Aviate, Navigate, Communicate:
Silence, Voice and Situation Awareness
in Aviation Safety

A Thesis
Submitted to the Faculty
of
Drexel University
by
Theodoros Katerinakis
in partial fulfillment of the
requirements for the degree
of
Doctor of Philosophy

November 2014
Dedications

To my family
Acknowledgements

I would like to acknowledge the support of my five committee members for their patience, guidance and constructive approach during the process of completing the current dissertation. There are several more specific contributions (among others) that I would like to point out for each member:

Dr. Douglas Porpora, Professor of Sociology at Drexel for the whole coordination, support, mediation and the open ear to discuss and refine all my ideas, as well as of prompting me to frame the broader project. Also, for the numerous hours of scholarly (and not only) discussion which was quite helpful in keeping the focus for this dissertation. My appreciation extends to his mentoring skills and his “ broad-mindedness” to cope with diverse ideas, motivate and restrict when necessary, and being a real mentor for the current dissertation and beyond.

Dr. Thomas Hewett, Professor Emeritus of Psychology and of Computer Science at Drexel for his availability to read through my texts, his steady pace to follow-up on the drafts as well as the accommodating approach during proposal defense. His directive to focus on knowledge acquisition from pilots, as “experts”, was quite fruitful, as well as his suggestions regarding protocol analysis and some real-life cases.

Dr. Janeen Kochan, a Human Factors Scientist and Designated Pilot Examiner, of “Aviation Research, Training, and Services, Inc.”. Her willingness to participate in this endeavor from the start was really encouraging. Her systematic way of looking to my drafts, as well as the comments on how to deal with pilots and controllers as “decision makers”, using concepts from grounded
theory, were quite productive. Her remarks, as a content expert, offered a cleared orientation and several extensions of the current study.

Dr. Emmanuel Koku, Associate Professor of Communication at Drexel, for the time we have spent in discussions of network theory and sociological issues of culture and power relations, as well as for his comments on power structures and methodology. Dr. Koku was also really supportive in one of my first relevant independent studies and other classes.

Dr. Alan Zemel, Assistant Professor of Communication at State University of New York at Albany, for the infinite hours we spent in classes for conversation analysis, data collection and suggestions on how transcripts are used. His detailed comments in the final draft of the proposal were really useful, mainly in the early phases of this study. Also, during the defense his comments helped me clarify key questions, focus on the appropriate data, and narrow down the topic on emphasizing on key informants and appropriate methodology.

As the topic has a clear context of the Greek Aviation realities, I would like to extend my thanks to Dr. Maria Hnaraki, as Director of Greek Studies at Drexel, for the opportunity to teach various Greek-oriented classes which allowed me to keep close contact with institutions and authorities of the Greek State. This type of contact was decisive for the completion of the current dissertation, as classes were conducted both in Drexel campus and abroad in Greece. Dr. Hnaraki was also enthusiastic about the project and its potential contribution to Greek Authorities.
I would also like to acknowledge Mr. Jack Medendorp, Executive Director of Human Research Protection of Drexel Institutional Review Board for his guidance and cooperation and the opportunity to participate in the Collaborative Institutional Training Initiative (CITI). This training process was quite informative and constructive when I was able to complete it.

Last but not least in importance, I would like to express my gratitude to group of my informants/experts and the aviation community I have discussed my scenarios with. More specifically the members of Hellenic Civil Aviation Authority, the Hellenic Aviation Incidents Reporting Committee and the Hellenic Air Accident Investigation and Aviation Safety Board, the Control Tower shifts in “Eleftherios Venizelos” Airport of Athens and the Area Control Center of Athens.

In the end, I am thankful to the community of pilots of 115 Combat Wing (Chania, Crete, Greece) where I spent substantial time of my military service, as well as several pilots of the former Olympic Airways airliner. The names do not appear due to the requirement for anonymity. The collaboration with all the members of the aviation community in Greece, on site while doing their work, was the ignition of the informal discussion with scenarios used for the ongoing terminological project in Greece (Special Committee for Air Traffic Management Terminology) and the current dissertation at Drexel.
### Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>11</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>13</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>14</td>
</tr>
<tr>
<td>CHAPTER 1: INTRODUCTION</td>
<td>17</td>
</tr>
<tr>
<td>1.1 Overview of the Current Dissertation</td>
<td>17</td>
</tr>
<tr>
<td>1.2 Intended Contributions to Communication</td>
<td>22</td>
</tr>
<tr>
<td>1.3 Communication Phenomena in Aviation</td>
<td>26</td>
</tr>
<tr>
<td>1.3.1 Silence and Voice Labels in Phenomena</td>
<td>26</td>
</tr>
<tr>
<td>1.3.2 Language-based Communication Errors in Aviation</td>
<td>35</td>
</tr>
<tr>
<td>1.4 Implementing the Study</td>
<td>44</td>
</tr>
<tr>
<td>1.5 Two Landmark Flights</td>
<td>48</td>
</tr>
<tr>
<td>1.5.1 A Major Accident in the Saved Falcon VIP flight</td>
<td>49</td>
</tr>
<tr>
<td>1.5.2 A Fatal Silent flight: the Helios “Ghost Plane” flight</td>
<td>56</td>
</tr>
<tr>
<td>1.6 Personal Background Regarding this Study</td>
<td>61</td>
</tr>
<tr>
<td>CHAPTER 2: METHOD</td>
<td>68</td>
</tr>
<tr>
<td>2.1 Overview of this Study in a Grounded Theory Approach</td>
<td>68</td>
</tr>
<tr>
<td>2.2 Application of a Grounded Theory Approach for Selecting Sources</td>
<td>69</td>
</tr>
<tr>
<td>2.3 Towards the Core Concept of the Study</td>
<td>77</td>
</tr>
<tr>
<td>2.3.1 Core Concept: Aviation Safety and Grounded Theory Dimensionalization</td>
<td>77</td>
</tr>
<tr>
<td>2.3.2 A Grounded Theory Causal Category: Situation Awareness</td>
<td>80</td>
</tr>
<tr>
<td>2.3.3 The Grounded Theory Emergent Theoretical Model</td>
<td>89</td>
</tr>
<tr>
<td>2.4 The Flow of a Grounded Theory Approach</td>
<td>95</td>
</tr>
<tr>
<td>2.5 From Theory to Scenarios with Protocol Analysis Lessons</td>
<td>105</td>
</tr>
<tr>
<td>2.5.1 Introducing the Scenario of Silence</td>
<td>110</td>
</tr>
<tr>
<td>2.5.2 Introducing the Scenario of Hesitation</td>
<td>112</td>
</tr>
<tr>
<td>2.6 A Process of Sorting and Coding in Grounded Theory with an Example</td>
<td>116</td>
</tr>
<tr>
<td>2.7 Discourse Analysis with Close Reading in this Grounded Theory</td>
<td>123</td>
</tr>
</tbody>
</table>
CHAPTER 3: LITERATURE REVIEW

3.1 Intended Advancements of Literature

3.2 Overview of Literatures

3.3 Systems Theory

3.3.1 Limits of Systems Theory in Aviation

3.3.2 Topics and Types of Analysis in Systems Approach

3.3.3 Communication Literature and Soft Systems Theory

3.4 Human Factors in Aviation-Related Issues

3.4.1 Limits of Human Factors Literature in Aviation

3.4.2 Extending Human Factors with Lessons from Discourse Theory

3.4.3 What is Human Factors

3.4.4 Describing Human Factors in Aviation

3.5 Concepts in Discourse Theory for Communication

3.5.1 Discourse-Oriented Topics and Intended Contributions of the Study

3.5.2 Range of Topics for Machine-Mediated Communication

3.5.3 Flight Tele-copresence, Discourse and Inquiry

3.6 Summary of Intended Inquiries

CHAPTER 4: WHEN SILENCE IS NOT GOLDEN

4.1 Organizing the Chapter of Silence

4.2 Aviation and Silence in Interaction and Beyond

4.3 Using the Silence Scenario to Address Safety

4.4 Pilot Silences with Air Traffic Controllers’ Point of View

4.4.1 Pilot Initiating, due to Hidden Pressure, Sometimes Required

4.4.2 Suspending Talk, Violating clearance, Apologizing, Collaborating

4.5 Pilot Silences from Fighter Pilots’ Point of View

4.5.1 Instructor knows better, Mutual Silence, Mentoring

4.5.2 Safety Culture, Trust, Situation Awareness and Leadership

4.5.3 Conducting Checklists, Morals, VIPs, Arbitrary Non-Reporting

4.6 Summarizing the Chapter of Silence
CHAPTER 5: THE VOICE OF CHOICE ......................................................... 241
  5.1 Organizing the Chapter of Voice .................................................... 241
  5.2 Communicative Transactions of Paralanguage and Hesitation ............. 243
  5.3 Verbal and Non-Verbal Communication Blend ................................ 245
  5.4 Using the Scenario of Hesitation .................................................... 256
    5.4.1 Safety First with Clear Short Messages ..................................... 259
    5.4.2 Pilot Interpretation and Controller’s Bad Moment ......................... 263
    5.4.3 Prudence, Fear and Situational Awareness .................................. 267
    5.4.4 The Ears and the Eyes of the Pilot on the Ground ......................... 275
  5.5 Directness in Language and Familiarity Relationship ......................... 282
    5.5.1 Directness and Familiarity Scenario ......................................... 287
    5.5.2 Phraseology, Professionalism and Cultural Familiarity ................. 289
    5.5.3 Minimizing Mistakes, Helpfulness, Personal-Professional Separation .............. 294
    5.5.4 Home Base, Surrounding Traffic, Intimacy Limit and Mindfulness ............ 300
  5.6 Touching the Mother Tongue in Aviation Communication .................... 306
    5.6.1 Mother Tongue Scenario and Code Switching in Language ............. 309
    5.6.2 Responding to the Mother Tongue Scenario ................................ 310
  5.7 Summarizing the Chapter of Voice ............................................. 314

CHAPTER 6: CONCLUSIONS ................................................................. 316
  6.1 Overview of Contributions .......................................................... 317
  6.2 Silence-Related Theoretical Contributions ..................................... 321
  6.3 Voice and Language-Related Theoretical Contributions ..................... 325
  6.4 Situation Awareness Communication-Related Contributions ............... 331
  6.5 Partnerships and Further Research ............................................. 339

BIBLIOGRAPHY .................................................................................. 345

APPENDIX A: THE SHEET OF SCENARIOS ...................................... 384
  A.1 Short Instructions in English ....................................................... 384
  A.2 Short Instructions in Greek ......................................................... 384
  A.3 Contents of Scenarios and Themes of Open-ended Questions ............. 385
APPENDIX B: ISHIKAWA DIAGRAM AND QUESTIONING ROUTE... 404
   B.1 The Ishikawa Diagram ................................................. 405
   B.2 Questioning Route of the Ishikawa Diagram ....................... 406
APPENDIX C: "EGO- ALTER" INTERACTION WITH AN ADJUSTABLE
   QUESTIONNAIRE.............................................................. 408
APPENDIX D: ICAO- FAA BASIC ENGLISH PHRASEOLOGY
   DIFFERENCES.................................................................... 413
APPENDIX E: NAMING CONVENTIONS AND PROFILES................. 414
VITA.................................................................................. 417
### List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACARS</td>
<td>Aircraft Communications Addressing and Reporting System</td>
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<tr>
<td>ASRS</td>
<td>ASRS - Aviation Safety Reporting System - NASA</td>
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<tr>
<td>ATC</td>
<td>Air Traffic Control, Air Traffic Controller</td>
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<td>ATSB</td>
<td>Australian Transportation Security Board</td>
</tr>
<tr>
<td>AWACS</td>
<td>Airborne Warning and Control System (Aircrafts)</td>
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<tr>
<td>FBEA</td>
<td>French Civil Aviation Security Bureau (Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile)</td>
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<tr>
<td>CDR</td>
<td>Cockpit Data Recorder</td>
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<tr>
<td>CRM</td>
<td>Cockpit Resource Management that evolved to Crew Resource Management</td>
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<tr>
<td>CW</td>
<td>Combat Wing</td>
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<tr>
<td>EAPA</td>
<td>Hellenic Aviation Incidents Reporting Committee</td>
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<tr>
<td>EASA</td>
<td>European Air Safety Agency</td>
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<tr>
<td>ELETO</td>
<td>Hellenic Society for Terminology</td>
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<tr>
<td>EUROCONTROL</td>
<td>European Organization for the Safety of Air Navigation</td>
</tr>
<tr>
<td>FDR</td>
<td>Flight Voice Recorder</td>
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<tr>
<td>FIR</td>
<td>Flight Instruction Register</td>
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<tr>
<td>FOD</td>
<td>Flying Objects Debris</td>
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<td>GA</td>
<td>Global (Situation) Awareness</td>
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<tr>
<td>GEETHA</td>
<td>Hellenic Joint Chiefs of Staff</td>
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<tr>
<td>GT</td>
<td>Grounded Theory</td>
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<tr>
<td>HAF</td>
<td>Hellenic Air Force</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>HAAIASB</td>
<td>Hellenic Air Accident Investigation and Aviation Safety Board</td>
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<tr>
<td>HCAA</td>
<td>Hellenic Civil Aviation Authority</td>
</tr>
<tr>
<td>HELLAS</td>
<td>GREECE (official name and known name of the country)</td>
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<tr>
<td>ICAO</td>
<td>International Civil Aviation Organization</td>
</tr>
<tr>
<td>IATA</td>
<td>International Air Transport Association</td>
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<tr>
<td>IFALPA</td>
<td>International Federation of Airline Pilots’ Association</td>
</tr>
<tr>
<td>IFATCA</td>
<td>International Federation of Air Traffic Controllers' Associations</td>
</tr>
<tr>
<td>LA</td>
<td>Local (Situation) Awareness</td>
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<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
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<tr>
<td>NATO</td>
<td>North Atlantic Treaty Organization</td>
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<tr>
<td>NTSB</td>
<td>(United States) National Transportation Security Board</td>
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<tr>
<td>OMEODEK</td>
<td>Special Committee for Air Traffic Management Terminology (of the Hellenic Civil Aviation Authority)</td>
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<tr>
<td>RCAI</td>
<td>Romanian Civil Aviation Inspectorate</td>
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<tr>
<td>RoE</td>
<td>Rules of Engagement</td>
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<tr>
<td>SA</td>
<td>Situation Awareness (and Situational Awareness, in literature)</td>
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<tr>
<td>SATCOM</td>
<td>Satellite Communication (System)</td>
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<tr>
<td>SOP</td>
<td>Standard Operating Procedures</td>
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<tr>
<td>TA</td>
<td>Transitory (Situation) Awareness</td>
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<tr>
<td>TACAN</td>
<td>Tactical Air Navigation System</td>
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<tr>
<td>TRM</td>
<td>Team Resource Management</td>
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<tr>
<td>USN</td>
<td>United States Navy</td>
</tr>
<tr>
<td>VIP</td>
<td>Very Important Person</td>
</tr>
</tbody>
</table>
List of Figures

1. Figure 1.1. (a): A flight as a chain of voice-silence periods (from Qantas Flight Safety, 2002)………………………………………………………………………………..28
2. Figure 1.1(b): General Aviation accidents per stage of flight (adjusted from Zeldes, 2008)………………………………………………………………………………..28
3. Figure 1.2: Communication Errors and Aviation Safety Events (modified from Malakis, 2005)………………………………………………………………………………..39
4. Figure 1.3: Mnemonic Table with Naming Convention of Informants……..46
5. Figure 2.1: Deconstructions of Awareness concept (a synthesis from illustrations of: Endsley, 1988; Freeman & Cohen, 1995; Hone et al, 2006a; Hone et al, 2005)………………………………………………………………………………..81
6. Figure 2.2: The core concept of the study with inter-related categories……90
7. Figure 2.3: The process of a GT approach applied in this exploratory study .96
8. Figure 2.4: Example of Constructing the Theoretical Dimensions of “Pilot Incapacitation and of Ineffective Crew Resource management”………………119
9. Figure 3.1: Structures and Layers of Culture (adapted from Braithwaite, 2001)…………………………………………………………………………………………132
10. Figure 4.1: Selected responders for the Scenario of “Silence”………………169
11. Figure 5.1: Selected responders for the Scenarios regarding “Voice”…..242
Abstract
Aviate, Navigate, Communicate:
Silence, Voice and Situation Awareness in Aviation Safety
Theodoros Katerinakis

The purpose of this dissertation is to show how important human communication is in order to accomplish a safe flight. A flight is represented as an act of conversation that combines culture with communication of co-present and cooperative actors, in the highly mediated environment of the flight deck. The value-added contribution of this dissertation has been to infuse communicative components to, both, human factors and systems theoretic approaches to aviation, in a way that has not been done before by communication scholars.

The discursive space of a cockpit consists of actors that take roles and apply rules to complete tasks with their social actions. Conversation takes place in a time-critical situation and interlocutors have to keep track of responding to demands. They must comprehend the system in its entirety, position their role in it, and remain vigilant for consequentiality. Cockpit conversation is an interaction “spoken not yet heard; heard not yet understood; understood not yet agreed; agreed not yet applied; and applied not yet always applied.”

Talk and, as emerged, silence too is inseparable from the task, as necessary to develop understanding of the flight situation. Language and action are juxtaposed in real-time speech acts. Interlocutors (pilots and ATC) act according to what they communicate and communicate in order to act.
With the use of a grounded theory approach, real-life scenarios for in-depth interviews with aviation informants were developed and analyzed using discourse analysis and closed reading. Four theoretical contributions were accomplished: (i) the deconstruction of silence phenomenon in multiple dimensions (personal, operational, institutional and regulatory), as part of an interaction; (ii) the synthetic proposition of a voice-categorical label which consolidates paralanguage and hesitation, non-verbal and verbal attributes, in a communication channel applicable in aviation; (iii) the incorporation of situation awareness, with its views of local, transitory and global, as a component in communication models; and (iv) the revisit of mother tongue as a non-conflictual but complementary communication tool which may facilitate linguistic security, instead of competing with the topical standardized English in aviation.

Aviate, navigate, communicate is the tri-fold of flight implementation in search of the flying instinct.
CHAPTER 1: INTRODUCTION

1.1 Overview of the Current Dissertation

The purpose of the dissertation is to show how important human communication is in order to accomplish a (safe) flight mission. A flight has been represented in various ways but not as an act of conversation that combines culture with communication of co-present, mediated and cooperative actors. An airplane flight, among other things, is a communication session taking place in the highly mediated environment of the flight deck. The discursive space of a cockpit consists of actors that take roles and apply rules in order to complete tasks with their social actions. Conversation takes place in a time-critical situation and all interlocutors have to keep track of responding demands. They must understand the system in its entirety, position their role in it, and remain vigilant for consequentiality.

Talk and, we will see, silence too is inseparable from the task, as necessary to develop understanding of the flight situation. Language and action are juxtaposed. Talk and broader communication occurs not because people want just to interact, but because they need to establish and sustain relationships for a cooperative environment, to get things done in their flight. Participants in flight situations are communicating (using verbal language but not only, as we explain in this study) not just to declare what is true or false but to “do things”, correct errors, contribute to increase awareness for the other flight interlocutors, and report an action when done. Conversation utterances in flights are real-time speech acts. Interlocutors (crew members and air traffic controllers) act according to what they communicate and communicate in order to act. Even
when interlocutors just report facts (the facts they observe in the situation) they meta-communicate the confirmation of what they have accomplished. When actions are attempted and not completed communication is again the next step to continue.

**Readback, Hearback and Affordances**

Pilots must respond to controller’s instructions with a full readback of critical components of the instruction. For example, the message "**Climb to 320, Aircraft 531**" contains critical information that the readback "**Roger, 320 for Aircraft 531**" misses (the movement upwards). The hearback from the controller "**Climbing, Aircraft 531?**" complements the missed part (the “moving up”). Controllers, on their side, must use the pilot’s readbacks to ensure that the original message was received by the intended aircraft and understood. The controller's hearback (of the pilot's readback) is intended to confirm that the pilot heard it right, but also helps to validate that the controller send it right. This is the message-readback-hearback chain with the embedded redundancy which is typical in flight interactions. The language factor is crucial, as spontaneous interaction may deviate from the Standard Operating Procedures (SOPs in flight manuals) in style or content (English or other, with code switching).

An airplane flight represents a communication session with the purpose to realize the mission from departure to arrival point. The communication model serves as the proper attainment within an ideal flight session. Speakers and addressees work together to ensure that their utterances are mutually
understood, as pilots are “many” to address “one” controller with accuracy and in a rapid pace. Controller-pilot communication follows a collaborative scheme. Aviation discourse is completely mediated, highly regulated, intense to be mission critical, and primary actors (crew members and air traffic controllers - ATC) emerge from different organizational structures and cultures (Braithwaite, 2001).

The discursive space of a cockpit includes actors, roles, rules, mediation equipment and affordances as abilities to manage social interactions, emotional context, or social presence (Gibson, 1979; Gaver, 1991; Greeno, 1994). The concept of affordances, as introduced by Gibson, would describe environmental attributes of the cockpit relative to human operators. These are objects of the physical world in the cockpit, like information displays, control sticks, switches, buttons and paper materials of manuals, and the memory storage of flight recorders which enable or constrain behavior of their users. For the controllers, who are co-present in the cockpit, affordances describe their own operating environment in the ground control centre with different information displays, handling and communication devices.

Gaver (1991) noted that affordances exist not just for individual action, but also as possibilities offered by the physical environment for social interaction. Greeno (1994) connected affordances with the abilities (as attributes) of the participants who contribute to the interaction. Using Gaver’s terms we could include the affordance of functionality in the interaction between pilots and controllers. The cockpit and the ground control room relate the physical characteristics of information displays of pilots and controllers with
the competence of both parties to communicate. In turn, inside the cockpit affordances of functionality may determine the understanding of the interaction between pilot flying the airplane and co-pilot non-flying. The position of the side sticks, the mechanical connection of control wheels, the autopilot configuration, the colors of leds and switches, and the position of the crew rest area are all characteristics that connect perception with action inside the cockpit. The example of the 2009 crash of Air France AF 447 flight in the Atlantic Ocean is a typical occurrence of functionality-interaction-competence problematic. In that flight captain, relief pilot flying (when captain was resting), and co-pilot could not afford to interact and act in their cockpit environment, when “all of a sudden everything started going wrong” as dictated in the accident investigation report (FBEA, 2012, p. 167-182).

**Navigate (first) Aviate, , Communicate**

In terms of physical location of these communication sessions, "cockpit" or "control cabin" was used for the captain’s station in boat transportation. In the late 1960’s, when the Boeing 747 aircraft’s program was launched, the term “flight deck” was decided to include control cabin, extra crew seats and a possible crew rest area with bunks. In this study, the term cockpit is used in reference of pilot-specific communication control; otherwise the two terms are used interchangeably. The marking of checklists for flight parameters, the collaboration of crew members inside the cockpit and the report to air traffic controllers are greatly influenced by these functionalities. Furthermore, investigation or reenactment of incidents during accident investigations is based
on such functionalities and the way they allow or constrain the action of crew members.

The cockpit (as the operating space to “navigate, aviate, communicate”) in the flight deck is an automated cooperative environment and also a special case of a computer supported collaborative environment (CSCE, see Suchman et al, 1999; Suchman, 1997; 2009). In its form of CSCE, interaction as attention management (cross-device interaction, cross-mode interaction), perception with comprehension, context management, establishment and maintenance of relationships are instrumental. Human actors have to be capable of understanding the system as a whole, of positioning their role in it, identify with the group tasks and operation of automation parts, and remain conscious of “what differences their actions make”.

In this study, the exploration focuses on human communicative practices in various channels and tools employed from cockpit-to-cockpit, cockpit-to-cabin, cockpit-to-airport tower control room, and cockpit-to-command center (of operations in commercial flights or mission control in military flights). Communication interaction between human actors in those “spaces” establishes an integrative flow for physically present and co-present interlocutors. The modes, channels, practices and concerns of their communication with the consequences to flight safety are in the core of this study.
1.2 Intended Contributions to Communication

Little is known about the human communication use of silence and voice in flights, especially in unusual or emergency situations. In addition to voice, this study explores the role of silence (personal, operational, institutional and regulatory) and its impact on effective flight communication. In aviation communication interaction is purposeful, since pilots and controllers develop consciousness of “where is the one and where is the other and in what status” only when they exchange messages. The channel of voice between pilot and controller may contain periods of operating in silence, but voice should restart in order to have a meaningful exchange of information (with no uncertainty) between their physically distant spaces. The empirical data from the aviation informants used in this study are expected to accommodate a whole range of instances of voice and silence. The channel of voice has a scope covering verbal signals with certain phraseology till truncated messages of hesitation, interrupted messages and dialogic marking of checklists.

In terms of communication, airplane flights are abstract representations of the basic model of communication with flight operating manuals dictating all activities; but this rather happens in routine cases as ideal flight situations. The routine cases are very important as they frame a sense of “flight normality” and assign attributes and expectations to the human participants involved. Schemes of conversation from actual flights and incidents will be used to examine how communication is produced and how each recipient acts on that. Such conversations in textual forms are common in archives of Aviation Accident Investigation Authorities (like ATSB, USNTSB, EASA, FBEA, HAAISB; also
see in Walters & Sumwalt, 2000; MacPherson, 1998, Murphy, 1980). Different scholars had highlighted diverse aspects in such texts like linguistic factors (Cookson, 2009; Nevile & Rendle-Short, 2007); problematic discourse (Howard, 2008); message misunderstandings (Barshi, 1997), and human error and expertise (Dismukes et al, 2007). The current study aims to show the convergence of that conversation in communication terms.

