracted to a testing service provider, or they may approve testing provided by an airline, an air navigation service provider, or a civil aviation training institute.
 - A CAA may accept the language endorsement from another Civil Aviation Authority.
- It is the responsibility of airlines to ensure that their pilots demonstrate English language proficiency at least at the ICAO Operational Level 4. (ICAO Annex 6; para 3.1.8.)
- It is the responsibility of air navigation service providers to ensure that their air traffic controllers demonstrate English language proficiency at least at the ICAO Operational Level 4. (ICAO Annex 11; para 2.29.)
- Pilots and air traffic controllers must demonstrate ICAO Operational Level 4 in *each* of the ICAO Rating Scale descriptor areas: Pronunciation; Structure; Vocabulary; Comprehension; Fluency; Interactions. (ICAO Annex 1; Appendix 1)
- ICAO Annex 1 requires that language proficiency be documented on pilot licenses. (Annex 1: para 5.1.1)
- ICAO LPRs require proficiency **not only** in the use of ICAO phraseology, **but also** in plain language.¹³ (Annex 10, Vol 2, para 5.1.1.1).

¹³ The use of ICAO phraseology is a standard prescribed by ICAO Annex 10, Vol. 2, para 5.1.1.1: “ICAO standardized phraseology shall be used in all situations for which it has been specified. Only when standardized phraseology cannot serve an intended transmission, plain language shall be used.”

Notes:

- The level of English language proficiency required for cross-cultural flight deck communications, for effective crew resource management, or for flight training in English contexts may be higher than required for radiotelephony communication.
- Radiotelephony communications are generally relatively constrained, while CRM, flight deck communications, and flight training in English require intensive communications in plain operational English that may extend beyond the requirements of performing at ICAO Operational Level 4.

At ICAO Operational Level 4, pilots and ATCs should be able to:

- Communicate effectively in voice-only and in face to face situations;
- Communicate on work related topics with accuracy and clarity;
- Use communicative strategies to check, confirm, or clarify information;
- Handle with relative ease the linguistic challenge presented by unexpected turn of events with context of work;
- Use an accent that is intelligible in an international context.

Excerpts from ICAO Rating Scale, Operational Level 4:

Pronunciation...only sometimes interferes with ease of understanding.

Grammar errors may occur...but rarely interfere with meaning.

Vocabulary is sufficient to communicate work related topics. Can paraphrase.

Fluency permits effective communication.

Comprehension mostly accurate on work related topics.

Interacts adequately, can initiate and maintain exchanges, can confirm and clarify.

ICAO Language Proficiency Rating Scale

LEVEL	PRONUNCIATION	STRUCTURE	VOCABULARY	FLUENCY	COMPREHENSION	INTERACTIONS
Expert 6	Pronunciation, stress, rhythm, and intonation, though possibly influenced by the first language or regional variation, almost never interfere with ease of understanding.	Both basic and complex grammatical structures and sentence patterns are consistently well controlled.	Vocabulary range and accuracy are sufficient to communicate effectively on a wide variety of familiar and unfamiliar topics. Vocabulary is idiomatic, nuanced, and sensitive to register.	Able to speak at length with a natural, effortless flow. Varies speech flow for stylistic effect, e.g. to emphasize a point. Uses appropriate discourse markers and connectors spontaneously.	Comprehension is consistently accurate in nearly all contexts and includes comprehension of linguistic and cultural subtleties.	Interacts with ease in nearly all situations. Is sensitive to verbal and non-verbal cues and responds to them appropriately.
Extended 5	Pronunciation, stress, rhythm, and intonation, though influenced by the first language or regional variation, rarely interfere with ease of understanding.	Basic grammatical structures and sentence patterns are consistently well controlled. Complex structures are attempted but with errors which sometimes interfere with meaning.	Vocabulary range and accuracy are sufficient to communicate effectively on common, concrete, and work-related topics. Paraphrases consistently and successfully. Vocabulary is sometimes idiomatic.	Able to speak at length with relative ease on familiar topics but may not vary speech flow as a stylistic device. Can make use of appropriate discourse markers or connectors.	Comprehension is accurate on common, concrete, and work-related topics and mostly accurate when the speaker is confronted with a linguistic or situational complication or an unexpected turn of events. Is able to comprehend a range of speech varieties (dialect and/or accent) or registers.	Responses are immediate, appropriate, and informative. Manages the speaker/ listener relationship effectively.
Operational 4	Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation but only sometimes interfere with ease of understanding.	Basic grammatical structures and sentence patterns are used creatively and are usually well controlled. Errors may occur, particularly in unusual or unexpected circumstances, but rarely interfere with meaning.	Vocabulary range and accuracy are usually sufficient to communicate effectively on common, concrete, and work-related topics. Can often paraphrase successfully when lacking vocabulary in unusual or unexpected circumstances.	Produces stretches of language at an appropriate tempo. There may be occasional loss of fluency on transition from rehearsed or formulaic speech to spontaneous interaction, but this does not prevent effective communication. Can make limited use of discourse markers or connectors. Fillers are not distracting.	Comprehension is mostly accurate on common, concrete, and work-related topics when the accent or variety used is sufficiently intelligible for an international community of users. When the speaker is confronted with a linguistic or situational complication or an unexpected turn of events, comprehension may be slower or require clarification strategies.	Responses are usually immediate, appropriate, and informative. Initiates and maintains exchanges even when dealing with an unexpected turn of events. Deals adequately with apparent misunderstandings by checking, confirming, or clarifying.

LEVEL	<i>PRONUNCIATION</i> <i>Assumes a dialect and/or accent intelligible to the aeronautical community.</i>	<i>STRUCTURE</i> <i>Relevant grammatical structures and sentence patterns are determined by language functions appropriate to the task.</i>	<i>VOCABULARY</i>	<i>FLUENCY</i>	<i>COMPREHENSION</i>	<i>INTERACTIONS</i>
<i>Levels 4, 5 and 6 are on preceding page.</i>						
Pre-operational 3	Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation and frequently interfere with ease of understanding.	Basic grammatical structures and sentence patterns associated with predictable situations are not always well controlled. Errors frequently interfere with meaning.	Vocabulary range and accuracy are often sufficient to communicate on common, concrete, or work-related topics, but range is limited and the word choice often inappropriate. Is often unable to paraphrase successfully when lacking vocabulary.	Produces stretches of language, but phrasing and pausing are often inappropriate. Hesitations or slowness in language processing may prevent effective communication. Fillers are sometimes distracting.	Comprehension is often accurate on common, concrete, and work-related topics when the accent or variety used is sufficiently intelligible for an international community of users. May fail to understand a linguistic or situational complication or an unexpected turn of events.	Responses are sometimes immediate, appropriate, and informative. Can initiate and maintain exchanges with reasonable ease on familiar topics and in predictable situations. Generally inadequate when dealing with an unexpected turn of events.
Elementary 2	Pronunciation, stress, rhythm, and intonation are heavily influenced by the first language or regional variation and usually interfere with ease of understanding.	Shows only limited control of a few simple memorized grammatical structures and sentence patterns.	Limited vocabulary range consisting only of isolated words and memorized phrases.	Can produce very short, isolated, memorized utterances with frequent pausing and a distracting use of fillers to search for expressions and to articulate less familiar words.	Comprehension is limited to isolated, memorized phrases when they are carefully and slowly articulated.	Response time is slow and often inappropriate. Interaction is limited to simple routine exchanges.
Pre-elementary 1	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.

APPENDIX D—REFERENCES

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