The current dissertation aims to use that framework to move forward on crisis interactions when flight situations contain non-routine phases or are identified as flight in crises, as a whole. Therefore, we begin with two paradigmatic non-routine flights that lay the foundation of several communication-oriented phenomena of interest aggregated under the labels of “silence” and “voice” (of Chapters 4 and 5). The cockpit system has to be what engineers call a fault-tolerant system (in the event that a component fails, the faulty component is determined and taken off service and a backup component or procedure can take its place immediately with no loss of service). This technical attribute impacts the way human actors operate in order to detect and correct errors and collaborate to ensure flight safety. But the only way to see that system functioning is in the signaling and ratification by speakers of workarounds.

When flight crew members confront an emergency or abnormal situation in flight, they are expected to prioritize their immediate actions in the order of “aviate, navigate, and communicate”. “Aviate” means to ensure the safe flight path and condition of the aircraft (flying the aircraft but also the completing of checklists). “Navigate” means to find a safe flying position, decide to continue
to or divert from the originally intended destination or proceed to an emergency descent. The decision may be immediate but requires coordination via communication with air traffic control and other parties, except when carrying out critical activities that will be reported afterwards (as it happened with the Falcon VIP flight in rapid descent). “Communicate” happens in the previous stages but may include a “standby” to save time or declare an emergency (when the pilots believe to be facing an emergency situation) as soon as possible (as noted in the example of section 2.6 with the fatal delay) and cancel it later if normality is restored (as noted in section 4.3.1 with controller’s responses and expectations).

Literature on flights tends to focus only on conversation within the cockpit. I aim to extend this literature by incorporating as well the dialogue with the co-present interlocutors in the whole chain of interaction. The role of the air traffic controller as a substantial co-present actor is highlighted in this study. Furthermore, responders evaluate the instances when their interaction extends to “outeraction”.

Outeraction is a process of imminent conversation and flexible informal communication (Hwang et al, 2009; Nardi et al, 2000). In this view, outeraction is a catalyst for interaction, as social exchange is a preamble of the conversation for the main functions. Interaction, in this view, has a more specific meaning of information sharing and problem solving. In the case of aviation, outeraction covers discourse that connects controllers- pilots with each other and manages their communication out of exchange information only. Controllers and pilots may converse with each other in social ways “outside” information exchange
(using an alternative frequency, before or after the flight or even during the flight, in brief). Connecting in social ways when contextual features are negotiated through conversation facilitates information exchange. That kind of outeraction was also part of the introduction of my conversation with most of my aviation informants (as shown in the first stage conversations of Appendix C). Some informal conversation on mutual acquaintances in HAF, as well as shared memories from mission design or air travel were useful to start the discussion and forward an interview to go deeper.

Psychologists and engineers studying flights have emphasized these issues of trust and safety, insofar, as they relate to technology and automation (Hopkin, 1995; Muir, 1987; 1994; Muir & Morray, 1996; Muller, 1996). I intend to extend the literature here too by researching inter-personal trust and what high-level practitioners call safety culture, how they interpret just culture, and understand human error and its consequences.

Lastly, from a methodological point of view, the incorporation of a grounded theory (GT) approach in this study resonates with the people who experience the phenomena under study and also have a professional interest on the study (pilots, air traffic controllers and accident investigators (Brown et al., 2002; Strauss & Corbin, 1990). The communication discipline is expected to gain insights with a GT approach in this study due to the complexity and variability of human action even in mission critical environments. Communication inquiry in aviation using a grounded theory approach is intended to connect “what is really going” with data from the field; to ratify the belief that humans take an active role in responding to problematic situations.
and are sensitive to the evolving events in micro-scales of time; and show the relevance of theory grounded in data. The observed interrelationships in aviation among conditions (structure), action (process), and consequences (as in Strauss & Corbin, 1998, p. 9-10) are quite compatible with the communication continuum that the discipline adopts (Devito, 2011, p.143-145). In this study via grounded theory is a realization that meaning is defined and redefined through interaction and the human participants act on the basis of meaning.

1.3 Communication Phenomena in Aviation

1.3.1 Silence and Voice Labels in Phenomena

Silence does not function in the same way in all cultures or sub-cultures (Vainiomali, 2004; Tannen & Saville-Troike, 1985). Silence can be attributed to low self-respect, and self-consciousness in the professional environment. At other times there is an obligation of non-silence when reporting incidents or filling out an operational log. Humans are generally unwilling to speak-up in organizational environments (Morrison & Milliken 2000; 2003; Milgram, 1974). In flight communication team members in the airplane cockpit or cabin and sometimes controllers function as a safety mechanism when they voice their opinion/observation in unusual or emergency situations. Besides voice, this study explores silence in personal, operational, institutional and regulatory levels. All have an impact on effective flight communication and safety.

Silence is personal when a pilot is not-talking or not-reporting in flight logs as a choice, operational when it is needed for take-off and landing, institutional from corporate culture and power structure, and regulatory when silence is imposed from regulations when emergency is happening. When
silence is broken, a multitude of verbal and non-verbal signals are examined in order to explain how human communication works in flights where incidents occur, conditions of emergency are anticipated and then change, or peak-point emergency escalates. Situation understanding as awareness, constraint time prioritization of speech and act, compulsory embedded redundancy, and language security are concepts that emerge as contributions to communication theory and modeling, while flight safety is in top priority.

**Cockpit-Air traffic Controller Communication**

There are several critical phases in cockpit-air traffic controller communication cycle or continuum. Silence is part of the interaction and voice should be used (till the computerized data link with text messages will become wide spread). Controllers and pilots, using the vocal channel, assess the trustworthiness of each other (as speakers) and the information provided by the technology they use. By replacing voice with a (even high-quality) text message, the “manner, phrasing and pacing of speech” is lost (Hopkin, 1995, p. 347).

Periods of silence are part of the process but for how long and what happens when silence should break with voice? The following figure (in two parts) breaks down a flight in stages, notes the switch between silence and voice in pilot-controller communication and mentions the type of communication (part a). In part (b) the figure shows the percentage of flight accidents, in the flight stages of part (a) in order to connect communication with flight activities that have an impact on safety. Furthermore, part (b) includes the elapsed time (on average) for each stage of the flight as a percentage of the total flight time.
Considering both parts of the Figure in parallel, we can form a clearer picture about the type of communication, the relevant workload in the cockpit, and the time used for each flight stage. These aspects of a real flight situation provide insights about the stage when an accident/incident may occur. We will go through the Figure 1.1 with parts (a) and (b) in the following:

Voice-Silence Continuum and Stages of General Aviation Accidents Occurrences

![Figure 1.1(a): A flight as a chain of voice-silence periods (from Qantas Flight Safety, 2002)](image1)

![Figure 1.1(b): General Aviation accidents per stage of flight (adjusted from Zeldes, 2008)](image2)
The intervals of part (a) show the type of messages; the stages of part (b) show
the usual activity of the flight, and the amount of time spent in that activity (per
flight). E.g. the cruising stage takes 60% of the time per flight, it is a period
when 15.7% of the total number of accidents occurs, and all types of
communication messages are exchanged. That is why the two parts are
explained in parallel steps below.

In Figure 1.1(a) a flight is accomplished when we can reach from a
departure airport A to an arrival airport say B (in the direction of the dashed line
on the bottom), from the left hand side start to the right hand side destination (in
the bottom part of the diagram), with safety. The flight is divided to seven
stages, three before and three after the main “axis” in the period of “all
communication” in the center (it is a cruising phase of the flying aircraft,
usually with the use of autopilot). The stages are represented with symmetry in
regards to what is communicated (from a regulatory point of view). The
projected flight model is an average routine flight, approximating an ideal
situation, as designed for flight instruction and training purposes in civil
aviation. Those stages will be mentioned in the data analysis of Chapters 4 and
5.

In the start for part (a), doors close and cross-checked in the first stage
on the left, in which only safety-related messages are communicated between
pilot and controllers (voice). In part (b) it is the pre-flight taxing activity of
ground movement for the aircraft. The second stage, with no contact messages
(silence), has the ground acceleration for take-off roll, the take-off and initial
climbing till the landing gear is up. In part (b), it is the take-off and initial climb stage of flying. In the third stage, with only safety related messages to be communicated (restricted voice), the airplane is airborne and climbing till the seat belt sign is off (usually beyond the 20,000 feet, depending on the type of the airplane and the airliner). It is the climbing stage in part (b). The fourth stage, open to all types of communication (voice and silence), is the stage of the “main” flight which corresponds to the cruising activity and usually covers the 60% of the whole flight, in part b). Although this stage is open to all types of communication and the use of autopilot mechanism, it is quite common in long flights over the oceans (and international air space) to experience long periods with no vocal communication (similar to a communication vacuum) with the outside world (till the next ground controlled airspace). Modern commercial aircrafts (after 1978) include an Aircraft Communication Addressing and Reporting System (ACARS\textsuperscript{1}) to transmit and receive messages from ground facilities (airline operator and maintenance department, aircraft or system manufacturer, etc). The use of such transmissions during the cruising stage (and beyond, in order to position the flight’s cruising location and project flight systems “health checks”) became widely known in the media regarding two recent tragic events: (i) the deadly crash in the Atlantic ocean (on June 1, 2009 with 228 people on board) of Air France flight AF 447 from Rio de Janeiro to Paris, for which the French Civil Aviation Safety Investigation Authority

\textsuperscript{1} ACARS can make use of the SATCOM, the radio system that uses satellites (for voice and data transmissions) to transmit its data to ground stations. The system rely on “pings” (like most utilities in internet-connected machines), as simple probes used to check the reachability of SATCOM systems aboard the planes. The pings tell us that the plane has power and it likely intact (because it has power). Eurocontrol’s skybrary electronic repository provides a detailed description for the ACARS functions and messages at http://www.skybrary.aero/index.php/Aircraft_Communications_Addressing_and_Reporting_System.
published a final report (FBEA, 2012) and (ii) the disappearance of the Malaysian Airlines flight MH370 flight from Kuala Lumpur to Beijing (Mar. 7, 2014, with 239 people on board) in the Indian ocean (as a likely location) that is still under investigation\(^2\) and has not been resolved yet.

The fifth stage in Figure 1.1 (a) is the start of descent to the destination (part b) with only safety-related issues to be communicated (\textit{restricted voice}). The flight is down around the 20,000 feet altitude, the seat belt sign is on and there may be some maneuvering till the final approach to destination. Descent and maneuvering together could take 21\% of the whole flight time (on average, in part b). The sixth stage is with no contact messages (\textit{silence}), the landing gear is for landing. The aircraft lands, slows down and turns off the active runway on the ground. It may take approach and landing time of part (b), with a total of 4\% of the flight time. It is striking that this sixth stage accounts for 33.8\% of the total number of accidents, in the top line of Figure 1.1 (b). Lastly, in the seventh stage the aircraft is taxing to arrive at the terminal, only safety-related messages are communicated (\textit{restricted voice}) in a ground movement that is not counted as flight time, but still accounts for 4.7\% of the general aviation accidents.

In Figure 1.1 (a) the first three and the last three stages correspond to the sterile cockpit implementation and compliance to general aviation regulations (and practices). The sterile cockpit/flight deck is the concept of restricting flight crew member activity to that \textit{“which is operationally essential during busy phases of flight”} (Skybrary, 2013). These phases are taxi out, take off, initial climb, intermediate and final approach, landing, and taxi in, as shown in Figure

1.1 (a and b). Taxiing happens in two stages as the movement of an airplane on the surface of an airport, under its own power.

It is no coincidence that the no-contact periods (of silence) in part (a), when no communication is permitted regardless the circumstances, are the stages mentioned in part (b) that take only 6% of the flight time but account for the highest percentages of accidents (23.4% in take-off, 33.8% in approach and landing), with the most workload for the crew. So, the majority of accidents occur when flights approach or depart from airports. In several studies (like NTSB, 1994) it is indicated that maneuvering flight, approaches, takeoff/initial climb, and dealing with weather factors are flight activities with the likelihood of the most serious accidents.

When crew members are not focusing on their flight activities, engage in non-essential conversations or in activities totally unrelated to flying, critical information can be missed or misinterpreted (especially during the critical parts of the flight mentioned above). After reviewing several accident events, the U.S. Federal Aviation Administration (FAA) established the explicit sterile cockpit rule in 1981 (Federal Aviation Regulation #121.542). In Europe the Sterile Cockpit concept is addressed by a European Commission Regulation (EU-OPS 1.085 paragraph (f)(9)). Several of the aviation informants in this study are addressing the sterile cockpit rule and practice mainly in Chapter 4.


**Air Traffic Management**

Lastly, from the point of view of the controllers who participate in the study, a flight is the object of Air Traffic Management (ATM) as implemented by Eurocontrol in Europe (Bonini, 2005, p. 44-52). ATM includes Air Traffic Control (ATC) which deals with aircraft separation in the sky and the airport.

Air Traffic Flow Management (ATFM) is done before the flights with filing and analyzing a flight plan for each flight. In this process the expected capacity of the airspace is calculated and the controllers dispatch expected times for departures, for the safety of the flights. If they capacity is reached, the aircraft has to wait on the ground until it is safe to take off. Aeronautical Information Services (AIS) collects and distributes aeronautical information necessary to airspace users. These include information on: safety, navigation, technical, administrative, or legal matters and their updates. In this study the work of the controllers is focused on ATC when they respond for their actions.

The analogy used by Bonini (2005, p. 46-48), for flight airways, is the one of multi-story motorways with two lanes, one lane from east to west and one lane for flights from west to each. The two lanes have a number of different floors or levels. The civil controller needs to ensure that when the two lanes cross each other aircrafts are safely separated, and, with an efficient flow.

Regulation exists to avoid a conflict at crossing points of two or more aircrafts. The airspace of those lanes is divided in homocentric sectors around the airport with reference to their proximity and altitude. These sectors correspond to the stages of flight represented in Figure 1.1. Also, the control exercised by the civil controllers follow the seven stages of the flight in figure 1.1 (a, b). From the
ground at an airport upwards we have: ground space (with ground control from
gate to take-off or from landing to gate); tower airspace (with tower control
with initial climbing in departure or final descent in arrivals); terminal airspace
(with departure control or arrival control, in a specified distance from airport A
and airport B of figure 1.1); and en route airspace (with en route control,
between departure terminal area and arrival terminal area). In several cases,
oceanic control is included in the regulated spaces over the oceans. National air
spaces in different countries have sectors, as volumes of airspace, which are
crossed by a number of routes. The transition from one type of airspace to the
other is a checkpoint in pilot-controller communication; e.g. in the route of the
AF 447 flight before the deadly crash, the Dakar Tower (in Senegal) had the no-
reply in its calls and notified Air France in Paris. Dakar Tower Senegal was the
expected checkpoint station call after Rio de Janeiro Tower (in Brazil).

By controlling these airspaces and stages, the controller needs to detect
conflict and then resolve conflict in airspaces by separating the flights in
fractions of time. The controller is a decision maker who has to decide
according to demands of the operating environment, which changes after each
decision, as it happens to the pilots also. A flight is accomplished when we can
reach from airport A to airport B with safety and operates in a communication
continuum (air to ground, ground to air by means of communication devices,
hardware indicators and sensors). Communication begins on the ground
between cockpit and different types of controllers, depending on the altitude of
the plane and the airport configuration. In fact, communication starts (and
maybe crucial) on the ground when the planes start moving. And those
conversations continue throughout. There are periods where silence is imposed and others when cockpit sterilization is required or communication is lost behind closed (cockpit-locked) doors.

In this study aviation informants share their stories which include narratives and experiences from flights in different airspaces and stages. For the fighter pilots, their flight is considered (here) as simplified to the same generic model and their responses add a component of “airman” sub-culture with their mindset and camaraderie. That is why they are used in this study as expert performers (in the whole set of pilots), in comparison with the other pilots and actors, using Ericsson’s terms (2006). Their controlled airspace include several level of control (during airborne with the fighter formation chief who flies with them, and the mission commanders (usually in two hierarchical levels) who coordinate what they do. The military controller is mainly dealing with the non-cruising stages of figure 1.1 (b). The sterile cockpit rules applies in the Air Force with take-off and landing and “combat in” and “combat out” periods, during the cruising stage.

1.3.2 Language-based Communication Errors in Aviation

In aviation communication occurs in an environment which challenges effectiveness and where failures may have severe consequences. Although English as a lingua franca was designated for international aviation use in 1951 (Rubenbauer, 2009), substantial issues of culture (in terms of habits and safety), professional behavior, operational training, and compliance in standardization still exist (Seidlhofer, 2005).
As Cushing (1994) has analyzed, contextual constraints and language are combined in communication problematic inside the flight deck and when pilots and controllers interact. Jones (2003), in his review, writes about “symptoms of miscommunication”; those include procedure or instruction violation (like clearance avoidance) and communication-specific problems (like arbitrary interpretation, dialects, and inappropriate phrasing). Also, Jones speaks about “phraseology defects”, like multiplicity of meaning, multiplicity of synonyms, and implausible words, with a contextual meaning that may be different from the colloquial meaning, as pointed out by Howard (2008).

Cockpit conversation generates meaning through detailed order of spoken exchange in which rules, machinery and structures manifest themselves in specifiable forms (Psathas, 1995). Cockpit conversation, as Lorenz (1973) describes human communicative behavior generally, is an interaction: “spoken not yet heard; heard not yet understood; understood not yet agreed; agreed not yet applied; and applied not yet always applied.” Incident and accident data from flight conversation concern units of speech sent but not yet received on the other end; utterances received but not yet perceived from both ends; and when perceived may not yet read back, as mutual confirmation or dependability on both parts develops. Even when instructions are read back there is a step forward needed to manage-coordinate acceptance in language for international multi-lingual flights.

Moreover, as the professional controller Bonini states (2005, p.43-44) the margin of error is large (Leveson, et al., 2002), as well as a considerable amount of redundancy designed into the system (Rognin et al., 2000). An
example of redundancy in the ATC system is the pilot’s reading-back to the controller instructions just given (by the controller) to confirm that the instruction has been “heard and understood by the correct pilot”. The information provided by a pilot is not always a hearback by the controller, but is compared with the aircraft’s trajectory on the controller’s radar screen, to ascertain that the instruction has been followed.

Conversation order is occasioned and meaningful for those who produce the respective utterances. Speakers and addressees need to be aware of each other, where they are located (demographic understanding), what the others know (knowledge understanding) and what they are able to do (capability understanding) in order to complete a communication transaction. Preliminary interviews for this study, revealed the transactional mode in conversation in which interlocutors in the cockpit (corporeal present or co-present) establish a relationship of trusting partners when their conversation escalates towards crisis warning phrases (Watzlawick & Beavin, 1967; Schegloff, 1982). It is a case of people-to-automation trust and people-to-people trust (Lee & See, 2004), in which partnerships may project overreliance on automation (Sparaco, 1995), misuse or disuse of automation (Panasuraman & Riley, 1997), or failure of crew intervention (NTSB, 1997). Trusting the others and the available technology, at the appropriate level, is regarded as an effective strategy to manage workload (Wilson, 2000).

The language factor is crucial, as spontaneous interaction may deviate from the Standard Operating Procedures (SOPs in flight manuals) and Rules of Engagement (RoE, mainly in military aviation) in style or content (English or
other, with code switching) of its tacit knowledge. Analysis of genre of interviews will reveal aspects of how cockpit conversation with ATC involved is a staged, goal-oriented, and purposeful activity (Martin, 1984).

In this context, there are several communicative problems that arise. One set of problems involves issues of reference, repetition, ambiguity, sequence breaking, and the like (Cushing, 1988; 1995; 1997). A second set of problems concerns the implementation of Standard Operating Procedures (and Rules of Engagement in military aviation). Although, there are highly detailed SOPs, what counts as following them in a crisis situation is not always clear, and sometimes it happens not to be followed at all. All of these problems need to be negotiated in time-critical situations, as long as trust in automation and among interlocutors is established.

It will be the purpose of this dissertation to examine how this is done, how, for example, pilots and air traffic controllers talk, interact, and outeract with orderliness; how they engage in error monitoring and correction for conversation repair; and how they negotiate whose interpretation of an SOP or implementation on RoE will prevail. Also, in the process, it will be examined how a trusting environment is fostered and how inner and outer identities and culture are sustained in crisis conversation.

Research topics are investigated around the following overarching inquiry: How is it possible for interlocutory actors to understand each other, ensure that they do, and establish trust to rely to each other and their equipment? Figure 1.2 describes the effect of various communication errors in
aviation safety. The effect to aviation safety comes through the label of a “non-desirable situation”, less severe like the “incident” or crucial like “an accident”.

The Effect of Erroneous Communication in Aviation Safety

In message exchange, ATC and pilots speak to each other by addressing the “receiver first” unlike ordinary conversation between people where they address “the sender first”, both with a call sign (like “Athens Tower” or “OA 531”). Pilots and controllers exchange strings of information and imperative sentences and are trained to remember and implement those strings and then report back. A string is typically a unit of information containing a parameter and a value (for the parameter). The sentence “*turn left to three five zero*” has the instruction (turn left) and a given value (three five zero). That is a single unit of information.

Howard (2008) extends the single unit to a complex unit of information: “*five three oscar alpha, turn left heading one three zero, go down and maintain*
ten thousand, contact arrival one thirty nine point two”. This message contains four units of information: (i) callsign of the hearer “53 OA” (ii) turn left with a numerical value (130), (iii) go down and numerical value (10,000) to maintain and (iv) contact another controller (arrival) with the numerical value of the frequency (139.2)”. This definition of units of information shows that is not only the number of words and the time used to verbalize but also the informational content of each element that may accumulate workload (Barshi, 1998).

Many inquiries will arise as such data are examined regarding aviation safety. E.g. what is the appropriate number of units of information per turn (in the exchange between controller and crew)? Is it recommended to use unitary information or be economical on the frequency and contain multiple units per interaction? Is there a need of follow up, especially here when a readback is quite complex and the resultant hearback maybe further complex? Is it safer to have one unit per exchange, similarly to one word- one meaning instruction or it is not realistic? The quantity and quality of information mentioned in Figure 1.2 is directly relevant with those exchanges of units of information. Safety relates with the designed redundancy through overlapping expertise of staff, mutual checking (between crew members inside the cockpit, between controllers and pilots and between controllers working together), and technological support to capture information from different sources and locate erroneous messages or actions.

Figure 1.2 starts on the left with the top and bottom box of communication actors. The major participants in aviation communication are
the controllers and the pilots (with the airline operators who also participate and interfere in the discussion, usually from another frequency). In these inputs (from operators) we could include messages rooted by mechanical devices (like the autopilot or information displays) in the cockpit or the control room, but the role of automation in human communication is in the side of this study. Their communication may generate errors in the way both parties interpret the message to extract information.

The erroneous content of these messages is divided to five categories (in the boxes in the middle). First is, insufficient information when, for example, a prompted action or a callsign or an instruction or a direction number is missing. Second is unreliable information when, for example, hesitation mutes a given instruction or when the prompt has uncertainty modifiers. Third is contradictory information, when, for example, a message or a reply or a hearback in contrast with the weather, altitude, direction or a previous transmitted message. The fourth box has plethora of information that is rather “too much”, meaning inappropriate for the situation and the timing transmitted. For example, when several instructions are prompted in sequence instead of one-by-one with proper timing, or when the sterile cockpit rule is broken by a controller or crew member. The fifth box contains non-interpretive information, like a simple “OK” that cannot connect with a call, an incomplete hearback, and the use of non-standard words or words from a non-shared mother tongue.

All these symptoms of erroneous communication led the arrow to the box of erroneous situation awareness. Thus, errors are coming in and an erroneous result is generated. Situation awareness (SA) is analyzed as a concept
of this study in section 2.6. In terms of this box it refers to the pilot’s (and the controller’s in several cases) mental model for the evolving tasks to execute for the situation. SA includes the acquisition representation, interpretation and utilization of information in order to stay in control. It is the comprehension of the operational environment and other situated factors affecting current and near future goals. SA enables or restricts, if erroneous, the rapid decision making, effective action and the communication of those. The control of complex, dynamic systems and high-risk situations like those happening in flights goes side by side with the level of awareness. The erroneous SA that may start from the pilot (and transition to the controller) means that the pilot does not know “what is going on” and (therefore) “cannot figure what to do.” The lack of SA, due to erroneous inputs, is a primary factor in accidents attributed to human error.

Erroneous SA leads to the generic non-desirable situation with two types that vary in severity. Incidents are usually violations of instructions or legal parameters, like bypassing a clearance, violating aircraft separations, not filing a flight plan etc. Incidents might still affect operational safety in aviation, as lessons used to avoid accidents. Unlike the perception of accidents in aviation where the situation is more important than the blame, discourse about accidents, as a category of events, has several conceptual parameters to take into account.

Suchman (1961) has tightened the criteria of labeling an “incident” (quite severe or even fatal) as an “accident” with several factors: expectedness (unanticipated or not); avoidability (preventable or not); intentionality (intended as outcome); degree of warning (no warning leads to accident occurrence); the
duration of occurrence (quick phenomena are easily labeled as such); the degree of negligence (if negligence is associated it is less likely to be an accident), and the degree of misjudgment (more misjudgment is less likely to call it an accident). In any case, the accident is mostly labeled because of its consequences in human lives or material destructions (Vigiland & Williamson, 2003). It is considered comforting, a consolation to survivors and protection of the victims to speak about an accident. In Chapter 3, we will use the discourse about accidents in the specific context of aviation and human error patterns and resolution.

The last part noted in the Figure 1.2 is the foundation box in the bottom which contains the floating communication tools in human aviation communication (with the dashed arrow in both sides of the diagram). Phraseology used is standard from International Civil Aviation Organization (ICAO) or US Federal Aviation Administration (FAA). Despite the desired level of standardization, discrepancies in the use of typical terms in English phraseology still exist between ICAO and FAA, as exemplified in Appendix D. Another aspect of language is the mix of plain English language with technical jargons and colloquialisms, and the non-verbal phenomena of paralanguage and hesitation. Non-verbal signals are used in problematic situation to complement the verbal language. Lastly, the mother tongue cultural component affects all information exchanges, especially when details are needed or an emergency is happening.
1.4 Implementing the Study

Unlike other investigations of human interaction, this study of aviation communication pays attention to any sole flight instance, if we consider as a unit of analysis a single flight. That means that no two flights are the same following the general scheme of a flight operating manual. Any two flights vary because of unscripted task demands and because of the different responses of crew members to these demands (Loukopoulos et al., 2009, p. 45-47). A flight according to flight operating manuals is the ideal situation; this study shifts analysis to actual flight operations (the real flight situation) where the environment is more complex and the tasks for the crew (and controllers) have demands that compete for attention and interrupt one-another in the course of time and with incoming signals. Both the crew members and the controllers need to monitor those tasks and pick up the thread to complete interrupted tasks and interactions.

Hence, the research inquiry is not only to find conclusions to generalize (usually in routine cases) but single instances in which, under certain conditions, human communicative behavior leaded to an erroneous situation, an incident or an accident. Thus, the importance, practical and theoretical, of namely one flight, one incident, a single interaction, a certain choice of wording, a certain interruption or choice of action, the value of occurring exceptions and outliers is substantial. This one flight or interaction in a flight might impact the way the industry and organization standards work, applied, enforced, imposed and how good practices are communicated or need
modification to avoid safety risks (even when all the other things and factors remain the same).

After reviewing several methodological tools for this study, I have chosen to selectively apply a top down approach to focus on aviation phenomena evaluations using informants deeply involved in the sector. The bottom-up philosophy of a grounded theory (GT) approach seems quite applicable because: (i) a multi-modal set of data sources is used, (ii) a personal view on conceived inquiries is incorporated in the study and (iii) a constant comparison and selection of concepts is compatible with the level of acquired data, in order to support the theory construction (Glaser & Strauss, 1967, p.45). Besides that, the questioning route was informed with lessons of protocol analysis, where discourse analysis practices facilitated textual comparisons and sorting, as well as detailed iterations through the data via closed reading.

**Stages of the Study and Aviation Professionals as Informants**

The study contains the following stages: (i) realizing personal experiences in aviation communication from my logs, background, and visits; (ii) identifying topics that concern the aviation community and are important in accident investigation, and start interviews; (iii) locating an applicable sample to forward data collection with deep-interviews as discussions and few evaluators; (iv) developing an instrument with scenarios (refined from questions) to approach the sample in a more relevant manner; (v) articulating concepts, categories and relations in a theoretical model for aviation safety; (vi) designing the methodological flow for the GT approach of this study to evaluate the concepts
using several iterations; and (vii) analyzing the collected data by selecting those that fit the theoretical model of aviation safety, by connecting the replies with important topics in communication theory. The first six stages are implemented in Chapter 2. The second step has also used material in Chapter 3 and the seventh step is covered on Chapters 4 and 5.

With a series of visits I was able to locate aviation safety phenomena of organizational and institutional interests. I wanted to evaluate several experiences experienced in the Air Force and actively observe in aviation installations, control and command shifts, and briefing-debriefing activities. A process of constant comparison starts with the first level of reading and identifying phenomena of interest, and then a decision on the theoretical sampling is taken. Twenty five aviation professionals (fighter and civil aviation pilots, flight engineers, accident investigators and ICAO delegates) were located based on the expertise and sensitivity on issues of language. There are not treated as subjects but as informants who offer their expertise. More details about them are documented in Appendix E. All responders are named with the convention “aviation informant professional number 1 to 25”, abbreviated as shown in Figure 1.3 below:

<table>
<thead>
<tr>
<th></th>
<th>AIP1, Fighter Pilot</th>
<th>13.</th>
<th>AIP13, Accident Investigator</th>
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<td>2.</td>
<td>AIP2, Fighter Pilot</td>
<td>14.</td>
<td>AIP14, ATC</td>
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<td>3.</td>
<td>AIP3, Fighter Pilot</td>
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<td>AIP15, ATC</td>
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<td>4.</td>
<td>AIP4, Fighter Pilot</td>
<td>16.</td>
<td>AIP16, ATC</td>
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<td>5.</td>
<td>AIP5, Fighter Pilot</td>
<td>17.</td>
<td>AIP17, ATC</td>
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<td>6.</td>
<td>AIP6, Helicopter pilot</td>
<td>18.</td>
<td>AIP18, ATC</td>
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<td>7.</td>
<td>AIP7, Fighter Pilot</td>
<td>19.</td>
<td>AIP19, ATC</td>
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<td>8.</td>
<td>AIP8, Civil Aviation pilot</td>
<td>20.</td>
<td>AIP20, Flight Engineer</td>
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<td>9.</td>
<td>AIP9, Civil Aviation pilot</td>
<td>21.</td>
<td>AIP21, ATC</td>
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<td>10.</td>
<td>AIP10, Civil Aviation Pilot</td>
<td>22.</td>
<td>AIP22, ATC</td>
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<td>11.</td>
<td>AIP11, ATC</td>
<td>23.</td>
<td>AIP23, Fighter Pilot</td>
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<td>12.</td>
<td>AIP12, ICAO delegate</td>
<td>24.</td>
<td>AIP24, Civil Aviation pilot</td>
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<td>25.</td>
<td>AIP25, Civil Aviation Pilot</td>
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I have grouped the scenarios, described in twenty five questions, sorted conceptually in four larger categories of interest, for deep-interviews: communication phenomena (themes like silence), the culture of professionalism (themes like relationship and familiarity), expertise, knowledge and decision making (themes like the two-challenge rule), and personal factors (themes like the perception on briefing-de-briefing). The selection of guided scenarios for questioning was made so as not to satisfy preconceptions with predetermined replies, but to make them relevant to what the participants experience in their daily routine. It is an attempt to avoid “confirmation bias,” (Lewicka, 1998, p.240). Thus, scenarios are grounded on anonymous testimonies of aviation professionals, in national reporting systems (usually in a confessing style) or in briefing (rather de-briefing) remarks of empirical situations as aviation professionals experienced them. The flow of questions which elaborate the scenarios is sequential but responders are aware of the routing of the questions that explain the expected point of view of the answers. The structure contains some control questions asking form the point of view of the “other side” of aviation professionals. The full list and wording of the scenarios is included in Appendix A (A3).

The replies in the scenarios were sorted to match the theoretical model of aviation safety developed on section 2.3.3 (Figure 2.2). Comparisons among different responses were made to relate replies with categories of interest, during an iterative process. Further analytical sorting was accomplished through coding the textual information with labels of action and interactions. In this sense, Chapters 4 and 5 connect the instances recorded with the communication
concepts of theoretical significance and compatibility with the core concept of aviation safety.

1.5 Two Landmark Flights

Aviation is clearly the safest form of transportation. That safety comes, in part from the particular attention to exceptional cases (beyond the routine). There is a consistent feedback mechanism maintained in the industry: each flight has a flight log to report and the report is data for the manufacturer. Thus, attention to detail goes hand in hand with attentions to exceptional situations.

The two flights explained in the sections 1.5.1 and 1.5.2 below are landmark in (at least) two ways; in the Falcon flight, the Deputy Foreign Affairs Minister of Greece with his son and other passengers were deadly injured, while the aircraft was shaking as an “afraid horse” but the pilot flying was able to save the aircraft (and himself, and those who were buckled); the Helios 522 is a case whose flight path and situation are followed from the outside and not from the inside (by the intercepting fighter jet pilots, with very limited voice recording data).

The accident investigation of the Helios flight concluded with a re-enactment of the actual flight, as if the bottom-up grounded theory approach was part of the actual investigation (with backtracking of the events). The Helios 522 accident investigation from the Hellenic Air Accident Investigation and Aviation Safety Board (HAAIASB) validated its findings with an additional re-enactment of the accident flight designed “by the textbook” (HAAIASB, 2006, p. 71-72) to apply a hindsight mechanism. An identical reserved Boeing
using the same flight parameters, the same schedule and route from Larnaca (Cyprus), with the hypoxia conditions and pressurization switch to the manual, the interception with F-16s etc. It took off carrying only the HAAIASB committee members, the district attorney, and paramedical personnel. The new flight was conducted in the actual (not simulated) environment and confirmed the findings (Tsolakis, 2013, p. 410-414).

In both cases, after the events a series of recommendations were implemented in several agents and tools of the sector: the operators, the manufacturers, the flight and maintenance manuals, the training topics and setting of controllers (at a national level for Greece, international level from ICAO and FAA).

1.5.1 A Major Accident in the Saved Falcon VIP flight

The so-called “afraid horse VIP flight”- which reshaped the concept of silence in terms of accountability in the eyes and ears of the aviation community is the flight of the VIP aircraft of the Greek State on September 14, 1999. The pilot of that flight, namely AIP9, has witnessed a major incident of rapid descent without controls and he was able to hold the shaking aircraft and to prevent it from crashing.

The airplane had a flight log with a repeated unresolved entry regarding the maximum speed and the autopilot use, as well as a repeated warning signal in the cockpit that needed further investigation although not crucial for flight navigation. AIP9 did not accept institutional inertia of not- speaking up when a repeated remark is entered in the flight log. He kept entering the comment as soon as he was entering the aircraft. The aircraft cabin defect log is usually
filled by the cabin crew members and the aircraft technical log is filled in by the flight deck members. The two logs combined communicate flight realities to the next shifts, where as the two flight recorders –for voice and indications- are the real-time archive of the flight. Also, he did not want a co-pilot to remain silent (in a VIP flight) and always choose to fly together with the specific fellow pilot who understood the speaking-up mindset from their briefing. He always wanted to be in the aircraft at least two hours before flight in order to perform his pre-flight ritual: walk around the aircraft for a visual check. AIP9 was only imposing the sterile cockpit rule in his take-off and landing, a practice he was keeping religiously, regardless the VIP passenger and the status of the cabin.

This flight created a completely new framework in discussing silence, as a parameter of employment relations and personal accountability. The flight is remembered by HCAA personnel as a road map in corporate governance in the aviation industry and repositioned aviation safety as a lasting responsibility before and after the flight. It was a VIP flight in the sense of an official state flight with a governmental diplomatic delegation.

AIP9 was an experienced and accomplished pilot who spent a career in the state-owned airliner Olympic Airways. Working as a jet pilot was a dream that came true for AIP9, as he was growing up when Olympic Airways was privatized by the late iconic tycoon Aristotelis Onnasis and became an international player in the industry during the 1970’s. He was selected to lead the Prime Minister’s crew, although without political affiliation, due to his decisive cruising style and his open character in crew teamwork (as he noted in the discussion).
What Happened in the Falcon Flight

The flight took-off in a bright clear day of the Greek fall. The Aviation Safety Network\(^3\) summarizes the notable part of the flight when approaching to Romania in the extract below:

The Falcon reached a cruising altitude of FL400 until 47 minutes from take-off, when a normal descent to FL150 was initiated, with the autopilot engaged in vertical speed mode. Approaching FL150, the co-pilot had a request for a further descent. Just before FL150 the ATC re-cleared the flight to continue descent to FL50. One second later the autopilot disengaged and thereafter the aircraft was manually flown by the captain. Between FL150 and FL140, for approximately 24 seconds, the aircraft experienced 10 oscillations in rapid descent which exceeded the limit of the load factor and all controls in the cockpit did not respond. At the request of the flight crew, radar vectoring was provided by the ATC, and a visual approach and landing was performed on runway 08R. It appeared that the cabin interior had been completely destroyed, resulting in fatal injuries to seven passengers.

The passage epitomizes the Falcon 900B SX-ECH\(^4\) flight which started as an ideal flight situation with cruising autopilot, in a bright shining day, although

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\(^3\) The Aviation Safety Network is a private, independent initiative founded in 1996. On-line since January 1996, the Aviation Safety Network covers accidents and safety issues with regards to airliners, military transport planes and corporate jets. The ASN Safety Database contains detailed descriptions of over 10,700 incidents, hijackings and accidents (as described at http://aviation-safety.net/about/).

\(^4\) It is a French manufactured plane by Dassault Aviation, the company founded by the pioneer industrialist Marcel Dassault immediately after WWII. It holds a wide market share for executive business jet or jet-taxi for VIP passengers (or those who want to project the idea of a very important person). Several models are now in the market and are considered to be in the elite of private jets, as explained at http://www.dassaultfalcon.com/en/Pages/Home.aspx
the aircraft had a history of malfunctions\(^5\) that were not addressed promptly by the manufacturer\(^6\), as AIP9 points out. The whole process is a continuum and requires appropriate input from the pilot-in-command to communicate it to the airliner-operator which has to communicate the maintenance difficulties to the original manufacturer (like Dassault in this case). The footnoted safety enhancement SE170 accents that communication flow and exchange from these parties is not efficient, as AIP9 realized during his service. He started the chain of events and the sequence of reporting multiple times but the expected actions were not taken.

Back to the flight from Athens to Bucharest, Romania, the aircraft experienced ten perturbations in the axis of the wings, for approximately twenty four seconds, which exceeded the limit maneuvering load factor. The descent was in a high speed caused by inappropriate operation of the autopilot\(^7\). As a result the passengers experienced a motion, as if they were flying inside a “coffee shaker” on the move (RCAI, 2000). The flight was in a severe emergency and silence was crucial for AIP9 to hold a very heavy control stick

\(^5\) In the Falcon 900B SX-ECH accident investigation (RCAI, 2000) and series of judicial proceedings (Tsolakis, 2013, p. 328-337) several determinants of the situation remain unresolved as the protagonists reveal. But, the pitch feel warning signal and its impact in controlling the aircraft and choosing the maximum speed (with the autopilot disengagement after certain speed levels) was a repeated entry in the flight logbook remarks from the pilot-in-command, with no provision from the manufacturing company till this tragic event. The accident investigation team members for this crash were important informants in this study, with long discussion days regarding my topic.

\(^6\) Aircrafts are in constant monitoring for their operating and maintenance record with a service history log which ensures a memory function in their operating history. Eurocontrol’s skybrary electronic depository explains: “The safety enhancement SE170: Monitoring of Service History ensures that maintenance task difficulty data is collected and reported to the original equipment manufacturer (OEM) and proper maintenance is being performed to ensure aircraft systems continue to function as designed. The Federal Aviation Administration (FAA) was tasked in Output 1 of SE-170 with publishing a ‘best practices’ guide to standardize how these processes should be implemented by operators and OEMs (data from http://www.skybrary.aero/index.php/SE170:_Monitoring_of_Service_History).

\(^7\) AIP9 and other pilots proposed for investigation the potential of an electronic warfare magnetic field that was activated in the area due to military missions that were conducted in that airspace. In this view the sudden loss of control during decent would be the result of electronic interference; this is a scenario that was difficult to verify, despite some available indications from other flights that landed in Bucharest airport, on that day.
and land the plane visually. But seven passengers, including the Greek Foreign Affairs Deputy Minister, were killed and everything inside the cabin was destroyed, as AIP9 remembers.

The pilot-in-command was consistent on stating the mechanical warning signal and led in his logbook, regardless of how many times he was repeating himself or was neglected by the manufacturer and partially from his supervising authorities, as AIP9 noted emphatically. The flight attendant prompted the “seat-belts fastened” but she could not enforce it, as it was the Minister and his son who did not comply, and they could have survived the twenty four seconds of “shaking”. In her testimonies she was consistently using the metaphor of the airplane as a reactive wild horse.

**Consequences in the Media and the Industry**

The Falcon “shaking” VIP flight, as AIP9 sometimes calls it, established new standards in the Hellenic Civil Aviation and Hellenic Air Force VIP operations, at an institutional level, for negotiating with silence and speaking up to everyone who needs to hear (regardless the level of statesmanship, industrial authority or even familiarity and friendship). Moreover, the flight covered media headlines and stories, a series of hearings and trials (similar to those analyzed by Dekker, 2010). Aviation safety is, to a large extent, built upon the trusting pilots, air traffic controllers and other aviation professionals in the process of accident investigation. There is a growing trend to criminalize these same people following an accident investigation a trend with implications for aviation safety (Michaelides-Mateou & Mateou, 2010).
The protagonist, the VIP pilot AIP9 who managed to land a plane that was “shaking” prior landing against all the odds, spent four days (in Greece and in Jordan) in conversation with me regarding the flight. AIP9 was stigmatized from the public opinion’s contradiction, although he was not guilty in court; how could he be responsible for deaths (of people who were not sited with seat belts fastened) while he was capable to land and save the Falcon plane from a crash? He felt trapped in a scapegoating process with the sole responsibility being to activate the “fasten seat belt” sign.

When he learned about a similar incident (with the same technical malfunctions) in the next Falcon model that was grounded with an emergency airworthiness directive on 2011, he felt almost relieved and revitalized professionally, “I told you, they did not do anything and it happens again” he said. But, he was always voicing his opinion to everyone involved: from the Prime Minister to the manufacturing company and the airliner in his own organization. That was his message for the others, as part of his value system. That is why despite the severity of the incident he was able to continue his flight career, unlike what happens with pilots in other accident cases. He had commercial pilot appointments in other European countries and Russia being selected in VIP airliners or business tycoons.

AIP9’s bottom line was that “when I speak of love, I think about family and my aircraft. When I am holding the controls the plane unifies with my body;

8 It was June 17, 2011 when EASA issued an Emergency Airworthiness Directive (AD), prohibiting flight operations of Dassault Falcon 7X jets, due to an incident involved a Falcon 7X which experienced an uncontrolled pitch trim runaway during descent. The crew succeeded in recovering a stable situation and performed an uneventful landing (data from Aviation Safety Net at http://news.aviation-safety.net/2011/05/26/easa-grounds-all-dassault-falcon-7x-aircraft-pending-incident-investigation/)
I manage the plane as if I am alone in the universe”. That said, AIP9 added that when he realizes a potential distress he explicitly addresses a standby to the controller to remain silent and proceeds when he thinks he is done, in case he needs support. In AIP9’s case, speaking up was an individual decision of professional ethics, accountability, and integrity (Dekker, 2012). And it made a mark in the minds of the aviation professionals which participated in this study.

Checking on the Replies

AIP9 beliefs were replicated in later conversations I had with a member of the accident investigator team of the HAAISB, namely AIP13. In the start AIP13 had a controversial opinion for AIP9, but soon after the court trials they became close friends, with mutual respect and appreciation. Both figures are aviators with a strong commitment to “do their job”, as duty, as an ideal from their own points of view. AIP13 investigated all flight parameters of the Falcon flight, using also the RCAI (2010) report and realized that landing the falcon plane was a “miracle with virtuosity”, but he still thinks that AIP9 forgot to activate the “fasten seat belt” sign, at an earlier stage before the rapid descent; and he spent almost five years dealing with the Falcon flight, due to the series of repeated judicial proceedings and appeals (in the form and intensity analyzed for other flight litigation cases in Michaelides-Mateou & Mateou, 2010).

AIP13 echoes the aviation conscience, in several parts of this study, as he is an iconic figure in accident investigation, after a career as fighter pilot in HAF, a career as civil aviation pilot in Olympic Airways airliner and thousands of flying hours in several different aircrafts. He graduated from Air Force
Academies in Greece, USA and Sweden and specialized in aviation safety in the USA and Sweden. His contributions were valuable inputs to control questions and replies of others respondents in this study.

1.5.2 A Fatal Silent flight: the Helios “Ghost Plane” flight

Another paradigmatic flight – the so-called “silent ghost plane” - laid the foundation of re-thinking the concept of silence, in at least two ways (inside the plane and outside the plane). A plane was called from different control ATC authorities with no reply (silence to others), and the lack of open communications between cabin crew members and flight deck (silence or sterilization inside). It was a challenge of the sterile cockpit rule and was noted in the media, as the Greek “9/11” threat.

Hypoxia, Silence, and Renegade Alert

Helios Airways Flight 522 in a Boeing 737 originated at 9:07 a.m. from Larnaca, Cyprus on August 14, 2005 with a history of minor depressurization issues, a contract pilot and substitute chief purser. Three hours later, the flight crashed into a mountain in Grammatiko area, outside Athens, Greece. The pilot and co-pilot seemed to have missed the checklist entry for a crucial air conditioning switch which remained in manual (instead of auto) position, because of an early ground pressure check before the flight from the airliner mechanics. They set the autopilot to reach cruising height towards the Greek

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9 It is a unique accident in world aviation history. Only two other accidents with similar conditions, in small scale flights, have been reported: Beech Super King Air 200 VH-SKC, September 2000 in Australia (see https://www.atsb.gov.au/media/24344/aair200003771_001.pdf) and Sunjet Aviation, Learjet Model 35, October 25, 1999 (http://www.ntsb.gov/investigations/fulltext/aab0001.html)
Area Control Space, which was the next checkpoint with a ground control station (while approaching the Greek islands).

It took just thirteen minutes for the air pressure to drop as the plane was climbing. Oxygen starvation, known as hypoxia, was developing as an insidious process; it impairs human judgment without noticing it. They communicated with false awareness of the situation. As a result, pilot and co-pilot misinterpreted the true nature of the warning horn that was blaring on the flight. They thought their electronics were overheating, and they became unconscious in minutes.

In the main cabin, however, passengers settled down sleepily, and the cabin crew saw oxygen masks sprang down automatically due to the loss of cabin pressure. The plane was still climbing with the autopilot, instead of carrying out an emergency descent. The cabin crew was unable to walk in to talk to the pilots, as the cockpit entrance was locked\textsuperscript{10}. If they had had easy access they could have provided a clear picture of the passenger cabin, and the captain would have been alerted to use his own oxygen mask (Griffioen, 2009).

Both Cyprus Air Traffic Control, at Nicosia, and Greek Athens Area Control Center were repeatedly and desperately calling to contact the aircraft. The Greek Air Traffic Control authorities asked with adjacent civil aviation flights to call but still with no reply. But, no reply was received nor recorded.

\textsuperscript{10} Following the events of 9/11 aircraft hijacking and attacks, the air transport industry and airlines in particular have instituted a range of physical and procedural defenses to deter and prevent such acts. For larger airplanes, regulatory changes followed. With effect from November 1, 2003, ICAO Annex 6 was amended so that under Chapter 13.2.2 “all passenger-carrying aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60 shall be equipped with an approved flight crew compartment door that is designed to resist penetration by small arms fire and grenade shrapnel, and to resist forcible intrusions by unauthorised persons. This door shall be capable of being locked and unlocked from either pilot’s station” (from http://www.skybrary.aero/index.php/Flight_Deck_Security). Of course locking the cockpit reduces cockpit-cabin communication, and affects in-flight situational awareness of both ends.
Silence in this case is perceived as suspicious threat (Renegade flight, see Tsolakis, 2013, p.408-414) and at 11:24 a.m. two HAF F-16 fighter aircrafts scrambled and established visual contact with Helios flight 522. They reported that the first officer was motionless at the controls, the captain’s seat was empty and that oxygen masks were dangling in the passenger cabin, and there was no movement. At 11:49, a flight attendant entered the cockpit and sat down in the pilot’s seat. Before he had much of a chance to try, after several attempts to enter through the code-sealed cockpit entrance- both engines run out of fuel and the plane crashed with all 121 passengers and crew. There were no survivors. The scrambled F-16’s were reporting, so communicating the situation of Helios flight from the outside. Depending on what they report Tactical Chief of HAF, Chief of HAF and the Chief of the Joined Chiefs of Staff are in open line with the Prime Minister who has the authorization to decide whether to shoot down the aircraft or not. It is a decision with no return for all participants in the aviation complex and shows how communication makes it irreversible.

11 A situation where a civil aircraft is used as weapon to perpetrate a terrorist attack is usually referred to as a Renegade (when substantial deviation from the flight plan is identified, or the plane is not following the Area Control Tower instructions, or does not reply in calls and remains silent). The Renegade protocol requires fighter jet scramble for identification and interception. In many cases bi-lateral agreements have been set up to better coordinate cross-border incidents. In most European countries the number of interceptions due to communication loss at least doubled after “9/11”. An atypical of those cases, with loss of communication for about two hours, is the tragic crush of the “Helios Airways Flight HCY522” as investigated by the Greek AAIASB (at http://www.aaiasb.gr/imagies/stories/documents/11_2006_EN.pdf) and is in the mind of all the air traffic controllers that were interviewed for this study.

12 Five minutes before the crash another dyad of fighter planes from the quick reaction alert squadrons, two Mirage 2000-5s, were ordered for a five minute readiness to scramble to replace the two F-16s that were running out of fuel due to the maneuver and holding patterns around the Helios jet. The Renegade case of the “ghost plane” was already in the briefings of two major HAF bases, 111 CW for the F-16’s and 114CW for the Mirages. The incident became a hot communication topic in the informal mouth-to-mouth network that is resilient in HAF’s micro culture, as in most active Air Forces.
The Agony and Other Consequences

AIP13, the accident investigator mentioned in the Falcon flight of section 1.5.1, shared with me the agony in the mind of the Prime Minister when the flight was still over Athens; “For nothing in this Earth, I would want to be in his position, to have to decide for those people lives if needed. Imagine, also the feeling of the F-16 pilot who was observing the Helios flight unable to help them”, AIP13 commented on the severity of the Renegade response protocol. He wanted to emphasize that responsibility for human lives is the ultimate care in aviation safety and contains a moral judgment call which supersedes political or governing power. And communication with accurate observation was the key factor, since the initial impression was that is a real hijacking flight (in several Greek and European media the references was about a “false Greek 9/11” in the end).

But the scrambled F-16s pilots established an additional visual communication channel in which the message was transmitted from the outside using the visual input (and the recordings for more hindsight information, after the crash). Notice, at this point, that without the establishment of that new channel of communication, there would be no message, no information flow and no validation of the situation for decision making.

The Helios 522 flight and story is landmark case, attracted world media coverage\(^{13}\), and several changes and recommendations (to HCAA, to EASA, to Boeing, to ICAO, and to NTSB among others) were submitted, as they derive

\(^{13}\) The Discovery Channel, National Geographic, Near-Miss Productions among others produced documentaries. Also, in the Guardian newspaper in UK (December 18, 2006) Andrew Weir’s position article approached the Helios 522 flight from several interesting dimensions; he pointed out a safety and security problematic that represents a vivid discussion in aviation and society at large regarding cabin-cockpit contact (at [http://www.theguardian.com/business/2006/dec/19/theadvertising.industry.travel](http://www.theguardian.com/business/2006/dec/19/theadvertising.industry.travel)).
from the accident investigation (HAAIASB, 2006, p. 152-164). One of these recommendations was implemented immediately\(^{14}\); to apply a software warning flag-counter on the radar screens of air traffic controllers of Athens Control Approach Center to be activated when an aircraft is not reporting position more than three minutes after asked. This is the silence-breaker counter, as they now call it, informally. As I have noticed during my visits in the Athens Control Approach Center it is like a headlight they are carrying during their shifts.

For another time, this tragedy confirms the open channels of communication which operate in the globalized aviation industry, not only about an event but also in the follow-up phase of implementing the suggested recommendations. Helios plane was flying for two hours with everyone (but one or two) unconscious because of oxygen starvation. Immediately before that, the cabin crew could not communicate with the flight deck and the plane as a whole never responded to repeated communication signals. It remained silent and generated a hunted story for the “ghost plane”, in the minds of all participants in this study. When silence prevails in a flight, controllers remember it, fighter pilots in readiness alert tell stories for it, and the government cabinet wishes not to be confronted with the irreversible decision.

**Concluding**

AIP9 introduced a landmark case of the “shaking VIP flight”, in which silence had a deeper content in organizational reporting; to speak up regardless how many times you are not heard and address the appropriate managerial

hierarchy who is responsible for accountability. He reminded the increasing trend of scapegoating for human error which has consequences in aviation safety, as well as the complexity of civil aviation with economic, market and political concerns.

AIP13 described as an outsider the Helios “ghost plane” flight; it maybe one of the handpicked cases in which the hindsight mechanism (there are no survivors and very limited data from the recordings exist) is necessary to communicate the silence of a haunted story. Helios 522 flight redefines what it means to communicate in a timely manner, without waiting silent for feedback. Besides that, it started the discussion for the open channels of communication between the cockpit and the cabin crew members. These two flights constructed a system of reference regarding silence for all responders who were on their duty when the accidents occurred.

1.6 Personal Background Regarding this Study

I am not approaching aviation realities as a tabula rasa, as there are several preconceptions about the field of aviation, its position in social life of individual actors an its role in collective society (at least in the case of Greece). These preconceptions inform the content of several questions that were turned in scenarios for data collection (in Appendices A, B, C, mainly in A1, A2, and A3). Certain conditions of human activity and experience imply some degree of predictability. In my case, my personal background in the Air Force, the bonding cultivated in the time of service in real crises, and the affiliation with several businesses active in military procurement due to my business
involvement provide familiarity, access to people and sites, entrusted
discussions, and valuation criteria.

Grounded theory aims to describe as well as explain. The differences
between the pioneers Glaser and Strauss are rooted on the position of the
researcher towards the study. Glaser's viewpoint favors neutrality, where as
Strauss (with Corbin) supports the interpretive role of the researcher from the
inside. In this study my approach is closer to the methodological school of
Strauss in a hybrid manner with selective concepts from Glaser, towards what
works better for the data and the participants of the study. A GT approach is
not concerned solely to propose academic insights but also aims to show “why
and how the theory can be used in practice” (Glaser & Strauss, 1967, p. 237).
The description of my main experiences that follow is another indication of the
density of time in actual Air Force life. Although, I was on the ground service,
the multiplicity of events, projects, missions, and service extend the perceptual
time frame of the living experience.

**Joining the Military after an Early Visit**

My first visit to an Air Force base was on 1985 in 115 Combat Wing in
Crete, as a student prize from a regional mathematical contest. I have spent
three days living in the guest dorm and observed their typical routine activities,
while I was able to spend two hours in the flight simulator that was emulating
training flights. It was the first time I started keeping a journal (for what was
non-routine for me) with an entry that “I should get back here when I join the
military”. Pages from that journal present the social and cultural environment which informs my participant observation for this study, from early on.

Coming from an island with a pivotal geo-strategic position, defense news and discussions are part of routine conversation. The long standing tension with Turkey rooted deeply in history, and the compulsory constitutional military service (at least for men) are significant parameters in the life of residents in the Greek island archipelago. Thus, all people in Greece feel that they have a right to address “their own military point of view” and the active service personnel (especially Special Forces and the Air Force) have developed a duty culture of service and defense motivation, and not just of professionalism. Unfolding the log of my journal, I could stop to the fact that the Air Force Academy is one of the most prestigious schools in the National University exam despite the news reports that pilots have an intense duty, high life risk, and isolation from social life while establishing camaraderie and brotherhood bonds between each other.

On 1995, I enlisted in the Air Force with a degree in information science and analysis; I was trained in HAF’s General Staff as one of the only five information analysts of that year. After the first three months I received advanced officer training in the Greek Pentagon being surrounded with “stargenerals” (with insignia of one star or more), not typical for airmen or other service officers who would meet and greet high rank officers only in ceremonies. The overnight shifts I was assigned were either in the Pentagon computer room (for the end-of-day information processing of HAF’s General Staff till 4.30 a.m. with a Colonel of the Air Force), or in sentry points on top of the Pentagon wall with mixed patrols from the Joined Chiefs of Staff hierarchy.
Both shifts were instrumental for my experience and familiarity with all aspects of military service. The intensity of those shifts led to a condition of exhaustion in the end of the service time, through which I was able to connect and spent time with the highly-specialized medical personnel and officers of the 251 General Air Force Hospital. During my hospital treatment, I had numerous discussions with doctors who were evaluating physical and mental examinations for pilots and take several notes on perceptual and decision making attributes.

After an evaluation of the first two intense months I received the authorization of “Top Secret”; the upgrade came in the next two months to “Top Secret/Special Handling”, the highest authorization for document handing and installation access in the military correspondence protocol. Thus, I was able to participate in security briefing, to monitor military cables signaling topics as new aircraft trial and delivery, military attaches transfers between embassies, immediate delivery orders (meaning you receive the cable and leave your position to deliver hand to hand) from the Air Force Chief to the Commander of the Squadron to name a few of the topics. After a six month period and two consecutive evaluation exams, I was transferred back to 115 Combat Wing to become the associate in the Basic operation Directorate of an Air Base with the top safety and targeting efficiency statistics in HAF.

Going back to the place I first visited on 1985, I found several civilian personnel members in supervisory positions (from subordinates at the time) and officers in charge that were my high school classmates at a rank of a flight lieutenant. Hence, I was able to participate in an intense but “extended-family” like atmosphere. Soon, I started being involved with the operations of the
Commanding Officer and the Deputy Commander both Colonels of HAF. My previous service record as well as my reporting capacity and diversity in service shifts (from flight objects garbage collection, to their children school bus escort, till overnight shifts in the Center of Operations and Communications) allowed me to cultivate a sense of trust, dependability, and mutuality, as well as to develop direct communication channels of immediacy with quite a few pilots, ground engineers and commanding officers, with multiple overnight discussions about their readiness, the dangers they have experienced, the classmates they have lost in training, and their interpretation of the aviation instinct and ultimate goals.

A Crisis Experience and USN in Souda Bay

At the end of 1995 and the start of 1996, I was assigned to the Fighting Group in the Center of Operations/Communications of 115 Combat Wing during the Greek-Turkish crisis, as a mission stamper. I have spent a seven-day week of consecutive twenty-hour shifts starting with national drill and continuing to the Imia Crisis, with the wing commander and thirty officers inside the operation center and all fighter pilots and engineers engaged in their hungers. I was responsible for the monitoring of the report-back of the fighter jets, to stamp the cycle of “command-implement-report back”, in a non-stop process where immediacy was more important than ranking. Tactical design deployments and weaponry configurations were allocated, in compliance with the “National Defense Plan” for retaliation/counterattack missions in the event of Turkish offensive activities in the Aegean Sea. The reference point for the
territorial dispute was the Imia island complex, close to island the island of Kalymnos (Katerinakis, 2009, p.110-130).

Immediately after the de-escalation of this crisis to the “status quo ante” (see Ignatiou & Ellis, 2009, p. 177-181), I was transferred to the liaison position for HAF in the US Naval base in Crete, known as Souda Bay. I was responsible of air traffic control clearances (for major freight aircrafts till fighter jets deployed for NATO or US missions), issuance of diplomatic identity cards and contractors licenses, hunger security and the fortnight reporting to the joined bi-lateral Foreign Affairs Committee. In that position, I had experienced numerous emergency landings, airport Tower communication multiple times a day, cooperation with US Navy and US Air Force men and women during extended hours, security and patrol procedures, commander’s briefings, coordination of logistics between 115 Combat Wing and Souda Bay etc. I was able to get closer to the professional command-oriented culture in the US Armed Forces, the life balance of the personnel, and further cultivate my insights for Air operations for NATO and US Reconnaissance missions.

Also, I have realized an important attribute in the value system of the behavior of the US Navy/Air Force colleagues during our common shifts; their personality evaluation was founded on the basis of a “job well done”, a high-level of professionalism, and a reliable cooperation which cultivates dependability (as the necessary layer of trust). Although, I was in an auditing position as a delegate of the HAF in USN activities, both their command and their personnel were quite expressive in their formal citation letters describing my duty, asking me to come in the base, as a civilian, and complete an operating
manual for the liaison activities. These insights and the resultant familiarity or (sometimes) mutuality have informed several of my choices since then and shaped some of the questions in the scenarios, in a comparative mode between US and Greek military culture towards rules, safety, and efficiency.
CHAPTER 2: METHOD

2.1 Overview of this Study in a Grounded Theory Approach

The current study is an exploration of human communication with the point of explanation of its consequences to aviation safety. I decided to use a bottom-up approach, which moves from qualitative data gathering, with a conceptual framework in mind, to identify relations between communicative behaviors (actions and interactions) with iteration and refinement, and allow core concepts to emerge with theoretical sensitivity; core, here, means that the concepts have an impact to human communication and consequences for aviation safety.

This approach follows the grounded theory paradigm (GT, Glaser & Strauss, 1967), and is quite compatible with a qualitative research practice and quite important generally and in organizational studies particularly. “Grounded,” means that it is following a strategy of bottom-up theory building on discourse issues rather, than a top-down approach dominant in other discourse theoretical perspectives (Strauss, 1998).

I use a GT approach with selective parts from the two dominating streams of literature in the sector, the Glaser’s stream and the Strauss’s stream, as they evolved in coding (Charmaz, 2006; 2009; Grover et al, 2014; Jantunen & Gause, 2014), theory construction and comparisons (Corbin & Strauss, 1990; Glaser, 1992; Christiansen, 2011; Kelle, 2005; Ritchie & Lewis; 2004), evaluation (Wagner et al, 2010; Suddaby, 2006; Robson, 2002; Guba & Lincoln, 1994) and iterative sorting and analysis (Muller, 2014; Muller & Kogan, 2010; Reichertz, 2007; Locke, 2001). The differences between the
pioneers Glaser and Strauss concern the position of the researcher towards the empirical world of study (Locke, 1996). Glaser's viewpoint, of a neutral researcher who investigates the natural world as it is, is compatible with a positivist tradition. Strauss (with Corbin), in contrast, supports the researcher as interpreter of the data (Locke, 1996; Patton, 2002, p. 445).

My approach is closer to the methodological school of Strauss (Corbin & Strauss, 1990; Strauss & Corbin, 1990; 1998) with selective concepts from Glaser (Glaser & Strauss, 1967; Glaser, 1992, 2000), as I lean to the hybrid practice of using what works better for the data and the participants of the study. As Kelle (2005) concludes, I tend to agree towards the position that the two schools complement each other. Thus, the phrasing I use refers to “a GT approach or approaches” without any definite article in front.

2.2 Application of a Grounded Theory Approach for Selecting Sources

In the beginning, I explicitly take into account my own position as Suddabay suggests (2006). My personal preconceptions, biases, and view on aviation serve as the main preparation of the study and are explained in the following sections. A process of constant comparison starts with the first level of reading and identifying communication phenomena with human actors. Analysis of data proceeds in search of theoretical categories that the previous phenomena relate to, and the decision for new sampling (selection) for types of data tightly connected with the theoretical concepts of communication interaction is taken; it is about what type of data are to be collected next to
support the theory construction of how human interaction relates to a
communication concept with impact to aviation safety (Glaser & Strauss, 1967; p.45).

When exploring aviation, as a workplace, institutional environment, communication context, and a social world, I use a variety of empirical tools in order to acquire insights on routine and problematic moments and meanings. The multi-faceted reality of actual flight operations requires multiple sources to discover an emerging theory which matches the data, and would work in the real world of aviation (Glaser & Strauss, 1967, p. 45). A GT approach applied as qualitative research analyzes words, language, and their implied meanings (Miles & Huberman, 1994). In such an approach, extended empirical data are treated as texts with multiple meanings. Data collection acquires theoretical significance with the selection of additional data (events, testimonies, visual productions, activities, experts, etc.) to exposit all properties of the developing conceptual categories and develop them further, at both the individual and social levels (Locke, 1996, p. 240). I will take us through each different data source, in a process where the more useful concepts are sustained and others, less compatible with the evolving theory do not continue further. These resources for data gathering, categorizing and analyzing include the following:

- personal experiences and preconceptions;
- ethnographic field visits to airports, air bases, control towers and aviation authorities;
- case studies of landmark flights;
- interviews with aviation professionals;
- life stories in biographical books and oral narratives;
- artifacts, cultural texts and productions via a special drama series on fighter pilots;
- observational, historical, interactional and visual texts, in documentaries and media interviews.
- protocol analysis lessons to facilitate the acquisition of insights and discourse analysis practices with close reading for the theory construction, sorting and comparisons.

The above listed resources forward the investigation and emergence of concepts that relate with safety risks and are observed in real flight situations. Unlike other investigations of human interaction, aviation communication pays attention to each sole flight instance, when a single flight is considered as a unit of analysis. Flight operating manuals describe an ideal flight situation, where as the real flight operating environment is quite more interactive. Cockpit crew has to interact with a range of human actors on the ground and in the air. These actors send critical information to the crew, expect information from the crew, and affect the timing and configuration of crew’s tasks with their demands (Loukopoulos et al, 2009, p. 45-47).

My personal experience originates from a long standing relation with aviation since my high school years, the affinity that society in Greece has with the Air Force, and a strong affiliation with the Air Force, due to my military duty in HAF and USN bases. This experience has generated a network of relations and few preconceptions about roles, attributes and practices of the members of the aviation community. Therefore the process of acquiring and
selecting information was accompanied from introspections in challenging my Air Force experience.

A main source of substantive information was the fieldwork in on-site visits; at a conceptual level with the main concerns of the industry and Air Force trends, and at the level of empirical data with flight transcripts, regulatory documents and note-taking in memos which became quite useful during the coding-sorting iterations of a GT approach. During these visits I spent time (from three to eight hours, sometimes in more than one day) observing the work of air traffic controllers on airport towers and control approach center, as well as to monitor pilot briefing and mission design while taking notes for my memos. In one of these visits, I was prompted to the transcripts and accident investigation reports of two landmark flights related to aviation accidents. The use of these two landmark flights as case studies (Helios 522 “ghost” plane and Falcon VIP “wild horse” plane, both presented in Chapter 1) augments the theoretical sensitivity of the study with immersion in the data, as a Glaser’s GT approach requires.

Comparisons between segments in this data and expert comments add concepts (like silence, accountability, and non-verbal communication) and relations of communication phenomena with aviation safety, the main topic of the study, as a GT approach closer to Strauss suggests. An entry was repeatedly stated in the flight incident log but was not arranged with fatal consequences, and a persistent no-reply call due to which fighter jets engaged to communicate cockpit-to-cockpit, are typical episodes from these two flights.
I was able to conduct a certain number of “compare-and-question” activities via three stages of interviews with air traffic controllers, civil aviation pilots, military pilots and the comments of accident investigators. Few short question/answer sessions showed the inefficiency of that form of data collection, as open discussions were going off topic (an example of an interaction is shown in Appendix C). In a second stage, an Ishikawa (fishbone) questioning tool (shown in the Appendix B) with another core theoretical concept was used (Ishikawa, 1968). The topic was the practitioners’ ability to deviate from rules using tacit knowledge. Fighter pilots were inclined to this format, as it was close to the tactical design charts they use but controllers and commercial pilots could not connect with (USAF, n.d., p.33; DoN, 1993, p. 5-15 - 5-27).

Hence, I went to the third and final stage, with scenario-oriented interviews (with limited direct single questions) which became the most applicable tool across different aviation professionals. During the first eight interviews, in the first two stages, the discussion incorporated a personal tone with contexts outside aviation and more related to personality traits. When I switched to the more focused and explicit Ishikawa questioning route, the proposition regarding “knowledge expertise and deviance from the letter of the rule” was applicable in the flexible mission design of fighter pilots, but was not comfortable for controllers and commercial pilots. A communication shift in the clear pattern emerged: respondents follow rules but also take own initiatives in specific situations as they interpret information of what is around them. Safety is their priority but they need to communicate their choice of action to the other
actors who may not expect that action. The three-stage process was a valuable iteration from data to responders, to forms, to concepts.

As noted the third stage tool contains scenarios labeled with actual core concepts, as Glaser’s GT approach recommends. On the other hand, the scenario structure is a skeleton compatible to the axial coding that Strauss’s GT approach supports. Strauss’s coding paradigm, with conditions prompting interactions (of pilot and controllers), as well as underlying strategies (used by the actors) with certain consequences, had a full application in the scenarios structure. In the following parts of this chapter, specific examples from those stages are presented, where as the full version is posted in Appendix A1.

Secondary but enriching sources were the life stories of pilots who have survived near-crashes and saved the aircraft, as well as stories from fighter pilots who were engaged in (almost daily) dogfights over the Aegean Sea. The first part consists of severe instances like the flight “US1549” on the Hudson river of New York (NTSB, 2010, p. 6-10; also in Kochan, 2009) or the Falcon “VIP flight” (Konstantaras, 2007, p. 398-450; Tsolakis, 2013, p. 328-337). Crew coordination, pilot initiative and efficient judgment, and controller’s limitations were apparent in the civil aviation flights. The second part refers to the specifics of bursting interactions during dogfights which remain in orality (stored in flight recorder and cockpit videos), due to the confidential nature of the missions/channels. I was able to access two examples through my personal security clearance. Despite their orality these narratives disclose crucial skills in aviation communication, like multichannel listening, mother-tongue laconic explicit interaction, implementation of rules of engagement via communication
etc. Therefore, such oral narratives have the historicity and materiality of documented information (Turner, 2010).

These stories add on the multiplicity of viewpoints that GT approaches encourage, are consistent with the exploratory nature of the study (Glaser & Strauss, 1967) and with the search for a generalized causal model (Strauss & Corbin, 1990; 1998) in the form of “what contributed” to pilots’ efficacy in navigating during major accidents and save the planes. How did they communicate their critical situation for a safe outcome?

Another piece of data was the drama series collection “Silence in the Air” (Anosis SA, 200) which I decided to watch, as it was the only drama series for fighter pilots life in Europe, in broadcast for three years with their artifacts and cultural texts. The series used cultural attributes of the Greek society (like the striking affinity of HAF in the Greek society, the duty obligation and ethical practices in interpersonal relations) to project an idealistic image of squadrons of fighter pilots and accentuate the bonding, the mutuality and camaraderie in their subculture of an air base. After the first forty episodes the plot moved to display a contrast between the intense but organized professional service life of fighter pilots and the instabilities they have to deal with in their private life.

The professional-personal life balance was the script in several memo notes of mine, while probing in conversations and informed relations of sociality and directness in phraseology and communication, as well as the “rushing-to-return” phenomenon which was present in two scenarios. Note taking in memos and connecting interpersonal communication concepts like keeping face and emotional stability traits in the workplace, were part of a
taxonomic process for the attributes collected in initial interviews. Memos and sorting functions are required in iterative mode in both Glaser’s and Strauss’s GT approaches.

Lastly, observing historical documentaries and media interviews — from stations like C-Span, National Geographic and the History Channel, as well as investigative reporting episodes of the Greek television with former Air Force officers or air traffic controllers, and broadcasts of judicial proceedings after accident investigations — allowed me to formulate a more holistic view of aviation, its actors and practices beyond my own prejudices and frame the aviation safety concept in a concrete way. In Chapters 4 and 5 I am citing broadcasted analogies in the footnotes.

GT approaches recommend diverse sources of evidence, in the same way that this study expanded to compare and analyze a rich depository of data (Wagner et al, 2010). The desired attribute is transferability in the form of expanding theories. Theories should provide “a general guide to multi-conditional, ever-changing daily situations” (Glaser & Strauss, 1967, p. 242). The decision about the amount of different types data collected is evaluated towards the end of the study from the conceptual relations which the sources associate with aviation safety (the main concern of the study). By the time when more attributes connect with aviation safety and are associated with communication concepts, then a closure of search for the core component of human communication is reached. The degree to which different types of data converge towards communication parameters (for this study) determines the
theoretical sensitivity trait of GT approaches for both streams of literature (Glaser & Strauss, 1967, p. 64).

2.3 Towards the Core Concept of the Study

In a GT approach concepts originate from theoretical notions of social sciences, like the concept of "role-expectations", in which participants react according to the expectations of their roles. In this study such a concept applies in ideal flight situations where the information might compare with phenomena of real flight situations. The concepts of silence and voice are categories observed in real flight situations and have an impact in aviation safety. A second type of categories relate with specific local knowledge of the field of study of aviation. The various types of signals and the emergence of the perception of situation awareness fall in this category.

2.3.1 Core Concept: Aviation Safety and Grounded Theory

Dimensionalization

The “core category” in grounded theory derives from a constant comparative method of every part of data (codes, categories, properties, and dimensions or different parts of the data). Comparisons with all other parts of the data explore variations, similarities and differences in data (Hallberg, 2006). The literature of GT approaches use the terms “category,” “label,” and “concept” interchangeably (Martin & Turner, 1986).

Strauss’s (Strauss & Corbin, 1990, p. 101) has similar definitions with Glaser’s (1992, p. 46-50) regarding concepts, but with two important differences. First, concepts are identified and their properties and dimensions
are discovered in the data (for Glaser this is an “intervention to data”). The core task is dimensionalizing a category’s properties (i.e. the dimension “silent to non-verbal to vocal” response signals for the property of pilot-controller interaction). Second, theoretical understanding (the so-called sensitivity with some “distance from data”) is accomplished with opening up the data is what the responders themselves are saying (for Glaser) and with questioning and analytic tools (for Strauss). Both of these two theoretical understandings are incorporated in this study.

Taking this typology into account, as well as other research applications (like Webb, 2001), this study starts with the core concept of aviation safety and category properties and relationships are described through dimensionalization, with theoretical understanding from the responders and questioning tools to codify their interactions. It is what Glaser calls the “chief concern” of the people in the substantive area (Glaser, 1992, p. 4). Furthermore, in aviation as a service industry and organization, safety is also the chief concern of all the others who are the users of the aviation system and, therefore, is prioritized in research. Variations and categories with properties are constantly re-visited during the process of comparing, coding and analyzing the empirical data. That is why the process of examining raw data (reading through for phenomena), moving to concepts (through sorting), to preliminary theory (through coding) and finalizing theory is not linear (Martin & Turner, 1986, p.149-151). In the GT approach of this study the core concept is the central phenomenon for categories to be integrated; i.e. aviation safety via its communication concerns. A category is a classification of concepts grounded under a higher order (like silence and
voice). These concepts are discovered by comparison of one against another and appear to fit to a similar phenomenon. Concepts are meaningful labels on discrete happenings, events, and other instances of phenomena with properties. Properties are attributes or characteristics in these concepts. Lastly, a causal category (like situation awareness) includes the events, incidents, happenings that lead to the development of the core concept.

In this study, two major categories that consolidate prior concepts and properties emerge from the data sources, regarding the core concept of human communication in aviation safety. The first is the concept of “silence”, as a phenomenon of institutional communicative behavior between aviation actors in the flight deck (with controllers and the airline operator from the outside) and the interpersonal interaction in the cockpit and cabin crew or across cockpits. The second concept is “voice” (vocal channel) as the complementary communication pattern that uses verbal communication (language and phraseology) and administers an interaction with interruptions and truncated messages which needs completion and confirmation.

In a certain overlap in between those two conceptual categories, two other communicative behavioral patterns (as concepts) were discovered in my material and interviews: the non-verbal airplane-to-airplane (and cockpit-to-cockpit communication) and the phenomenon of hesitation in interrupted talk as vocal but not verbal communication pattern (noted with dash lines in Figure 2.2), as a vocal channel including truncated messages which to be monitored for the completion of the interaction. Several properties of those concepts unfold when responders comment on scenarios (on Chapters 4 and 5).
2.3.2 A Grounded Theory Causal Category: Situation Awareness

Both conceptual categories of silence and voice have a significant impact on situation awareness (SA) of all the actors in this GT approach. Situation awareness is a causal category (with a crucial effect on aviation safety) in GT terms. SA (found also as “situational awareness” in literature) was formally introduced in human factors, critical systems design and cognitive engineering literature by Endsley (1988), while evolved in dynamic systems, weapon/missile systems and safety engineering, health care and humanitarian logistics (Adams et al, 1995; Endsley & Jones, 2012, p. 13-20; Endsley, 1995; Leveson, 2012; Dalrymple & Schiflett, 1997; Cozzolino, 2012, p. 17-35).

During World War I Oswald Boelke, an “ace” German pilot, seemed to identify the SA concept by realizing the importance of being aware of the enemy before the enemy does so (Garland et al, 1991; Shaw, 1985).

As Woods (1988) noted, the essence of SA is the separation between the understanding of system status by human operators and the actual system status itself. Researchers and military officers in military administration and systems of command and control also argue that “Situational Awareness” refers to the 1970’s sports psychology and has an implicit immediacy (Hone et al, 2006a). In Hone’s argument, “Situation Awareness” is a similar (related) construct, but, as linked with Endsley’s work it involves slower processes and removes immediacy. Endsley’s model and definitions (1988; 1995; 2012) have some discrepancies but they are still the de facto standard approach for the study of SA. The use of the acronym is more accommodating, and I lean on accepting
the three types of SA for cooperating actors with the time dimension and the original definition for the state of the individual actor.

SA relates to individual’s perception of the “here-and-now” while this state adjusts in time. In Endsley (1998), SA includes perception of the elements of a systems environment (who is where in the flight), comprehension of their meaning (what are they doing during the flight or have done pre-flight) and projection of their status in the future (what they will do as they navigate and aviate).

In military context, on the other hand, research challenges Endsley’s definition by dividing it in parts in order to add information processing tasks prior to the performed tasks (see Freeman & Cohen, 1995; Mavor et al, 1995). In Figure 2.1 a synthetic combination of different viewpoints and types of SA is pictured:

**Viewpoints of Situation Awareness**

(a) A single individual viewpoint – implicit in the original Endsley’s definition

(b) Actors with common interest, the same high-level task, but different data inputs and degrees of 3 types of awareness

Figure 2.1: Deconstructions of Awareness concept (a synthesis from illustrations of: Endsley, 1988; Freeman & Cohen, 1995; Hone et al, 2006a; Hone et al, 2005).
I will guide you through the representations in Figure 2.1 which use a pseudo-Venn diagrams with circles on the basis of “perception, comprehension, and projection”. The figure is divided in two parts (a, b) separated with the dashed lined. In the upper part as marked with (a), Endsley’s definition is reduced in three questions of operational nature; each question connects (using the short arrows around the circles) with the respective function of the actors involved.

For example “who is where” includes actors, objects and features of the environment of the situation. The functions of perception, comprehension, and projection are sequential and parallel and “awareness” starts at a local level (as current knowledge of task-related events), continues at a transitory level (as mere awareness moving from one situation to the other with turn taking in communication) and becomes global (as assessment of the full scope picture of flying, controlling or maintaining an aircraft). Awareness, in part (a) of the figure is a variable state, an attainment from the answers in the three questions (which in turn describe the phrases from Endsley’s definition). In this model, the three questions are considered to be components of awareness and their answers are necessary “to meet” in the intersection of the three circles. Each component is a stage that requires some data from different forms of information processing. Data input, processing, and reasoning all overlap (as discrete items and as a continuous flow) to lead to SA.

Air traffic control and airfield ground movement of aircrafts, as well as most forms of football, basketball, or disaster management deployment are activities to apply this model; i.e. the situation is in fluctuation, and where all
data, evaluations and assessments are of a transitory nature (Hone, 2003; Hone et al, 2005). That is why there is a shift to part (b) in the lower part of Figure 2.1. The combined answers to the three questions in the circles of part (a) formulate the Transitory Awareness (TA) in the bottom left hand side part of the figure.

Two other types of awareness complement the viewpoints of the concept; the local awareness (LA) and the global awareness (GA), in the middle and right hand lower side of the Figure 2.1. Those two diagrams of circles contain a separation with an increasing amount (smaller circles of LA and GA). The decisive factors for this separation are the constrained time of limited availability, the span of command (the number of people who report/communicate to a commander rather than the commander’s rank), and the geographical area of interest (or the medium, like air navigation or sea cruising). The arrows linking each circle indicate a slower process for memory and information processing, so that “awareness” would embrace locally-situated and then global events.

For example, in flight of commercial pilots in a two-person crew, each pilot has a different LA; the Pilot-in-Command who is the flying pilot will have inputs from the controls (and the actions performed) which may not be available to the co-pilot. The rate of change of cues in the environment and the key items of information determine measures of awareness. A pilot in a ground attack role experiences a far greater change to the TA than a commercial pilot approaching to land, although the LA situation may be quite similar. Thus, data that are of immediate importance in TA may evolve as of declining importance to
contribute to LA. Any variation in importance is also associated with the changes in operating and flying environment; it is a principle accented in the work of ecological approach to perspective (Gibson, 1979).

As prompted below the dashed line in the heading of Figure 2.1, Endsley’s inclusive approach to SA implies a single individual’s viewpoint and is deconstructed in three types or stages. When SA is conclusive for more actors involved then the typology of TA, LA, GA is a closer-to-reality description from multi-lateral points of view. In this sense, the air traffic approach controller and the pilot of an aircraft on final approach have a common interest and they are both concerned with the same high-level task, but they attend different data inputs and acquire different degrees of TA, LA and GA. Furthermore, when the aircraft is in ground movement (like like in section 5.4.3 or 5.4.4) TA, LA, and GA measures change again. In the Helios 522 flight the two fighter pilots intercepting the silent passenger plane possess TA (after their briefing) and LA but low GA, where as the Chief of HAF (in command post) had a high TA and the Prime Minister had high GA but limited TA and lack of LA. The Prime Minister has the ultimate decision privilege to authorize a shoot down of an “indentified” aircraft as it was happening with the Helios 522 flight. The pilot flying in the interception communicates his LA to increase the TA of the Chief of HAF, who in turn conveys the messages to the Prime Minister who has to rely on the communication flow of subordinate actors. The decision of “whether it is ever permissible to weigh life against life” and the consequences of a defense of necessity, in this case, is described in several oral accounts of Helios 522 judicial proceeding, discussions with HAAISB members, the fighter
pilots who have experienced a Renegade alert, oral accounts and televised interviews used in this study (see also Tsolakis, 2013, p. 382-400).

In the typology of awareness in part (b) of Figure 2.1, the transitory type is closer to the traditional conception in sport psychology, the local type approximates a closer relationship to the Endsley’s model; the local and global types are linked with situations of multiple levels of hierarchy of take-command-from and report-to (like in Mavor et al, 1995).

Assessment of awareness goes with actor’s performance for tasks performed, with interference to tasks or interruptability and completion in a certain time frame of availability. The separation of SA in types denotes that an individual could possess awareness of any type (or of all types at once). It is a matter of real topical situational factors (in flight, combat, or other activity) to indicate which type (or types) is relevant. An important warning that Endsley states regarding the assessment of SA is to avoid the tendency of measuring “the participants’ confidence in their situation awareness” rather than their “actual situation awareness” (Endsley, 1994).

SA, especially in the expansion of the three types, implies clear communicative dimensions as human actors should act upon, respond to, and confirm/correct important informational cues. Apart from that human communication forwards the information flow functioning in LA type, and facilitates the move to TA type. The GA type needs also reporting and critical evaluation and access to privileged operational and mission information. Awareness (of all types) is internal to the individual, and does not reside on any (technological) information display. The individual actor develops awareness
when considering the interpersonal interactions and relationships with relevant communication. Interpersonal here includes the form of the “individual-group-team”, or the form of “own vs opposing force/group” in command and control contexts.

Other Examples of SA realities

The high level of standardization in aviation is expected to streamline SA, but the operating environment still has humans with multiple languages and mindsets working together and interacting in international flights (in diverse conditions). The deadly Tenerife disaster at Los Rodeos airport on 1977, where Spanish controllers communicate with a US flight and a Dutch flight and crew members, is a clear example of how language and its semantics (the meaning) and pragmatics (the context that contributes to meaning) had an effect to LA and TA types of awareness. The utterance “we're now at takeoff” from the Dutch copilot was not understood (as being in the take off process) by the Spanish controller who replied with a vague “OK”, after the Dutch captain powered up and said "Let's go" (since he mistook the meaning of "clearance" at that specific point in time). Then the controller called for "standby and wait for clearance” and increased complexity in the interaction (see Roitsch et al, 1978; Cookson, 2009).

The copilot announced that the aircraft was taking off, yet the tower understood his comment as "we're now at takeoff position" and not in the “process of taking off” (Krock, 2006). The eight minutes of interaction escalating to a disaster was time scale with dynamic flux in TA and LA types
from one utterance to the other, as the controller had a change to the GA type due to the ground movement of the US flight (also). Then the controller speaks simultaneously with the US flight crew and the crew members in the Dutch flight find it hard to hear. Neither the copilot nor the flight engineer, in the Dutch flight, questioned their pilot who had a very senior position (as it happens in several responses in Chapter 4 and 5), and the impact occurred about thirteen seconds later.

Derangement of all types awareness for the different actors, in this disaster, was combined with additional factors all contributing in the process for “memory and information processing” of these actors (as indicated with the pointers linking each circle Figure 2.1, part (b). The fog in the weather, the smaller and less familiar aerodrome, the news of bombing Gran Canaria International Airport (which was their original destination), and the intended expedition and rush to cover the schedule delays from previous days, were all in the background of that disaster (and the TA and LA of the US and Dutch flight crews and the GA of the controller).

Rescue, disaster relief and military operations are now increasingly multi-national and multi-force, and therefore with increased potential for misunderstanding. For example, under the command of NATO or the UN, it is quite possible to have an English-speaking Commander whose orders are mentally translated into (let’s say) Dutch or Greek by his Chief-of-staff, further mentally processed and translated back into English, to be passed to a squadron Commander namely French or Turkish who repeats the double translation process to brief his Italian subordinate and his Norwegian Deputy Commander,
a woman who serves as a liaison officer with the local community (as currently in Cyprus in the United Nations Peacekeeping Force).

The relay of commands and the confirmation of information flow is a demanding communication accomplishment which has an effect to awareness of LA, TA and GA type (in a different way for these actors). A similar situation of interpretive messages fragmented information flow and gradual development of awareness happens in NATO reconnaissance flights with multi-nation crews of the NATO AWACS (like the pilot who responds in section 4.4.1). As Hone (2008) points out, such coalition processes in command and control environments generate a major communication challenge (of language and culture) that clearly affects SA (and consequently effectiveness and safety) especially in the immediacy of a flight situation.

In the emerging causal category of SA in this study, four key elements cooperate: humans, informational cues (as stimuli processed), behavioral cues (paralanguage and role expectation attributes), and appropriateness (as regularity) of the responses. This regularity implies the comparison of the response with an anticipated response (a choice from a number of possible expected responses). These expected responses formulate an instrument for a performance measure of SA, from both pilots and controller’s sides, as it is apparent in the responses analyzed in Chapter 4 and 5.

For example, for a HAF pilot SA (TA type) and means to understand the threats and intentions of the “non-friendly” aircraft or enemy forces, as well as the status of his own aircraft (LA type). In order to project the situation on his near future it is inevitable to communicate from the start (communication builds
a foundation for a GA type also). For an air traffic controller, SA denotes (at least partly) to estimate about current aircraft positions and flight plans and the required separation between these positions and entities (GA type), in order to predict future states of conflict (LA type). Of course the controller cannot be a simple observer, but communication is crucial in all stages and has a considerable effect to the SA of the cockpit crew (TA type for the controller).

Thus, as an emerging communicative parameter, situation awareness includes acquisition of information from the immediate (and the co-present controller) surroundings, integration with relevant knowledge of the situation, exploration of a mental picture for the situation, and anticipation of reactions for the immediate future. Hence, situation awareness has a clear effect on aviation safety and should become an added component in communication models.

2.3.3 The Grounded Theory Emergent Theoretical Model

The theoretical constructs of concepts and categories, using comparisons and sorting from empirical data, conclude in an abstract figure which represents the emerging theoretical model, in the scope of the current study. Figure 2.2 below shows the theoretical array of concepts (in the above typology) emerging from this study using a GT approach:
Figure 2.2: The core concept of this study with inter-related categories

Two main parts position themselves in the two branches of the figure as categories related directly with SA (described in section 2.3.2). Let us go over the structure and reasoning of this model.

Silence Category

On the left bottom part of the figure there are three interconnected circles containing concepts with properties identified in the data from flights. The first one is silence in the cockpit in the form of no-talk; not-confirming /reading in checklist marking between pilot and co-pilot or using a silent checklist to mark; not-replying to calls from air traffic control for extended periods; no-talking between cockpit and the cabin; standing-by silent in an expected interval till the next phase of flight; or in the form of not reporting flight incidents in the flight log or in the briefing/debriefing.
The second circle contains the concept of non-verbal communication of human actors across different airplanes and cockpits. It could take the form of waiving hands across cockpits; waiving wings during flight towards another aircraft; approaching the other in proxemic distance; using territorial markers in a cockpit to signal operating status; activating silent and audible but visually mediated messages in banners and symbols from the cockpit to the passengers or the form of radar locking in a fighter jet dogfight. All these attributes are different ways to signal a message in non-verbal channels.

The third circle contains an important vocal but still non-verbal concept describing the component of paralanguage in the form of non-verbal cues of the voice or mainly hesitation talk (that is rather truncated or not). Hesitation may convey emotion or nuance meaning with forms like prosody, pitch, volume, intonation. Hesitation is commonly accompanied by silence as a result of uncertainty for the receiver or a reluctance to correct from the sender. Hesitation is closely related with meta-communication, as it communicates about other already transmitted messages.

All three circles in the (pseudo-Venn) diagram have a common part of interconnection, as usually one is complement the other in an interaction as communication components. Per a GT approach we can combine (with the arrow pointer) all the concepts under the category of silence in the parallelogram above labeled “silence”. Silence in turn has a causal effect on SA, which is crucial to aviation safety (both relations are represented with a thick arrow pointer). Rarely, but with fatal consequences, silence may have a direct effect to aviation safety without passing through the SA of different actors (like
in the case of Helios flight crash). In such an instance, silence emerges as a causal category by itself, usually as a safety threat, represented with the dash arrow directing to aviation safety parallelogram.

**Voice Category**

Similarly, on the other side of Figure 2.2, we have two other communication components that are conceptualized for a GT approach under the label “voice”.

The first left circle from the right side of the figure represents a major verbal communication channel with several attributes of language. Standard phraseology is expected in message interaction, in the form of aviation English (in international flights) of the local language (in domestic flights); most checklists are specially designed verbal messages that are pronounced in a dialogic format (co-pilot asks, pilot acts on controls, co-pilot marks the checklist) to ensure collaboration and avoid mechanical parsing of the checklist. Language may also take the form of mother tongue, even as an exception from standard phraseology. The most common (and justifiable) instance according to the responders are emergency, constrained time or unusual situations, or laconic but metaphorical interactions during fighter jet pairs cooperating in a dog fight against intruding aircrafts.

The second circle in the right side of Figure 2.2 contains verbal communication rather fragmented, really applicable in real flight situations where the sequence of flight operating manuals does not represent the interactional realities. Messages are truncated messages to save times, change turns or continue a rapid pace; messages may be interrupted by other incoming
inputs or change of communication channels (e.g. stopping to converse in one frequency, asking for a clearance while a control checking is conducted, aborting a readback/hearback because of an occurring event or a request from another flight). In most of those times, a reasonable effort for a standby rather interleaving mode is needed (from the cockpit for their own tasks) and from the controllers (to catch up the next flight’s request). A monitoring process to “recover” the conversation or complete the truncated messages with new messages is needed. A process it is closer to meta-communication as original communication was interrupted and the new messages convey meaning about the old ones.

Again the two circles in the right side of the figure are represented with an intersection (in a pseudo-Venn diagram) to show that they are not mutual-exclusive but co-exist in the data and in the context of verbal interactions. In a GT approach they are combined under the category of voice. Voice, as a category, in turn has a causal effect on SA, which leads to aviation safety, as pointed out with the thick arrow to the left. In less common instances, voice may direct its impact to threaten aviation safety or enhance it by mobilizing a controller who shouts when looking outside of his window for the actual position of aircrafts in the runaway. In these occurrences the effect of voice goes directly to safety, making it a causal category itself (like in the case of the controller in Thira airport of section 4.3.2). That is the dash line pointer from voice to aviation safety parallelogram.

Lastly, as communication theory suggests and respondents point out (in section 5.3), paralanguage and hesitation have a vocal aspect and related with
truncated messages (Grice, 1989). This type of relation that connects the circles of different conceptual categories is represented with the dash lines from the respective circle (hesitation on the left to truncated messages circle and the voice category on the right).

In this study, a GT approach though immersion in sources of data, comparing and coding (in interviews and transcripts) leads to the identification of five different phenomena of communication, which function with interconnectedness (showed with intersections). The first three are non-verbal communication signals, silence and hesitation as paralinguistic instance. The next two are the use of language and truncated messages recovery emphasizes verbal communication. Both categories have a causal effect to SA which; in turn with its pointing triangle in Figure 2.2 ultimately signifies the direct effect to aviation safety.

Aviation safety is the desired result when moving people by airplane to a certain destination and includes investigation, categorization of flight failures, and the submission of prevention mechanisms to avoid for such failures. Aviation safety takes the form of a research question with the prompting of human communication as a key contributing factor with impact in aviation safety. That is the starting point of a GT approach with a certain preparation in literature of human factors, systems theory and communication in order to locate and select appropriate data sources, informants, archives and raw data from in-depth interviews, and filter them through iterations with real-life practitioners.
2.4 The Flow of a Grounded Theory Approach

A GT approach is iterative between theory, data, concepts, and constructs. In this section I describe this kind of dialectic.

For this study I use my preconceptions from the start, as well as the way I deal with scenarios instead of single questions to make them relevant with the actual practitioners and not with my pre-conceived ideas about the field. For example, the idea that fighter pilots have a mindset of urgency and “living the moment” qualifies a questioning process that is relevant with their work and highlights their main interest of aviation safety tight with mission efficacy. Also, in another idea, for communication directness in airport activities where the content of the message has to be expressed in low-context language, the questioning process requires self-sustained scenarios which point out to the direct topic.

A great deal of relevance was accomplished after a series of visits for evaluation and active observation in aviation installations, as well as from the accumulated participant observation and work in such environments. A process of constant comparison starts with the first level of reading and identifying phenomena of interest in the analysis of data and then a decision on the theoretical sampling is taken; it is about what type of data are to be collected next to support the theory construction (Glaser & Strauss, 1967, p.45).

A schematic representation of the GT approach as applied to this study is shown in the following Figure 2.3:
Figure 2.3: The process of a GT approach applied in this exploratory study
In this study, the GT approach involves identifying the theoretical and empirical core concept of aviation safety (sections in 2.3) and selecting the data resources (multiple times in section 2.2). The process is iterative (with comparisons and coding) at all stages as represented by the thick circular arrows in the bottom left of the figure. This iteration is a constant follow-up at any stage since it facilitates the cross-concept comparisons. Also, after the preparation and initial data collection described in section 2.2, coding, comparisons, memo note taking and sorting of information to for concepts to emerge were in the list of a GT approach for this study, as shown in the top left short list (labeled GT approach). The item “coding and comparing”, which is pointed out with the arrow in the list, is the main concern to allow “aviation safety” and its causal categories of “situation awareness, via silence and voice”, to disclose and build-up.

**Preconceptions Orienting the Steps**

Next to the right of the GT listing, a banner of “personal preconceptions” is drawn in order to initiate the questioning inquiries. From all my previous background with aviation, I have internalized three categorical experiences which had a radical impact in my theoretical mindset and conceptual thinking regarding the study area of aviation. Along these lines thee preconceptions oriented the next steps.

The first idea has to do with the denseness of aerodrome time which is full of events and expected arrivals, departures and occurrences for all professionals in its functions. The second idea is that fighter pilots appear to belong in a distinct category of service of a different kind of competency (consistent with Reinhardt, 1970). That means that their understanding of what is important has a scale from “a mission accomplished till a moment of silence staring the horizon”. In these terms, civil aviation pilots and controllers have sometimes difficulties to connect (and
communicate) with such a mindset. Several studies are consistent with the manifestation of such difficulties (Connel, 1995; Dismukes et al 2007, Retzlaff & Gibertini1987; Ashman & Telfer, 1983). The third idea is that communication directness in aerodrome activities goes hand-in-hand with professional responsibility and mutual trust. Mistakes are made but should be recognized and clearly corrected them, and use it for self-improvement (as in Dekker, 2010).

**Three- Stage Questioning Route**

The next step going down in Figure 2.3 with three document layers corresponds to the three stages of a questioning route that was part of sampling for theory to find applicable formats and representative concepts. As pointed in section 2.2 a questionnaire was the first attempt which was dissolved due to the lack of discussion focus; then I introduce the Ishikawa (fishbone-shaped) diagram with contributing “causes and a key effect (in the fish head)” with the a different core topic regarding the conformity and deviance to rules. The operation-related fishbone format disqualified its use from commercial pilots and controllers, where as fighter pilots where keen on it. The Ishikawa diagrams (also known as fishbone diagrams or cause-and-effect diagrams) are visual tools that show the path for contributing factors to a certain event (area of interest or problem). Ishikawa diagrams were first introduced in quality improvement of industrial processes (Ishikawa, 1968). The diagrams display the factors that affect particular quality characteristics or problems (Tague, 2004; AOTS, 1985). Typically a fishbone
diagram matches a process of brainstorming (Nelson, 1998), used in this study in the second stage of data collection, regarding the topic of knowledge and rules. A fishbone diagram is one of the first steps in investigating a field of interest, and includes people involved, processes and requirements, assessments, categories/questions and the environment. In aviation industry this tool was used to investigate the quality of air travel service, among other topics (Newby et al, 1996; Smith & Ragan, 1993).

A GT approach recommends the appropriate tool for the greater amount of data and the search of common conceptual indicators in interviews and observations. Hence, the core concept of this study shifted from rule deviance and tacit knowledge to aviation safety via communication. The qualified tool in the third stage was the collection of scenarios of real flight situations which encourages the responders to offer an opinion closer to a reenactment of their own functions, practices, and experiences and not as a predictable (by the manual) response.

Each questioning tool was sorting out topics and was orienting the study closer to human communication and its effect to aviation safety, despite other operations, cultural, technical and commercial parameters that came out from the first two stages of interview. That is why the arrow buttons in the Figure (from questionnaire to Ishikawa to scenarios) are pointers in a roadmap. The scenario collection became more representative to concepts as more expert responders were recruited to achieve consistency in the content and the relationships with the concept categories of “silence” and voice”. The responses to those scenarios
disclosed the observed complementary character of the five communication components of no-talk, non-verbal communication paralanguage of hesitation, language and truncated interaction. These concepts complement each other in aviation interactions and generate overlapping attributes in the main categories.

In the lower bottom foundation of the Figure 2.3, I have indentified the main raw data archives I was able to use from the main sources of section 2.2 (in a textual representation of file forms): deep-interview scenarios, transcripts, accident reports, participant observation on site visits. The dashed connecting lines to the first two stages of questioning tools represent the process of consulting data and sources in each stage before constructing a new tool and selecting the appropriate topical scenarios. Appendix A, of the current study, includes the questioning tools in the three stages, and the full collection of scenarios that allow this study to expand further in next stages. Two examples of scenarios are introduced on section 2.5.1 and 2.5.2. Also, an example of a coding scheme using a different type of data (from accident investigation reports) is presented on section 2.6.

**Sorting, Comparing and Coding**

On the right hand side of Figure 2.3, two snapshots of the processing of a GT approach are represented; one technique of coding from a first order of codes (identifying properties in the data) to the second order of coding (structuring concepts) to the third order coding of an aggregate dimension which emerge as an
evolutionary stage of the structured concepts (from left to right, with another manifestation of the SA concept, in that flight). The label “coding” in the parallelogram is used as I applied the process in an accident report with secondary and not raw data from accident investigation, combining a transcript and investigators comments. The full example of this coding is described on section 2.6 for the Yakovlev-42 crash. The second square-like frame below the coding parallelogram is labeled “sorting/comparing” as it corresponds to the close reading/open coding process of a first stage questionnaire interview. “Ego” and “alter” interact in the right column and the actions that are communicated generate coding gerunds in the left column. The interpretation of the questions is italicized (on the left) and labels are selected to preserve language and action in the data (from the raw replies of the right column to codes like “reserving opinion, experiencing complexity or piloting and operating”). The sorting/comparing function informs the coding function in the upper right hand side parallelogram of Figure 2.2

In this direction, functions of coding, sorting and comparing are used for constructing theory in a GT approach. GT’s central function is the emergence of theories (Hildebrand, 2004). GT immersion in the data searches for: (i) the relevant conditions in which participants act in the study situation (e.g. routine flight, emergency flight, oxygen starvation, external or psychological but communicated signals) (ii) how the actors respond to changing conditions (e.g. in the case of Helios 522 silence in communication due to hypoxia or waiving wings from the
fighter jets to convey a message of interception), and (iii) what are the consequences of their actions (e.g. after understanding the autopilot control loss in a rapid descend in the Falcon VIP flight; the pilot or co-pilot did not activate the seat belt sign; the purser has been trying to prompt the VIP to sit and buckle, and the pilot had the priority to save the aircraft while the VIP on board crashed his body and died from the oscillations; when he had the option to sit he did not pay attention with fatal consequences).

In Glaser’s suggestions (1992, p. 4) theory construction starts from the inquiry on three generic questions in the third-stage of questions in Figure 2.3: (i) What is the main concern or problem of the actors in the area of study (how to communicate their situation to and from the cockpit, in this study as described in sections 2.3.1) (ii) what accounts for most of the variation (different options, choices, opinions and decisions, like silence, nonverbal communication, hesitation and use of voice with standardized phraseology, mother tongue and the monitoring of truncated messages in Figure 2.1) in processing the problem? (iii) What category or what property of what category does this incident (the observed variation) indicate (silence and voice with the intersection of hesitation and interrupted messaging in this case)?

These questions are floating during the comparisons, coding and analysis in the iterations of empirical data. GT process aims to catch the interplay and compare interactions and behaviors with other relevant realities as expressed by the responders (when we speak about interview data) or described in accident report (in
accident investigation documents) or monitored from flight recording devices (in the so-called “black-box” transcripts).

**Emergence, Theoretical Sensitivity and the Coding Paradigm**

Three other key concepts originate from Glaser’s and Strauss’s (1967) common ground: emergence, theoretical sensitivity and the coding paradigm. In this study, these concepts were useful during the iterative investigation process and the last coding phase.

A general comparative analysis of raw data would allow the “emergence” of conceptual categories from the data of social research, without forcing the data to fit theoretical literature of the study area. There is a downside in the “emergence” of categories from data using the open coded strategy of Glaser and Strauss (1967); i.e. referred also as substantive coding means reading the data text line by line for ad hoc coding may result to mass data in abstract insignificant categories with limited new information (when pairing for comparisons in the “sorting/comparing parallelogram to the coding parallelogram).

That is the point where “theoretical sensitivity” emerges, as the ability to reflect upon empirical data through the lens of theoretical terms. Both Glaser and Strauss (1967; p. 3) note that the researcher in GT should have a perspective to facilitate the identification of relevant data. In these grounds, I decided the move from the fishbone main inquiry (regarding rules and tacit knowledge) to the inquiry of aviation safety with scenarios; a shift which was more inclusive to commercial
and military pilots and controllers as well, and allowed me to motivate several higher-ranked professional to respond.

This study is using the “coding paradigm”, in the “coding” parallelogram, as a way to produce concepts that seems to fit the data (Strauss, 1987; Strauss & Corbin, 1990). The coding paradigm has four items: conditions, interaction among actors, strategies and tactics, and consequences. Coding operates by breaking down of data, developing concepts and organized in new ways and builds a skeleton or an “axis” (that is axial coding) to develop grounded theories (Strauss & Corbin, 1990; p. 57). Coding means analyzing but is also a process of putting tags, names and labels in pieces of data (Robson, 2002; p.493). It is a useful tool to unpack human communicative behavior as manifested in interaction with the potential of pointing out strengths and weakness in the communication process. The goal is to construct a theory to describe the data and the phenomena that are manifested through the data Charmaz (2006). That is why from both “sorting/comparing and coding” parallelograms dash lines lead back and forth the files of deep- interview scenarios, transcripts, accident reports, participant observation on site visits etc, in the bottom part of Figure 2.3.

The exploratory study is the essence of a GT approach. After collecting an initial small amount of data then theory construction begins for the specific domain. Data maybe insufficient data and the theory incomplete, but the researcher tries to determine its weakest point. A useful technique in this phase is the so-called abduction (Pierce, 1958; Reichertz, 2007); a process of forming explanatory
hypotheses to logically introduce a new idea. Abduction brings out a surprise that opens new insights and the kind of “discovery” that is at the heart of the grounded theory method (Reichertz, 2007; Muller, 2014). The weakest point of the incomplete theory is the start of a (what-if) condition (leading to a likely explanation) for new data selection. The goal is that by learning how it fails at its weakest point a large amount of information emerge for making a stronger theory based on that failure (Awbrey & Awbrey, 1995). With this process the main topic shifted in the second-stage fishbone questionnaire to the scenarios with the focus on aviation safety and not on deviation from the rules.

2.5 From Theory to Scenarios with Protocol Analysis Lessons

In the process of conducting in-depth interviews, I used several lessons from protocol analysis to facilitate the effective responding. When respondents reply the process went deeper, as I had several interactions with them in order to elicit their own practices and experiences, beyond what is mentioned in their books and manuals. The interviews started with an informal phase to speak about their careers, my involvement in the sector and my experience and their opinion on the importance of communication in their work. The next interview phase was to get a questions/answer interaction in order to understand what the most appropriate format for these kinds of interviewees was. As a result, a first version of a questionnaire was created for air traffic controllers in training and the final version with a selection of scenarios was prepared with the review from an experienced
accident investigator and fighter pilots who were faculty members in the HAF’s Air
Force Academy.

Informants in this study are not subjects but are considered high skill
practitioners at the level of experts. This is indeed true particularly for a certain
group of pilots- participants who are decorated in international Air Force
competitions and drills, as well as accident investigators with engagement in
analyzing hundreds of accidents with global recommendations.

Two phases of Interaction

After the first site visits and exchange of views and iterations regarding
“What to ask and in what manner”, I finalized a selection of scenarios accompanied
with a very small number of personal/opinion questions. The functionality of those
shorter questions was to be used as probing devices for respondents, to complement
one response with another in related instances, and to trace potential
inconsistencies when they respond from the point of view of their role (controller’s
were asked for the position as if they were pilots, and pilots as if they were
controllers or co-pilots, or pilot-instructors). In the closing iteration, regarding the
configuration of a questioning path for the carrying out the interviews, I was able to
cultivate and instruct responders to verbalize their thoughts in the way that they
complete their tasks in the certain moment of time; when, for example, pilots or
controllers are confronted with a hesitation, a repeated entry in an operating error
log, the reluctance of an authoritative passenger to follow purser’s suggestions, or a developing emergency when the controller is standing-by after the initial declaration of a situation of a crew member, to name a few of the tasks.

The interaction with responders followed two phases: in the first one, in a certain scenario, we had to discuss the actions of the pilot or controller as they are performed in a prescribed algorithm (a specific set of instructions for carrying out a procedure or solving a problem with a start and an end); in the second step we had to connect the actions taken, as functions that show concepts of the operating environment, with communication interactions. Sometimes in this process of their “reply and discuss”, responders did not offer an one-to-one correspondence of their verbal report with the processing steps, since the skills they possess and level of expertise makes them to take “their own knowledge for granted when they respond”, so their attention may be short-circuited with acquired skill. That is why, I have conducted a couple follow-up discussions with ten of the most keen responders in order to get their rumination (a week) after the completion of the scenarios; in Chapters 4 and 5, data analysis has additional probing questions and notes on background or regulatory tips and associations useful to unpack such occurrences.

A relevant example of using some of the tips of protocol analysis is the detailed description of a fighter pilot who did not speak-up on a navigational decision about approaching an airport without using local ground approach positional systems; he had to explain the operating principles of a certain
positioning device (namely TACAN) in order to connect it with his reaction of no-talk in a two-seat aircraft training flight with an instructor pilot. While he was thinking aloud about a no-talk instance of his, his recollection became an algorithmic reenactment of the flight; we had to go through the list of his tasks, together, since the mission briefing phase before take-off so that his thoughts mediating the completion of the task did not distort the story he was able to represent.

He related this flight with the scenario of “not-speaking up” despite his belief that a small gap in the routine flight planning phase generated a doubt and the instructor pilot (who is in command) was proven to have the same uncertainty. For this young second-seat pilot, the mission connected with silence when his superior officer (and pilot in command) spoke up in reply to his urging question. After an initial touch on the ground (landing with no-stop) and before continuing the next “touch and go’s” (immediate take-off with the same rolling in the runaway) the two pilots realized a mutual silence period (the one not asking, the other not telling) which evolved to a dependable mentoring relation after their interaction. The responder’s thoughts mediating the completion of a task are used to reconstruct a reply for the situation which was unfolding during the actual flight and can, therefore, be accepted as valid data on the responder’s thinking of what he was doing.
Lessons from Protocol Analysis Used

The central assumption of protocol analysis is the instruction to the responders to verbalize their actions in a manner that doesn’t alter the sequence of thoughts mediating the completion of a task, and can therefore be accepted as valid data on their thought process (Ericsson, 2002). The method involves making a detailed record of a person's verbal report while they are engaged in carrying out a task, for example, doing a mental calculation, solving a problem, making a decision, or interacting with an automated device. In this study, the reply was a retrospective representation of the pilot’s tasks as if he was completing those tasks in front of the scenario with the framing context (of what flight or incident of his practice is closer to the scenario description) he determined to reply to the scenario and the interpretation he selected for his silence in interaction. He was the one who practiced silence and decided to break it after a first landing approach judging that his uncertainty was a safety risk more important than the reservation he had for the status of his instructor. Unlike that, other responders, (like controllers) received silence and replied with another point of view in the same scenario. Hence, these lessons of protocol analysis assumptions were prompting devices for a more relevant reply in the scenario.

The verbal reports are then written in plain language, segmented into statements and coded (using episodes, based on participants’ working on a particular subtask) in reference to the concepts which related to the core inquiry of human communication in this study (as in Figure 2.2). This phase connects with the
coding scheme of a GT approach as this study emphasizes “what is communicated” and limits the search of the “underlying cognitive processes” which would be the aim of a pure protocol analysis study. Participants here describe and explain “what they did and not what they ought to do or (just) were taught to do.” That is why in several cases responders deposit their own deviations and the way the correct errors that accepted to have made. As it happens to a GT approach, also protocol analysis principles note that a subjective interpretation of verbal reports has to be recognized. Since the responders are not in an experimental control environment, the use of a small group of selected experts as evaluators and the deep closed reading of their data are deliberate choices I made to mitigate that level of subjectivity.

In the following section two examples of main scenarios from the third-stage questioning tool are presented as the basis of final data and concept collection of a GT approach. The full document with the scenarios can be found in Appendix A.

2.5.1 Introducing the Scenario of Silence

The first main scenario discusses silence, using research findings from the practice of silence to be discussed the informants-interviewees; after a certain discussion period the interviewees offer their commentary in writing. The point of views of different actors (pilots, controllers, crew members, accident investigators) determines various manifestations of silence and events in which silence was decisive of the conclusion of the flight or the safety of passengers on board.
Since the early years of (mainly) civil aviation, crew members’ reluctance to speak up, and the resultant silence has posed a serious threat to flight safety. Silence, in the mid of the responders, may be observed inside the airplane cabin (with passengers, pursers, and flight attendants), inside the airplane cockpit, between cockpits (in crisis situations) or may be measured institutionally with the flight log reports where the crew has to fill any noteworthy information (for the airlines and the manufacturer, such as mechanical problems, operating environment problems, technical inconsistencies and so on). Also, responders are asked to take the point of view of their role, so that silence would emerge as a phenomenon with multiple dimensions: silence from whom, addressed to whom, used by the controller or the crew member, perceived by the controller, crew member, an external pilot or the airline operator. Since a flight is accomplished in a collaborative environment NASA introduced a managerial requirement in 1979, promoting the cockpit resource management that evolved to Crew Resource Management (CRM). Symbolically, the prompting device of CRM was the triplet: communication, communication, and communication.

The scenario listed below, in the form of research report, investigates the theme of silence as studied by Bienefeld & Grote (2012) but extending it further: Several accidents have shown that crew members’ failure to speak up can have devastating consequences. Despite decades of crew resource management (CRM) training, this problem persists and still poses a risk to flight safety. To resolve this issue, we need to better understand why crew
members choose silence over speaking up. We explored past speaking up behavior and the reasons for silence in 1,751 crew members from a European airline, who reported to have remained silent in half of all speaking up episodes they had experienced. Silence was highest for first officers and pursers, followed by flight attendants, and lowest for captains. In this scenario, the focus is on silence as a contributing or causal factor of aviation accidents (crises) and on answering the “why” question, as if silence and speaking up are the two sides of a coin; those crew members could speak up but decided not to, in half of the times that had the opportunity or the need. It seems that the most extrovert members (flight attendants/pursers and captains) had a higher rate to speak up in cabin crew communication. The data chapter for this scenario is Chapter 4.

2.5.2 Introducing the Scenario of Hesitation

A second major scenario used has to do with the experience of hesitation in interaction that may leave incomplete information, truncated messages and generate uncertainty in the cockpit-controller interaction.

The scenario is taken from an anonymous report of a real (pre-) flight situation in the NASA’s Aviation Safety Reporting System (ASRS, 2013). It develops in three parts: (a) a captain (as pilot flying, or pilot in command in civil aviation) reports what he heard from the controller and the resulting dilemma and what he did in a rolling movement to take-off (b) after the action, the captain, is reporting and explaining the position taken, choice made, and action performed (so
he is meta-communicating on the interaction) and (c) the first officer (as a pilot not flying) is commenting and evaluating on the incident and the action of the pilot flying the aircraft. This is also another level of meta-communication (closer to de-briefing) for the initial interaction and the incident. It is an engaging scenario for the responders with the triggering question “what would you do?”

The vocal but (still) nonverbal dimension of speech channel of communication has to do with how one says something and not with what one says. Among the voice qualities, prior to actual talking the language, pause and hesitation are perceived and understood in the broader verbal interactions. Adjustment is necessary for both sender and receiver ends to communicate. That is why a second scenario from an actual reported flight situation in order to investigate the transition from silence to language, via paralanguage.

In this scenario we move from clear non-verbal instances to hesitation (which has a vocal component) as an indication of bypassing in the cockpit – controller interaction or as a contributing factor of aviation accidents. Why pilots or air traffic controllers hesitate in their communication flow? How do both deal with hesitation in order to avoid miscommunication towards an unfolding incident, with or without the rules? Let us see how the scenario is laid out with the captain of the anonymous report, his actions and the reaction of the first officer.

Part (a) Captain reports:

On takeoff roll approaching 80 knots, the Tower Controller called us and said in a very slow, unsure voice, “[Callsign 1…2…3…4…](pause).” He
sounded as if he had something to tell us, but did not know what to say. We both noted a tone of concern and hesitation in his voice as if he was still unsure of something at that moment. We were light weight and had 13,000 feet of runway ahead of us. We had to make an immediate decision.

The civil aviation pilot (the captain) reports that he has ended the taxiway movement, continued to the runway to take-off and starting rolling to develop the necessary speed. The call from the air traffic controller was made with a pause and murmuring the call sign (which identifies the aircraft in their interactions; it is usually the carrier name with a number). Although the message was incomplete the tone was thought-provoking and timing was critical as they have started the speeding up for the take-off process. They still had some a route to go and they had to decide with no other input, just their airplane data (fuel to avoid fire risk and the remaining distance to be safe). What did the Captain do?

Part (b): The Reporter’s Action

I elected to initiate rejected takeoff procedures. During deceleration the Tower Controller said, “Disregard.” The sound of one’s voice, the tone and force, all convey a message. I did not like the message I was receiving and could not gamble that he was trying, but unable, to warn us of something ahead. I would take the same action again.

The captain decided to take the incomplete call as a reason to reject the take-off and started the deceleration in order to stop the aircraft (due to its volume, weight, speed and technical configuration the airplane cannot stop instantly with breaks).
At that point the call from the controller continued with a “disregard”, as it was nothing to talk about, to ignore the call. The captain is explicitly saying that uncertainty was something he could not evaluate, in case it was a warning for a potential problematic situation ahead (they were cleared to take off and the call would project a reason to revoke that clearance). In the original, Callback report the First Officer in the same airplane posts their position, as an insider who was able to receive the same incomplete call. What is their evaluation?

*Part (c): the First Officer’s report on the same incident*

I believe the rejected takeoff was the right thing to do. When you get a call from Tower at that point in the takeoff roll, the first thing that pops into your mind is “something’s wrong.” In the few seconds before he finished his thought, we were left to guess what the call was about. We were still relatively slow speed on the roll, so the Captain did what was prudent and safe by rejecting.

The First Officer is fully confident for the action of the Captain, although, there is no information whether they have discussed it or not. It seems that, since the flight was actually accelerating to take-off a call from the Tower breaks the sequence which seems to be uneventful. The potential of anything unexpected is a call for being prudent than being sorry. The hesitation scenario explained above is the discussion topic for the discussants who shared their experience for this study. The inquiry was to evaluate the hesitation issue, to explain their action as if they were
pilots and suggest ways to repair hesitation and other interference for the First Officer. The data chapter for this scenario is Chapter 5.

2.6 A Process of Sorting and Coding in GT with an Example

Before reaching the point of the actual scenarios exemplified in section 2.5, I had to pass through a sorting and coding process to indentify relevant questioning topics and discover emerging concepts to build constructs. In this next section an example of a coding process using data from an accident investigation report presents one of the applicable coding/comparing techniques, in order to explain theory construction better. As explained in section 2.3.1 and 2.3.2, in GT methodological approach the core task is dimensionalizing a category’s properties (i.e. the dimension “silent to non-verbal to vocal” response signals for the property of pilot-controller interaction) and opening up the data is what the responders themselves are saying while extracting concepts with analytic tools (for Strauss).

As pictured in Figure 2.3, the parallelogram with coding comes after (and revisited) the phase of initial sorting and comparing in bottom right hand parallelogram. Variations and categories with properties are constantly re-visited during the process of comparing, coding and analyzing the empirical data. In this section, a structured coding process is explained with an example, as related to the core concept of aviation safety from section 2.3.1. The start is from an accident report (and not from an interview) in the GT approach applied (with the resultant concepts),
During the visit in the headquarters of the Hellenic Air Accident Investigation and Safety Board their emphasis was in improving the multi-dimensional communication and augment standardization in language use.

HAAISB’s personnel have agreed to serve as partners to evaluate other participant responses as per the concepts I am categorizing via the initial questionnaire. They also provided several reports from their accident investigations with transcripts and their institutional comments. The study of these transcripts allowed the identification of several codes and concepts to emerge, as well as side notes to evaluate the communicative significance of these factors and a route to connect with other parameters of the flight.

The accident report of the Ukrainian (AeroSvit Airlines) Yakovlev YAK-42 crash of December 17, 1997 in a mountain outside Thessaloniki in northern Greece is the primary resource for this example (HRMTC, 1998\textsuperscript{15}). For this phase, where information is based more on testimonies of the flight and judicial proceedings, an initial coding is oriented to operational attributes of the flight. It also incorporates several instances as observed before or after the flight. A summary from the accident investigation report follows:

\begin{flushleft}
\textsuperscript{15} Air accident investigation in Greece was carried out by the HCAA itself after World War II and then by a committee reporting to HCAA and an independent Council. The Hellenic Aircraft Accidents Inquiry Council was operating till the establishment of a functionally independent Accident Investigation and Aviation Safety Board (AAIASB) in February of 2002 (the legal framework of HAAISB is described at http://www.aaaisb.gr/en/aboutus/istoriko1en.html and EU Regulation 996/2010 at http://www.aaaisb.gr/images/stories/documents/R%20996_10%20EN%20%20Accident%20Investigation.pdf). NTSB was consolidated on 1967 and reestablished on 1974 as a completely separate entity (as described at https://www.ntsb.gov/about/history.html). ICAO (from 1951 to 2001) standardized the procedures for the investigation of aviation accidents and published Annex 13 of the Convention on civil Aviation on “Aircraft Accident & Incident Investigation” (ICAO, 2001).
\end{flushleft}
Flight 241 started at Kiev with a Boeing 737; engine problems required an aircraft change at Odessa, with a Yakovlev-42. After a missed landing approach (ILS system) to runway 16 at Thessaloniki “Macedonia” Airport, the crew was instructed to proceed to the North Hold for a second attempt. The airplane did not follow the published missed (ILS) approach procedure and headed West-Southwest, flying into the side of Mount Pente Pigadia at 3,300 feet, declaring an emergency with a considerable delay. After the last call on the direction from the Control Tower the pilot replied “I will report” but no reply is recorded after the truncated message. The wreckage (of the crash) was found at 10:30, December 20, due to the thick snow and harsh weather conditions with seventy four fatalities.

In the court trial two air traffic controllers were accused of many counts of manslaughter, of violating the designated transportation regulations for the use of radio facilities in that airport and for delay in responsiveness to the crew questions. The final verdict of the appeals court on 2002, for the two air traffic controllers, was a sentence of four years and four months in prison each.

By reading the transcript and the HAAISB’s accident investigation report, a first order coding and relation conceptualization is accomplished in a GT approach in a diagrammatic technique proposed by Grover et al (2014). Figure 2.4 that follows exemplifies a process of a building on codes to construct theory for the Yakovlev crash:
# Building on Codes to Construct Theory

<table>
<thead>
<tr>
<th>First-order code of flight facts and crew reactions</th>
<th>Second order code: Two categories emerge (for the crew)</th>
<th>Aggregate Theoretical Dimension for the crew</th>
</tr>
</thead>
<tbody>
<tr>
<td>• pilot confusion due to incomplete destination briefing</td>
<td>loss of situation awareness</td>
<td>Pilot (and crew) communicative incapacitation and ineffective crew resource management</td>
</tr>
<tr>
<td>• crew did not adequately plan and execute the missed approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• crew showed a “get-there-it-is” expedition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• crew delayed to declare an emergency when they lost orientation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• pilot missed to connect with the Macedonia Airport radio-navigational aids</td>
<td>loss of operational handling functionality (with radar and crew members)</td>
<td></td>
</tr>
<tr>
<td>• crew transmitted uncertainty (modifiers like “rather” or pending standby)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• crew members unable to maintain cockpit discipline and to collaborate with each other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2.4: Example of Constructing the Theoretical Dimensions of “Pilot Incapacitation and of Ineffective Crew Resource management”

I will guide us through the three stages process in this example. The first column on the left hand side of the table records the flights facts as recorded in the flight recording devices (CVR and FDR), the transcripts of crew-controller interaction
and the analysis of the accident the accident investigation team. Charmaz’s typology (2009; 2006) of coding questions recommends an inquiry for the goal of study, the pronouncement from the data, the point of view of the theoretical category, and the consequences of action from the participants. By evaluating these inquiries the coding process forwards ahead.

So, by unfolding backwards the safety risks discovered in this flight, crew reactions are categorized in the following concepts: pilot confusion due to incomplete destination briefing, insufficient planning as crew did not adequately plan to execute the missed approach in certain weather conditions; their cumulative workload of changing aircrafts and transit destinations crew showed “hurry-up” expedition to land as soon as possible in order to be able to return back; crew delayed to declare an emergency after they missed the first approach although they expressed an orientation problem (the controllers did not seems to grant the required priority due to the delayed emergency declaration). These reactions from the crew are combined (with the bracket in the margin of the second column) to the pattern of losing the SA, the sense of “here-and-know” and the next anticipated action.

In the second cell of the first column in Figure 2.3, crew reactions that relate to operational handling are grouped. The pilot missed to connect with the Thessaloniki “Macedonia” Airport radio-navigational aids that are complemented by a military radar for airport approach (a possibility that was not clear in their briefing and was not explicitly suggested by the controllers). The transcript shows
several hesitation or uncertainty moments with messages of modifiers like “rather” or pending “standbys” instead of definite qualifiers in sentences. Cockpit voice recorder monitored some tense talking and disagreement between crew members who were unable to maintain cockpit discipline and to collaborate with each other. The grouping of those reactions with an operational nature leads to the category of loss of operational handling functionality, as if the pilot and crew could not operate (navigate) inside the cockpit. The second bracket down to the margin of the second column shows the relations of the first order coding phrases with the category which emerges.

The second column of the figure connects (with the two thick arrows) the selection of coding phrases (of the first column) with the second-order codes which correspond to categories of incapacitation; no situation awareness and no handling capacity. In turn, those two categories aggregate in the third column (with the two pointing arrows) as causing communicative incapacitation and having a result of ineffective crew resource management. The interaction with the air traffic controllers did not accomplish a cohesive cooperative mode, as the crew seems to have a slight intercultural gap and did act efficiently inside the cockpit; i.e. they had trouble communicating as their handling was inconsistent to the circumstances, and other crew members did not have a positive contribution.

The coding scheme explained in Figure 2.3 allows us to locate another rather latent conceptual dimension in the representative nature of situation awareness. As Flach (1995) points out a form of circular reasoning might occur
when SA is overestimated as an objective cause of flight accidents: “How do we know that SA was lost? It is because the human actors responded inappropriately? And why did the human respond inappropriately? It is because SA was lost.” In order to avoid tautological conclusions, SA in this study is connected with human communication consequences/effects to aviation safety. The process of SA refers to how SA develops and sustains during flight. At the same time, SA is the resultant concept, like a product of the process. The coding process was not just a simple application but allowed me to uncover conceptual variations, as noted above, that were useful in configuring relations among categories in this exploratory study (as explained in Figure 2.2).

This is an example of reading data with coding analyzing, as processed from my reading of an accident investigation report. It is an additional source, before the interview questionnaire to increase applicability of the approach (Glaser/Strauss, 1967, p. 1). The inquiry developed the following three questions for further sorting in the data:

Was it a case of miscommunication due to the East/West split and incompatibility or an issue of linguistic standardization? Do we speak about a human navigation error or about the non-listening controller event (when the delay of hearback and instruction giving from the controller might be fatal)? Was there a gap in the airport maps with the radio navigation devices?

For another time an accident is attributed to a combination of (otherwise) minor events which accumulate with a communication breakdown situation.
Communication breakdown occurred across several dimensions and the crew members were not effective in collaboration repair.

2.7 Discourse Analysis with Close Reading in this GT Approach

The iterative character of a GT approach is quite compatible with the textual analysis for notes, narratives and interviews from specific field visits. Since the collection of materials has the form of text (directly or through my memos), the processing analysis of standard textual information takes the form of a discourse analysis in the Chapters 4 and 5 (Paltridge, 2006). In discourse analysis the phenomenon of study is identified (as the relation of human communication to aviation safety), different type of texts as data source are located (from accident reports to interview transcripts here), and tags to label significant features in the texts, as codes, are assigned.

Formal accident reports, operating and regulatory manuals generate the textual framework. The direct contact with pilots and controllers in informal after hours discussions in their environment are oral information documented in memo notes. Transcripts from flight recordings and relevant judicial proceedings allow comparisons of concepts and assertions. Memo notes from participant observation of actual work-doing on site inform the interpretation of observed interactions. The observance of institutional briefing sessions, the data coding and evaluation of concepts with the participants themselves the sorting of concepts and their relations with theoretical communication properties are all documented in text of different style and narrative.
In the analysis of oral and written discourse in aviation it is important to understand the mechanics of language (and the language of special purposes used in aviation), but how human actors practice “what to say to whom” and “how to say it appropriately in a particular situation”. That is the notion of communicative competence introduced by Hymes (1972) which what is correct and what is not (according to aviation phraseology and institutional contact standards), but also when and where to use language appropriately (like the motivating, collaborating language devices, the suspending order to co-pilots, the laconic calls to Control Tower, the readback of important instructions, the non-verbalisms that communicate emotion, activate mediated banner messages to the cabin or message updates to the passengers seats with no announcement) and with whom (controller, co-pilot, cabin crew members, passengers as a collective).

For example, communicative competence in aviation requires knowledge of the rules of speaking/addressing the others but also knowing the way the utility and expected response to speech acts (Searl, 1979). For example a “May day” call from the pilot should mobilize the controller for search and rescue procedures. An erroneous readback and the resulting clearance violation require immediate correction and apology from the pilot to the controller (even in person, if possible and needed like in the section 4.3.2).

Discourse analysis originates in studies of the sociology of scientific knowledge in the context of social psychology (on the one hand) and in the writings of Foucault (on the other hand). Hence, it is appropriate, for this study, of
highly skillful knowledge-practitioners in aviation. Also, because it involves gathering data from a variety of empirical sources, formal and informal, as it happens with a GT approach. The method suggests that interactive dialogue generates commonly-held beliefs in a sense making process (Wooffitt, 2005; Gilbert & Mulkay, 1984; Potter & Wetherell, 1987). In aviation, crew members and controllers need to establish their topical awareness, as it makes sense at the specific conditions they are in. This kind of discourse analysis, in social psychology, investigates accounts of utterances which serve some function of a context (Maddux & Johnson 2009; p. 86).

The coded concepts used which emerge in the study from a GT approach are cross-referenced with expert members of the participants who evaluate in iterations with me (in this case mostly accident investigators and top rank Air Force officers). Then the patterns of language across texts relate and to each other and to the social and cultural context in which language is used. These stages in the analysis of the discourse are in line with the coding-comparing iterations of a GT approach. A GT approach suggests continuation till the emergence of the two categories (silence and voice), as non-antagonistic but complementary tools in communication and the construction of the situation awareness concept of human interaction in the communication that contributes to aviation safety (in the top part of Figure 2.2). The nodes in Figure 2.2 are all communication constructs which arise from the interaction. A close reading process is used to deal with the text with care and a magnifying glass. Parsing the text for the first impressions, the
vocabulary and diction, the discerning patterns, the points of view and symbolisms directed the grouping of instances to aggregate concepts. The expectation is to notice the details and supporting ideas of the textual responses, as they recount the responder’s experience or opinion, or even criticism from his/her point of view of the scenario (as controller and if one were in the position of the pilot, or as pilot and if one were in the position of the controller). Close reading allows us to reflect on the meanings and the order of individual words and sentences, and the development of ideas which lead to a thorough understanding of the responder’s texts.

Consider for example the case of the Falcon VIP flight in which the cabin crew supervisor felt as if she was attached to an “afraid horse” and the pilot took one step back in replying to the questions to explain the wider picture of the vital risk he was coping with in the rapid descend. In another instance, the experienced controller accepts a bad moment to occur without blaming the pilot, thinking of the collaborative scheme in their work. The fighter pilot in the Renegade alert for Helios had a breathtaking moment of silence (when he witnessed the crash while it was happening).

The discourse analysis perspective, in this study with a GT approach, also includes the participant actors who perform and receive discourse with cognitive and normative communication devices. Analysis of discursive data proceeds with the detection of “oral evidence of mental constructs” and discovering power relationships with ideological stances, rhetorical devices and cultural expectations
(Turner & Allen, 2010). That is why discourses are realizations of social phenomena (both in sub-communities of aviation professionals and military officers, as well as for society at large). According to Hall (1997; p.4): “discourses are ways of referring to or constructing knowledge about a particular topic of practice”. That topic, aviation safety in this communication study, provides ways of talking about it, knowledge forms and associations with it.

Language and other social practices are responsible for the production, actualization, performance and transformation for such devices at different social, historical and geographical places (in this case the study deals with the aviation sector of Greece, as a leading example of the European and Mediterranean region and NATO alliance, with a dense network of flights and airports, during the era of economic crisis and with the open tensions regarding the Aegean Sea airspace and the exclusive economic zones of the islands).

Discourse is not an entity per se but a set of utterances, a theoretical device for sorting and analyzing data, a necessary hypothetical assumption to start research in certain time, social and geographical space. This study is analyzing discourse in the context of HAF and commercial aviation in Greece, with the social framework of an economic crisis in Europe.
CHAPTER 3: LITERATURE REVIEW

3.1 Intended Advancements of Literature

A successful flight is a systems result of the interactional accomplishment of human performance. The current dissertation is following a communication orientation via the basic model of communication (Shannon & Weaver, 1949) and notions from the helical model of communication (Dance, 1967). Every interaction is based on a first event, time is important, and communication process is a product of what actors have learned inward in ways that permit growth, and discovery. The nature of flight communication which considers meaningful information as the specific selection of a signal from the noise extends the basic model, towards the inter-human communication network (Leydesdorff, 2014).

In this sense, cockpit speech acts describe the special character of cockpit conversations with internal (on board) participants and the external ones, most notably the air traffic controllers. All participants are considered actors who follow the basic model of communication. Additional supporting literature on speech acts, actor-network theory, trust and trust in automation, as well as rules and roles and identity in the workplace informs the discussion of the current dissertation. Three major streams of literature are expected to advance with communication-oriented contributions of this study:

- Systems analysis on coordinating entities and holons (Checkland, 2006; Zexian & Xuhui, 2010; Ostrom, 2005; p. 11-15; Cushing, 1988; Leveson,
Holons are structures composed of subassemblies, in layers of part-whole units of complex adaptive systems. A whole system at one level is a part of a system at another level. In the soft systems approach the role of the human user is highlighted.

- Human Factors analysis of flights as decision making processes, where human error is considered a system property and safety is the outcome of coordination of individuals (Loukopoulos et al., 2001; 2003; 2009; Barshi, 1998; Dismukes et al., 2007; Dekker, 2002; 2010; 2011; 2012; Edwards, 1988; Endsley, 1988; Ericsson, 2002)

- Culture in organizational operations, behavior and decision making with aspects of authority and the parameters of safety, just culture and the relativity of mother tongue in perception (Merrin, 1996; Helmreich & Davies, 2004; Helmreich et al., 1999; Hofstede & Hofstede, 2005; Hayward, 1997; Wegner et al., 2002).

The literature review in this Chapter 3 primarily covers the literature in systems theory and human factors. Literature more closely connected with communication and culture is worked inside the data chapters with the empirical evidence.

The modern aviation system operates as a communication process constructed, organized, and regulated through human actions. Aviation safety is and will remain one of the central concerns of our times for all people live in this planet. Empirical data demonstrate that communication problems have indeed cost lives or were
crucial even when no fatalities occur. Comprehensive studies of the role of communication in aviation incidents are limited, but they demonstrate how incident data provide insights to accident causes. In this study, human communication takes the lead in occurrences, incidents, and accidents in flight situations.

Thus, a systems approach that is concerned with information flow and sender-receiver, feedback and noise perception in the cockpit environment is a contributing factor in the current analysis. Human factors analysis of cognitive interactions in mission-critical environments offers another ground to draw on how participants implement their interaction in time constrained conditions. Aviation human factors research describes the goal of all pilots “to get people from point A to point B, without disturbing or killing them”.

Discourse analysis literature provides a framework of understanding interaction, turn-taking and implementation of processes via communication. Interaction phenomena in the case of cockpit conversation extend common encounters of turn-taking and routine discussions to pressing operating conditions. In these conditions, human participants need to have established interaction relationships and apply disciplined actions to correct errors and follow consequential steps, accomplish cockpit identities and roles.

3.2 Overview of Literatures
The modern aviation system deals with the escalation of routine flights, unusual situations, incidents and major accidents in the taxonomy described in sections 1.3.2 and 1.5.

**Accident Occurrences and Socio-culture**

The current dissertation investigates accident occurrences and draws from two landmark cases (introduced in section 1.5.1, 1.5.2) which mark the own literature on their own and enrich accident investigation.

An accident, here, as defined by the International Civil Aviation Organization (ICAO, 2000; 2001), is an occurrence during a flight in which: (i) a person is fatally or seriously injured, (ii) the aircraft sustains structural failure or damage and (iii) the aircraft is completely inaccessible or missing. An *incident* is defined as an occurrence, other than an accident, associated with the operation of an aircraft which could affect the safety of operation. A *serious incident* is defined as an incident with circumstances indicating that an accident nearly occurred. Incidents are violations of instructions or legal parameters that may affect or have actually affected the safety of operations. Incidents and accidents reported in Eurocontrol repositories (Skybrary, 2010a) and Federal Aviation Administration (FAA) Aviation Safety anonymous Reporting System (ASRS, 2011) reveal over 60% communication problems (Tomkins, 1991).

Earlier studies in the 1980s indicate that those communication issues contain problematic information transfer (73% of incident data), as well as
language incompatibilities rooted from socio-culture and safety culture variations (Billings & Cheaney, 1981). Conversation related issues in the cockpit have been a constant concern of the international aviation community regardless flight mission, airplane type, airplane manufacturer, operator, or geographical region (Garzone et al., 2010).

The current study touches specific issues of organizational culture (like safety and just culture), as well as topics of professional culture for pilots’ habits and controller’s habits that extend previous literature. Cockpit conversation language and socio-culture affects all individual actors in overlapping layers, as shown in the following figure:

![Figure 3.1: Structures and Layers of Culture (adapted from Braithwaite, 2001)](image)

Let us go through these layers of cultures, from the inner to the outer one. Commercial, fighter pilots, controllers and accident investigators belong to different organizations (institutions) with different fragmented cultures (the inner parallelogram). The role of hierarchy, the respective vocabulary and the potential
flexibility could be part of that organizational culture. Due to the fact that they are in the aviation industry, profession and mission they acquire a professional culture of immediacy, living the moment, and obeying rules that defines the profession (both for pilots and controllers). Fighter pilots could be a smaller subset, as they are in the profession as service and not just as occupation.

The dashed line parallelogram overlaps with the organizational culture, as the intersection refers to aviators who exercise their own specialization in an organization. Being a service industry with demanding resources, aviation has another layer in the figure, containing the organization and the profession. Promptness in time, orientation to humans as users and cost-efficiency are attributes of this industry culture. Lastly, all participants operate in air and ground spaces of different countries or originate from other countries, where language (mother tongue) and inset may affect their meaning making. All these layers of culture in figure 3.1, usually, co-exist in human operators and lay the foundation for interpreting their behavior.

Airspeak English and Language Use

The current study highlights the phenomenon of silence in aviation interaction, as the source of multiple semantics and extends the language literature, in that sense. Although, aviation is often considered as over-proceduralized, with standard operating procedures to prevent threat and error, error is inevitable due to
human limitations (Helmreich et al., 2004). Crystal (2003) analyzed how English has become the global language over the past fifty years, mainly due to the power status of its native speakers and not to their number. Global English became a communication platform for business, science, and technology. It is a platform beyond a language of special purposes or globish English (Nerrière, 2004).

Furthermore, Crystal recognized conversation registers such as “Seaspeak” for maritime use and “Airspeak” for Air Traffic Control. On the other hand, the need for bilingual ATC communications was underlined in empirical cases with aviation professionals. Ragan (1994) suggests that “Airspeak” is a controlled language in aviation that is broadly regarded as acultural; in contrast, cultural factors and conversation interaction do have an effect on specialized communication. Conversation language has organization and meaning in everyday-life activities is shaped by context and renews the context, as well. Order is maintained during interaction and routine conversation lays the ground for the structure and organization of institutional talk (Person, 1999). Airspeak conversation is a controlled language with a singular context focusing on human-machine interaction and air transport safety conduct.

In this sense, cockpit acts of conversation and airspeak describe the special character of cockpit conversations with internal (on board) participants and the external ones, most notably the air traffic controllers; all participants are considered actors who follow the basic model of communication. Additional supporting literature on speech acts, actor-network theory, trust and trust in automation, as
well as rules and roles and identity in the workplace informs the discussion of the current dissertation.

The way language is used is a known source of misunderstandings in stressful situations. Instances like false interpretations, filling out incomplete statements in ways not intended by the speaker, and holding back important information for reasons of politeness and face-saving, have been documented repeatedly in actions like fire fighter operations and disaster relief missions (Ungerer, 2004). Ambiguity was involved in the most severe accident in commercial aviation history, the collision of two airplanes at the Tenerife (Norte Los Rodeos) Airport in March 27, 1977. This incident centers around the question of whether the phrase “we are now at takeoff” is to be interpreted as “we are now at the takeoff point” or as a kind of continuous tense, “we are [being] now in the process of taking off” (Roitsch et al., 1978).

There are other such word ambiguities or structural ambiguities in aviation language. Cushing (1994) mentions the verb hold, which in aviation terminology means “stop what you are doing right now”, but in ordinary English can also mean, “continue what you are doing right now.” Linguistic investigations of cockpit-voice-recorder have documented the effect of linguistic misunderstandings on plane crashes (MacPherson, 1998; Cushing 1988; 1994; 1995; 1997). From the point of view of aviation professionals a flight is accomplished through group work, and small groups provide an ideal environment for developing linguistic security, a notion important for aviation safety (DeMatteis, 2011). Linguistic security is
realized among cockpit interlocutors when they see their language as acceptable ("from those with whom one is most concerned about communicating"; Koch, 1975). This sense of security is a greater challenge when human actors in the cockpit have mother tongues other than English, as language is a fundamental marker of their identity (King, 1997).

That is why the current study proposes the phrase “cockpit acts of conversation and trust” to incorporate all relevant conversation aspects in that conversation-scape.

3.3 Systems Theory

3.3.1 Limits of Systems Theory in Aviation

The system is an assemblance of parts, facts, principles and processes forming a unitary whole. Such an entity is composed of other concepts down to a set of primitive concepts and formalized rules and criteria that determine when concepts apply. On the other hand, typical instances can be compared to specific phenomena to access similarities and differences. In the systemic view of the cockpit, the latter approach is applied when actor-members are practicing what they have learned through training. The former approach conceptualizes knowledge embedded in mechanical parts and expertise in “doing something” based on “knowing something” and not vice versa.
The cockpit meets the system complexity hierarchy but this study takes elements of predeterminism, self consciousness and language to connect it with its operation. In the operational sociocultural environment of the cockpit actors conceptualize rules that operationalize roles, values, and mainly trust in all individual. Control hardware devices provide messages, signals and symbols that are considered dependable and the human actors provide feedback actions forward, interpret and exchange signals to continue the flow of information that governs each flight.

That is why in the collective work of a cockpit in flight, the pilot evolves from an expert to a decision maker (Kochan, 2009; Skybrary, 2010b) and the air traffic controller to a gatekeeper of meaning-making. Human actors in the cockpit perceive messages from mechanical channels, interpret voice and silence signals that they receive from communication channels and follow rules of compliance imposed by the air traffic controller.

Information based analysis of conversation in the cockpit incorporates a cultural account of human action (Hofstede, 1980; Hofstede & Hofstede, 2005; Hofstede, 2009). This focus on conversation, as communicative use of information by the human actors, outgrows the traditional Computer-Supported Cooperative Work (CSCW) situations (Monteiro, 2004). Computers and communication devices in the cockpit are artifacts with purposes following the designer’s intentions but, also, the intensions of the machine in order to be responsive to the others’ actions (Suchman, 2009). Analyzing this interaction is expected to provide useful insights
to explain symbolic meanings and operational requirements in the cockpit. It is a
conversation environment that emphasizes CSCW (Hughes et al, 1993; Schmidt &

Cockpit conversation is about purposeful flight operation but also reassures
identity and membership in the cooperative task of the flight for all interlocutors.
System theory is the transdisciplinary study of the abstract organization of
phenomena, independent of their substance, type, or spatial or temporal scale of
existence. The conceptual definition and the system models provide an illuminating
consideration of how the cockpit can accommodate the external actor of the
controller in order in a single communication environment.

3.3.2 Topics and Types of Analysis in Systems Approach

DeGreene (1970) introduced a wider scope of the notion of the system as
the basic analytical tool of resolving problematic situations. A problem situation,
e.g. a major incident or fatal accident in a flight as administered, recorded and
managed in the cockpit, has to be recognized and defined, the respective system
entity is described with performance criteria and alternative configurations, and its
operation is monitored with data acquisition that explain its development while the
human actor participants are end-users and decision makers.

This is still a case when the concept of a system forwards the analytical
deconstruction of “what a system is” to investigating “how a system behaves, with
the human actors and co-present actors involved”. Following the behavior of the
system in the sense of how information flows, how reactions are contained as part of the system state, what makes it efficient to accomplish its goal, how deficiencies may occur but managed or resolved and how the system is operating even without ideal conditions, we continue to the classification of discrete or continuous systems (Law & Kelton, 2000). In discrete systems, state variables change at separated points of time with instances, where as in a continuous system these variables change dynamically. A cockpit is a continuous system with mission critical arrangements. Cockpit acts of conversation and airspeak are instrumental for the information flow and efficient operation of the cockpit as a system of human actors.

Interaction analysis of human actors in the cockpit that is pursued with the current dissertation has a starting point in Soft Systems Methodology (SSM) that emphasizes the role of information and procedures in an organization, a system entity with the teleological mission feasible to undertake in a risk-tolerant and resolving environment (Avgerou & Cornford, 1993). The cockpit is a system of information producing and managing; SSM provides the necessary logical abstraction tools to uncover these complex layers and focus on the essence of the instructional process that involves information, people, communication and technology (Cronen, 2001). Air transportation in the cockpit aggregates people with technology and achieves safety via communication (Tajima, 2004).

The terminological language framework we can use to describe the system and its constructing methodology is the traditional SSM (Checkland, 2006, revised
from 1981). This methodology is the CATWOE Analysis that enables a system analyst to determine and define the root definition of a system (Bergvall-Kareborn et al., 2004; Gasson, 2005; 1999). In other words, the systemic description of the cockpit will draw on the following:

- C for Client, using the view of the one that asks/receives the service provided by the system. The service is the mission of the effective communication in the flight deck to accomplish the departure-arrival flight routes.

- A for Actor, using the view of the “doer”, the one that has to activate himself in the direction of the construction or operation of the system. The Actor is the pilot/co-pilot and the exogenous actor is the co-present air traffic controller.

- T for the Transformation, in the terms of the operation and the process that the system is capable to perform. Involves the speech acts prompting specific action from the pilot as well as the interpretation of the air traffic controller for flight deck interactions.

- W for ‘Weltanschauung’, as the point of view that the human actors are willing to incorporate when they interact.
• **O** for the Owner of the system is the carrier and the State Authorities\(^{16}\) that define the scope, the operating goals, the benefits, the demands and the evolution path of the system.

• **E** for the Environment that forms the surroundings of the system, the exogenous conditions and parameters that affect or restrict its operation, the physical and artificial boundary of the system. As we speak about an open system the outside actor is the air traffic controller; in unmanned aircrafts (drones and others) even the pilot is an outside actor in the flight.

Thus, determining these CATWOE components in any problematic situation we are applying the systems analysis approach, the root definition for that situation.

A cockpit, also referred to as a flight deck, is an area located in the front of an aircraft from which the pilot controls the movements of the aircraft. Inside the cockpit, there is a panel of instruments and controls that are used to take off, land, and control the progress of the flight using procedures that operate all functional and communication components, as well as generate and control the flow of information.

In many cases, the cockpit is closed off from the rest of the aircraft and is only accessed by the pilot and a co-pilot or flight crew members, especially after 9/11 World Trade Center hijacked-plane attacks. In airplanes that have a pilot and a

\(^{16}\) Such authorities could be the National Transportation Security Board (NTSB) or the Federal Aviation Administration in the USA, the European Organization for the Safety of Air Navigation (Eurocontrol) covering the European air space. It could also be the Hellenic Civil Aviation Authority or the Hellenic Air Accident Investigation and Aviation Safety Board (HAAIASB). All these authorities were among the primary contacts for the current dissertation.
co-pilot, there are usually duplicates of some of the controls and instruments afforded to be accessible from each of their seats Depending on the manufacturer). In all cases, a co-present actor is the air-traffic controller as the plane evolves from one flight station to the other. These hard, soft and live constituents with information flow, operating protocol and procedures compose the entity of the cockpit, as a system even when there is no cause to blame at fault operation (Dekker, 2011).

3.3.3 Communication Literature and Soft Systems Theory

Introducing the notion of the system as a set of elements connected together to form a ‘whole’ that dominates, differentiates, expands or redefines the properties of its components we evolve to ‘system thinking’ as a way to understand the world’s complexity. Originally RAND Corporation (Smith, 1966; McKean, 1958) introduced systems analysis as a broad economic appraisal of all costs and consequences of alternative means of meeting a defined end and compare alternative options in the light of the possible outcomes. It is noteworthy that RAND was incorporated as a not-for-profit entity on 1948, keeping close ties with US Air Force (Abella, 2008).

The thinking process can be described, as a concept, in a chain of stages. A hard system is an organized set of elements, in which each level composes the elements of the level below, putting emphasis in the internal structure of the system that is engineered to achieve the stated objective. For Rapoport (1970) a “hard”
definition provides an unambiguous identification of the world defined, where as a “soft” definition offers an intuitive understanding. In soft definition, real world problems known-to-be-desirable-ends cannot be taken as given, but depend on the observers’ phenomenological stance. Hard systems thinking provide an explicit criterion of functional relevance. According to hard systems thinking, reality is an ordered, stable system that we need to represent rather than “to deal with reality itself” (Yourdon, 1989).

This pluralistic view of a system is introduced even from Boulding (1956/2004), who offers two complementary inquiries: (i) starting from generic phenomena which are found in many different disciplines, in order to build theoretical models relevant to these phenomena; (ii) categorizing empirical fields in a complexity hierarchy of organized units of individual behavior, and develop typical prototypes that represent each hierarchical level.

In the first inquiry the system incorporates the individual particles (from atoms to machine parts, to liveware, to organizations) with their behavior, as described by actions, states and conditions, and the tendency to change (Bertalanffy, 1956; Ashby, 1958). This change endorses growth as an aspect of behavior that denotes evolution, maturity, and enlargement, coupled with information and communication, in the broad sense of mind “affecting another mind” developed by Weaver (1949a; 1949b). Communication discloses structuredness and information is a measurement of orderliness, of organization in the system as proposed by Gleick (2011). Feedback loops, iterations, and resolving
noise or operating in the presence of communication noise disclose governing function in system when we monitor actors’ behaviors (Wiener, 1948; 1950).

These exchanges and flows are constant and inevitable as operating, in small time slices means to acquire the inputs, control the outputs, select actions and decide among different alternatives under risk. Thus, pilots and co-pilots mediate between the components of the closed isolated system in the flying deck and generate novel outcomes when they compile ATC commands that stipulate their environment and promote the cockpit as an open system (Monge, 1973; 1977) that evolves with history, memory of its conditions and self-sustained future, re-booted after each flight.

According to Bertalanffy’s review (1962) this is a man-machine system, a complex of interacting components and characteristic organized wholes, with interaction, mechanization, centralization, and transformation. Thus, speaking about the system makes it inevitable to utilize synergy of system aspects, creating co-operative, co-determined and interdependent effects in Corning’s terms (1996a; 1996b). Hall and Fagan (1956) in the engineering corpus defined the system as a set of objects that inter-relate and their attributes relate further. Rowe (1965) extended it from objects to functional units connected with rules under a certain purpose.

In Ostrom’s work (2005, as reflected from Koestler, 1973), the term holons is used facilitate the analysis of social hierarchy and human decision making in sub-wholes which portray behavior which is governed by rules or have stable
properties. Sometimes the parts may not be descriptive of the holon which they have created: the operating cockpit is something beyond the people, machines and processes that create it. In-flight communication flow and exchange may be more representative of the “holon cockpit” with the controller’s interaction included.

In the current dissertation the cockpit is considered as a human activity system explained by Thorpe (1974; 1978). In such a system, mechanical parts, procedures and human actors manage the flow of information that creates distractions, as changes of the state of the system. The texture of interpersonal relationships that are present in such a system promotes it to a social system, a network of connections described by Wellman (1999) and revisited as determinant of behavior by Christakis and Fowler (2009). Information, in its new scientific sense, is utterly distinguished from meaning (Shannon, 1948). Information flows in the cockpit system is transmitted via language that assists participants to perceive an aspect of their world as a system. Their world is shaped by their experience of it. That is a case of a soft system, a totality with emergent properties (Dahlbom & Matiassen, 2001), as we move through its levels, combining attributes from Boulding’s complexity.

3.4 Human Factors in Aviation-Related Issues

Human factors issues related to interpersonal communication have been implicated in approximately 70% to 80% of all accidents over the past twenty
years, especially in the issue of task management (Iani & Wickens, 2007).

Consequently, more than 70% of the first 28,000 reports made to NASA’s ASRS (which allows pilots to confidentially report aviation incidents) were found to be related to communication problems (Connell, 1995). Studies of collaboration among scientific and professional communities suggest that an initial period of physical proximity is necessary in order to build trust and to come to consensus on the focus of proposed goals and projects (Carley & Wendt, 1991).

The importance of understanding routine work, repeated and confirmed actions, practices, and situational requirements of the users in the design of tools and technologies that they use is recognized by many theorists (Norman & Draper, 1986; Norman, 1988; Winograd & Flores, 1987; Moran & Anderson 1990). NASA’s researchers analyzed the causes of civil aviation accidents and incidents between 1968 and 1976 (Cooper et al. 1980; Murphy, 1980) and concluded that pilot error was more likely to reflect failures in team communication and coordination than deficiencies in technical proficiency.

3.4.1 Limits of Human Factors Literature in Aviation

Human factors studies a multidisciplinary effort that considers all the issues that influence human actors and technological systems performance, like job and roles, procedures and task design, team issues and groupware, as well as human machine interface. The ultimate goal of human factors in aviation is to better match the system to the human, and the human to the system (EATM, 2007), although the
human is part of the initial “system of systems”. In this sense human factors is considered on the systems level (resources, design, and responsibility for system failure) and on the human performance level (awareness of the human actors, avoidance of overload for human actors, effect of stress and reliability, trustworthiness of the system). From an organizational perspective of human factors, dispersed work teams of liveware require social as well as technical support (Wellman et al, 1994; 1983; Garton et al, 1997).

Human factors work incorporates the holistic approach of examining the role of the human actor and human skills with technology, where as systems analysis uses all systemic components that explain interactions, information generation/flow and procedures. The cockpit system has to be tolerant to function and accomplish the mission even when fault occurs. Most airline accidents are attributed to errors made by the flight crew (Loukopoulos, 2001; 2003; 2009). Uncovering the causes of such an error is one of the greatest challenges in aviation operation and accident investigation, as many factors intermingle. That is why a flight mission should be represented via its communication occurrences, as interactions that materialize the intangible session of a flight. This communication point of view enriches the typical causality that searches for a “human error”, with informative interactions and oral documentation.

Communication has long been suggested as a critical issue in all aspects of human interaction. Most testimonies of ASRS and National Transportation Security Board database illustrate how critical communication is in aviation and aviation
safety, from the cockpit-controller interface to coordination in the cockpit to cockpit-cabin interaction to the management of safety and creation of a safety culture (Krinovos, 2007). Communication has a multi-faceted nature with a variety of settings and situations. Kanki and Palmer (1993) provide a useful structure on how communication functions in aviation and aviation safety.

Specifically, communication affects crew performance by providing information, establishing interpersonal relationships and predictable behavior patterns, maintaining attention to task and monitoring, and by providing a management tool for Crew Resource Management (CRM) (Helmreich et al, 1999; Helmreich, 1997; Helmreich & Foushee, 1993). Hence, the contribution of the current dissertation to human factors literature is the incorporation of a systems approach with emphasis in coordination and collaboration, as well as the focus on informational conversation acts performed by interlocutors who participate in the system operation.

3.4.2 Extending Human Factors with Lessons from Discourse Theory

Communication flow operates the system even in cases of increased sophistication. Engineers and pilots as two distinct communities in NASA’s Langley sites had a troubling communication to assess whether design changes helped when articulating the problem of aircrafts, as closed mechanical systems or as open human activity systems (Vincenti, 1993). Communication in human factors research is a projection of all essential considerations in making technological
systems safe, effective, easy and enjoyable to use, and aviation systems to fly and land on destination under certain conditions. Identification of cognitive, task, and organizational factors that make human actors vulnerable to error can be accomplished in their conversational interactions. Symptoms of miscommunication which include violation of procedures and instructions well as communication-specific problems and phraseology defects are disclosed using conversation analysis.

Human factors analysis is focusing more on conditions and evaluations, whereas in cockpit operation environment the issue seems to be more on how pilot, crew and ATC expertise is to be exercised (and thus) implemented in a dynamic decision making process. Pilots and ATC need to decide, re-decide, mutually confirm and continue in their turn-taking and only their conversation is showing “how they do that.” Thus, communication features like corrections of previous messages, evidence of misunderstanding, hesitation, hedges, emotional words, acknowledgments, affirmations, status reports, reports of reports, reports of action, and reports of status are needed to investigate the interactional organization of cockpit activities (Krifka et al., 2003).

Cockpit operation through conversation is understood as a process concerned with the reconstruction of segments of information and not with psychological interpretation (only). The epistemology of systems thinking applied to human activity with emergence, hierarchy, communication and control pave the way to discourse analysis to answer the question of “how interlocutors understand each other, ensure that they do so, and trust each other.”
3.4.3 What is Human Factors

Human factors originates in psychology and focuses on areas like workplace safety, human error, product design, human capabilities, and human-computer interaction. It is often used in the USA synonymously with “ergonomics” that is the common term in Europe. Human factors is mostly cultivated in the US research tradition, where as ergonomics is mostly concerned with design in the European tradition. Human factors, here, implicitly draws on systems theory.

Human Factors and Ergonomics Society (HFES) suggests a broad definition that was initially adopted by the International Ergonomics Society (2000):

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and other methods to design in order to optimize human well-being and overall system performance.

Human actors are the protagonists in the organizational setting of human activity systems. We cannot solely address the reductionist approach of the parts of systems but we must also achieve an integrated understanding of the operations of the systems themselves. Hence, human factors research incorporates actors but emphasizes on understanding of “how things get put together”, in a system of
systems (Popper et al., 2004). So, human factors promotes a holistic approach, clearly represented in CATWOE soft systems approach analyzed in systems review (section 3.3.2), in which considerations of physical, cognitive, social, organizational, environmental and other relevant factors are taken into account (Meister, 1982; 2003). Human factors is involved with the creation of things and processes that effectively support people in their work and living activities (Lundin, 1997). In the past two decades there is a growing interest in the use of social science to examine ways in which tools and technologies are used by people in real world, work settings (Heath & Luff, 1991), as well as in the ways that shape procedures and flow of processes.

Going beyond physical human factors – dealing with human and biomechanical characteristics – communication interactions are more relevant with cognitive human factors – concerning with mental processes, such as perception, memory, reasoning – and, for the most part, with organizational human factors dealing with optimization of sociotechnical systems, in which organizational structures, policies, and processes are involved. Human factors could also inform synergetic activities in different fields of knowledge, such as telecommunications, informatics, electronics and social science which lead to concepts like the internet of things (Artzori et al., 2010).
3.4.4 Describing Human Factors in Aviation

Human actors’ behavior and reflections as part of human factors formulate a thorough understanding of machine interaction and human conduct based in cognate processes (Cicourel, 1973; Kendon, 1977), interaction rituals and internalization of conversation in groupwork and leisure (Goffman, 1967; Collins, 2005).

Along these lines, organizational human factors include topics of communication, crew resource management, design of work, design of working times, teamwork, participatory design, community ergonomics, cooperative work, new work paradigms, virtual organizations, telework, and quality management. All these aspects realize in the context of an organization. Organizations are structured groups of people, working together, using technological artifacts and procedures in order to achieve compatible goals (Devito, 2011), utilizing procedures and above all communication that ensures information flow (Barnard, 1938/2005). In this study, silence communication and non-verbal aspects of communication enrich the human factors literature.

Human factors, as a discipline in public organizations, has a wide scope as the majority of employment is found in those organizations, their complexity increases, and they exert influence over public policy. A variety of topics on critical environments have used human factors; vehicle collision avoidance (Polychronopoulos et al., 2007), patient satisfaction in the health sector (Moss et
al., 2002; Rowland-Morin & Carroll, 1990), nuclear safety (Moray et al., 1988) etc. In the Air Traffic Management (ATM) system of pilots and controllers, human factors described the evolution in complexity and flexibility of workload environment (Laios & Giannacourou, 1995). In the current study, the association of situation awareness (as explained in section 2.3.2) with communication realities contributes to extend this literature.

The International Civil Aviation Organization (ICAO, 2011a; 2011b) has also taken a human factors approach by emphasizing the role of the people who have become instrumental in aviation safety as “liveware.” The term includes the human actors in the cockpit and stakeholders beyond that cockpit towards the air traffic controller, for the current study (Edwards, 1988). The European Air Traffic Management (EATM), known as Eurocontrol, issued its guidelines for best practices in 2007, introducing human factors to include the user-actor (human in system) in the cockpit and ATC working environment (as context), organization processes and staffing (supporting users), procedures- roles-and responsibilities (SOPs, flight instruction terminology, communication manuals) acquired though training and development, and team building via concrete communication adjustments, as relationship cultivation through communication.

This is a complete systems view of the working environment with the human actor in team work. Team work is accomplished via communication, applying procedures- roles and responsibilities cultivated in training phases that develop personnel necessary to populate and operate an organization around the
clock. When shifts change, appropriate transition and vigilance is necessary, so people conduct their roles and tasks although actual individuals change. The human factors field in aviation is also considered in driving a “systems level” with the following six areas of concern (Eurocontrol, 2008): human-machine interaction (HMI), organization and staffing, training and development, procedures- roles- responsibilities, teams and communication, and recovery from failures. HMI is by itself a form of communication that is mediated by human actors in layers in the cockpit and in ATC.

In the current study the term “human actors” is more inclusive to describe interlocutors that are physically present inside the cockpit (pilot and co-pilots), as well as external players mainly air traffic controllers (ATC), crew members, airline operators, and possibly pilots of other flights. All these layers cannot accomplish their tasks without establishing and relying to trust. There is a broad literature on trust in automation, where most are in agreement that accuracy of information is crucial in building and retaining trust.

It is an aspect of collective-self described as reflex (Salem, 2009), as a fixed expectation of culture in the flight mission, sometimes as being learned and situational. Trust is also considered as a resource of social capital, authority, and social support. As Salem states it is an “interaction variable leading to a probability to engage [with] another”.

Expected benefits from trust include better task performance (Golembiewski & McConkie, 1975) and the ability to cooperate (Deutsch, 1958;
There is a number of taxonomies for trust in human-machine communication and interaction (Barber, 1983; Rempel, Holmes et al., 1985; Muir, 1987; 1994; Muir & Moray, 1996). These taxonomies tend to distinguish three categories of trust (Lee & Moray, 1994): (i) trust based on observed consistency of behavior (persistence or predictability); (ii) trust based on a belief in competence (competence or dependability); and (iii) trust based on faith in purpose or obligation (confident responsibility or faith).

While faith-based trust is difficult to establish for computers, these taxonomies suggest that trust by consistency and competence can be achieved by explaining the purpose, capability, and reliability of the software or the system to the user. In the current study, trust is taken for granted in the interaction between pilots and air traffic controllers. Moreover, in the cockpit acts of conversation the issue of trust in automation and reliance to each other introduces another dimension (Lee & See, 2004; Ostrom, 1998; Muller, 1996), consistent with individual member tacit knowledge (Polanyi, 1966). Thus, when human actors operate mechanical and communication devices in flights they have to build trust in a mutual manner with all the other participants, in each stage of a flight mission.

### 3.5 Concepts in Discourse Theory for Communication

#### 3.5.1 Discourse-Oriented Topics and Intended Contributions of the Study

Discourse theory is based on the premise that language, and language use, do not only reflect or represent our social and mental realities, but they actually
contribute to construct or constitute these realities (Rorty, 1992). Language-in-use in ordinary lifeworld may both shape, and be shaped by, its use in particular social settings.

The language of real-time naturally occurring interaction includes the practices and reasoning by which participants create and make sense of “what it is they are doing” and “of what is going on” (Nevile & Rendle-Short, 2007). In the case of cockpit communication, where ATC is included, talk makes things happen, and the analysis has the goal to identify and explain something about how interaction makes things happen (Heritage & Atkinson, 1984). The current dissertation investigates the situated concerns of interactants inside the physical cockpit, focusing on its virtual aspect when ATC is included and the flight mission could be in the military aviation or civil aviation, when a crisis is observed, unfolds or is under resolution.

The study considers what people have to say, how they say it, and how the length of the turn they say it. Taking such data items, the dissertation forwards in eliciting information with scenarios about how interactants do their work. Furthermore, the current study incorporates cases from different aviation systems that start from different mother tongues, in order to indentify the effect of silence and linguistic factors in effective communication under pressure.

Regarding cockpit interactions, this study is expected to bring light to fixed turns, formalized lengths and standardized content that may be observed. Also, the study covers deviance from the protocol and intense turns to correct errors that are
consequential (without associating them with previous interactions). Lastly, the study connects with the “awareness of the immediate” which guides paired-versed interaction that need to react to instant realities. This concept leads to types of situation awareness, as used in this dissertation.

Sacks et al (1974) in their studies noted that conversation is factual when turn-taking occurs, one speaker talks at a time, and turns are taken with small gaps or overlaps when possible. In the case of cockpit conversation, the current study is expected to show how projectability and transition-relevance are accomplished with much inter-speaker coordination. Also, this study deals with how orientation to rules is displayed and with the situated practices that require expertise to resolve erroneous communication and accomplish interactions that have to be fault-resolvable and not just fault-tolerant. Cockpit interactants share a mutual subjectivity that is negotiated to establish an intersubjectivity of their own awarenesses, while they constantly encode-decode messages “behind observable phenomena of speech” (Hutchby, 2001).

3.5.2 Range of Topics for Machine-Mediated Communication

The communicative event for data analysis, as segment of machine mediated communication, could also be a type of virtual conversation (Hutchby, 2001; Paltridge, 2006). Internet relay chat and wireless relay communication are also styles that incorporate the virtual in the idea of co-present actor (vocal or not). It is a technology that affords communication in a similar way as a non-operator
telephone device but extends point-to-point to one-to-many and many-to-many interaction, eventually. It is a case of corporeal tele-copresence with actors/users present in person (or supposed to be) at their local sites but physically located in each other’s electronic or channeling proximity.

Consequently, one of the basic problems in the study of social interaction is the use of language (Pomerantz, 1980); how a finite set of rules produces an infinite set of sentences, how participant actors in interaction create idiosyncratic interactions “here and now”. Lastly, the notion of context is manifested only to the extent that the participant actors find it relevant in their interaction, otherwise it is considered as contentless (Schegloff, 1987). In cockpit conversation, participants are negotiating the ways of deviating from “their rules” when they need to take action with conditions or errors, faults or major incidents. Informants in this dissertation argue that expertise sometimes means to interpret the rules.

Discourse also covers texting dialects (instant messaging, text messaging, beeper messages etc) with “Generation TXT”, the new label for those who are growing up, first made its appearance in Japan. A special tool of interaction in the texting genre is instant messenger and similar technologies (IM), as the ability to easily see whether a chosen friend or co-worker is connected to the internet and to exchange messages with. IM differs from e-mail in that conversations happen in real time. This is why IM has become so popular (Tyson & Cooper, 2001). Similarly, internet social network chatting and twitter is evolving as providing access to multiple instantaneous interactions as raw data.
Such type of direct, phonetic and instantaneous transmission, report back and feed- forwards considered to be interaction in conditions of human collocation, as in corporeal tele-co-presence (Zhao, 2003). As conversations and messages exchanged within actors are usually very short, users employ informal language, loose grammar, and numerous abbreviations, with minimal punctuation (Drew, 1987). Contact lists are commonly referred to as buddy lists and users are actors engaging in conversation as buddies (Lescovec & Horvitz, 2007). IM systems and similar technologies are currently in line with the controller-pilot datalink communications\(^\text{17}\) and may provide benefits like those identified by DeRossi (2006):

- **Immediacy**: it affords the ability to instantly transmit or send a message to your direct channeled pilot.

- **Less people-centric and more message-centric**: conversations are based around participant actors, around the message conveyed last. ATC is responsible to coordinate flights that matter to them in each specific time frame, and if they want, their connected conversations.

- **Presence awareness**: actors are available, either busy or not, with very short tolerance on postponing answer. Presence awareness and the sense

\(^{17}\) Controller-Pilot Datalink Communications (CPDLC) system reduces the number of air traffic controller voice messages by sending electronic messages that are displayed on a computer screen in the cockpit (http://hf.tc.faa.gov/capabilities/cpdlc.htm). Canadian airspace has undergone safety and efficiency enhancements with the completion of the national implementation of CPDLC in suitably equipped aircraft flying above 29,000 feet (http://www.navcanada.ca/EN/media/Pages/news-releases-2014-nr10.aspx). Eurocontrol is using it on a simulation basis and Australian Civil Aviation Safety Authority is evaluating that technology.
of being together must work with transmitting frequency, pages, with location, with time (Antaki, 1998; Antaki & Widdicombe, 2000).

- Easement and straightforwardness in use: messaging systems were upgraded in early 90’s and have been manufactured small, simple and unobtrusive by definition.
- Simplicity in infrastructure: doing effective instant interaction does not require sophisticated application but standard text with structured vocabulary.
- Extension of direct real-time communications: cockpit and ATC actors communicate with pairing feedbacks, in a real time mode tightly connected.
- Privacy and security protection: this is another technical and institutional affordance of ATC communications, as interaction is recorded in multiple media and, if released, is anonymised under the Freedom of Information Act\(^\text{18}\).
- Standardized ability to express oneself using a vocabulary and phonetic protocol that minimizes variation and mother tongue differences (as it happens in aviation with ICAO language and the phonetic alphabet). It is clear in role taking and precise, and is tolerant to deviance in critical circumstances in the same communication modality.

\(^{18}\) The Freedom of Information Act (FOIA) is a law that gives you the right to access information from the federal government in the US. It is often described as the law that keeps citizens in the know about their government, as explained at [http://www.foia.gov](http://www.foia.gov).
• Directness with point-to-point communications: ATC interaction is a
direct communication mode between actors of the cockpit and ATC.

Other types of text messaging with diverse orientations could also be the
units of analysis, in a taxonomy by Thourlow (2003): (i) romantic/sexual
orientation; (ii) friendship orientation; (iii) salutary orientation (there are elements
of speech actions seeking for empathy); (iv) informational practical/relational
orientation (relation maintaining and information exchange are among the
functions); (v) practical/social arrangement orientation (such elements exist in
several points of the chat vi) urgent messages (nothing of that nature is analyzed);
(vii) professional orientation; (viii) family orientation; and (ix) chain messages
(usually in business environment). Physical circumstances in which such
interaction is conducted are based on how physical activities in the material world
play out (Jones, 2002).

3.5.3 Flight Tele-copresence, Discourse and Inquiry

In the case of cockpit communication questioning turns like the “Do you
recall...?” question in face-to-face conversation cannot be validated between
interactants, as they need to constantly adjust to their own current realities, and in
the next step to accomplish mutual understanding using their sensing and
awareness capacities. A reference in a previous conversation topic is quite unlikely
and interaction is encapsulated in direct pairing instances.
Presence, co-presence and tele-copresence are also occurring in a functional way via the air traffic control system that provides guidance and supervision to all flights. The following example is a typical instance of the catalytic role of communication in a flight mission, where decision-making is negotiated between control approach and the pilot-in-command. The space flight of Apollo 11 mission to the moon, deciding on an error message that could overturn a mission of historical dimensions\textsuperscript{19}:

Apollo Guidance and Navigation System were at the bleeding edge of technology in the 1960s. The system has to work the first time, and minimize fuel consumption because the spacecraft only contains enough fuel for one landing attempt.

It was a (flight) communication system that despite its sophistication had a critical moment to operate as designed, with no second choice.

And when mission continues a doubtful situation occurred:

On July 20, 1969, Neil Armstrong and Buzz Aldrin had entered the Lunar Module they named 'Eagle' and were descending to the surface. They were about 6,000 feet above the surface and the descent engine was halfway through its final 12-minute burn that would land them safely on the moon, when a yellow caution light lit up on the computer

control panel. It was a “1202 error”, indicating a memory overload, and the astronauts asked Mission Control for instructions.

The descent was a counting down moment for the Apollo 15 flight, as all components had a timed function which redefined the affordances of the mission. The warning signal, in the form of a computer error notification, was triggering an emergency call to the “space mission traffic controller” (not the astronauts operating as pilots) who had the authority to issue a “Go or No Go” decision on the landing. The “We’re Go” feedback was a clear speech act, since the first manned lunar landing was a split-second away from being aborted. The mission control in the Lyndon B. Johnson Manned Space Flight Center in Houston, Texas (combining air traffic control and ground engineer functions) continued with utilizing the special preparation they had from the pre-briefing phase of Apollo 15 mission:

The responsibility for deciding whether the error was crucial [to abort,] or tolerable [to continue] fell to 26-year old Steve Bales, the control room's expert in the lunar module's guidance systems. He was able to recall the nature of the computer error and for making the decision to continue, Bales received the US Medal of Freedom along with the three Apollo astronauts.
Although with historical significance, Apollo 11 mission operated as a flight with several major questions which needed awareness of the situation and situated tacit knowledge for immediate decisive feedback which, if wrong, could not be repaired\(^{20}\). Such indicative questions are the following:

- How do you deal with hardware/software failure in a flight deck and bypass the checklist rules?
- What is the necessary level of expertise, preparation and training?
- How does the space crew establish trust to follow the decision of NASA Mission Control room when the spacecraft was almost in destination?

The computer program alarm could be an isolated error in a modular system which was functional for other tasks. Simulations run before the mission to test the reaction of flight controllers to computer error codes and mission controllers have memorized the error codes to accomplish rapid response. Trust was established via working together in the long preparation period and extensive briefings when a plethora of what-if scenarios was answered. A case of doing the wrong thing at the right time could have changed history.

\(^{20}\) The historical narrative from NASA archives continues (at \url{http://www.nasa.gov/50th/50th_magazine/unsungHeroes.html}): Bales credited his quick decision to an even younger whiz kid, John R. “Jack” Garman, 24 years old, an expert in the guidance computer software. It was Garman who, a few months before Apollo 11, gave the simulation supervisor, Dick Koos, the idea of testing the reaction of flight controllers to computer error codes. He also supported flight controllers in Mission Control as a backroom advisor on computer systems. By the time the actual landing was being attempted by astronauts Neil Armstrong and Buzz Aldrin, Garman knew almost instinctively that a single 1202 or 1201 alarm did not mean the mission had to be aborted; it simply meant the computer was struggling to keep up. As long as the alarm did not become continuous – meaning the computer was not getting any work done and vital tasks were neglected – it would not prevent a landing.
The linear propagation of *mission order- standard operating procedure-outcome* message is relayed and represents reality confirmed in both the location of the sender and the receiver. The only feedback expected in this mission was the mission accomplished message. The realization of mission accomplished, in real-time and follow-up decisions could not happen without communication occurring, then, understood and confirmed.

### 3.6 Summary of Intended Inquiries

This dissertation intends to bring to light how important communication, via active conversation, is in order to accomplish a flight mission according to those who execute the flight. Conversation exchanges in flights are real-time speech acts; participants have to do what they communicate but, even when they just report facts, they meta-communicate confirmations of completed or attempted actions, as they do them. Standard operating procedures and rules of engagement restrain the language used, while spontaneous interaction may deviate from standards in style or content (English or other, with code switching).

An aircraft flight represented in the basic model of communication is an ideal flight “session acts” situation. Interlocutors work together to ensure that their utterances are mutually understood, as pilots are “many” to address “one controller” with accuracy and in a rapid pace. Controller- pilot communication follows a collaborative scheme to conclude with the desired result.
The discursive space of a cockpit includes participants with tasks, procedural and organizational rules, mediating devices and affordances for social interaction as abilities to manage social interactions, emotional context, or social presence (Gibson, 1979; Gaver, 1991; Greeno, 1994). The cockpit is a machine supported collaborative environment in which attention management (cross-device interaction, cross-mode interaction), awareness-showing, context management, relationship building, and maintenance are instrumental. Human actors must have system understanding, position their role in it, interpret and apply SOPs and RoE, and remain conscious of “what makes the difference” when they deviate from “what is expected”.

In this context, there are several communication-oriented problems that arise. One set of problems involves issues of “who is addressing whom and how feedback loop is maintained”. A second set of problems concerns the actual practice of SOPs/RoE and what counts as following them in a crisis. The third overarching factor is “how those processes need to be negotiated in time-critical situations”. It will be the purpose of this dissertation to examine conversation acts in the cockpit with ATC, application of rules, registers and protocols, and managing the affordances of time in flight instances. Also, in the process, it will be examined how interlocutors trusting identities and culture are sustained in crisis warnings and conversation.
CHAPTER 4: WHEN SILENCE IS NOT GOLDEN

Two core communication-related categories emerged from the GT approach of Chapter 2, with the labels of silence and voice (section 2.3.3). In this data analysis chapter, silence is explained in its multiple dimensions, as one of the two pivotal communication phenomena of this study.

4.1 Organizing the Chapter of Silence

The literature review in Chapter 3 primarily covered the literature in systems theory and human factors. On the advice of Dr. Porpora, Chair of the Dissertation Committee, literature more closely connected with communication and culture has been worked into the data chapters where it has closer proximity to the empirical evidence described.

The conceptualization of silence underlies several aspects of how the silence concept is instantiated in the reality of the participants in this study, with seemingly related observations and experiences. Different interlocutors, in this study, perceive silence differently in their roles and connect the phenomenon with diverse practices, regulations, incidents and concepts. Hence, the current chapter follows the different points of view of pilots and air traffic controllers, and the chapter sections reflect the dimensions that materialize silence when responders exercise their roles. That is why this Chapter 4 develops with one main scenario, where as Chapter 5 (for voice) incorporates three distinct scenarios and a different structure.
Silence is manifested as a framing mechanism of the landmark flights explained in Chapter 1 (sections 1.5.1, 1.5.2), and is taking several forms depending on the roles of aviation actors who interact. Air traffic controllers treat it differently in compare to cockpit crew members and fighter pilots; cabin crew members think about it as a restricted channel; cockpit crew members experience the silence of authority. From a regulatory point of view “sterilization” is imposed as silence in the cockpit, in certain intervals. Lastly, the lack of communication is perceived differently depending on who initiates (and then is expected to break) silence.

Silence intervals are part of the whole interaction (in section 4.2), but could have devastating consequences as found in intra-crew and inter-crew research, and structure a main scenario as a communication factor in the concept of aviation safety (sections 1.3.1 and 4.3). After connecting the scenario of “pilot silence” (introduced in section 2.5.1) the air traffic controller point of view is analyzed (section 4.5) with relevant concepts: initiating, violating clearance, pilot apologizing, feeling the hidden corporate pressures, dealing with emergency requirements, and no-talking with the collaborative scheme of pilots and controllers. Then the fighter pilot’s point of view is presented (in section 4.6) with the “instructor knows better” mentality, the mutual silence, the mentoring outcome, the safety and trust culture, its connection with situation awareness and leadership, its impact in checklist monitoring, VIP transfers, and the arbitrary and
non-standard choice of not sharing crucial information. These sections coupled
with a conclusion summary are those to follow.

For this chapter I selected the responders whose interpretations went over a
simple predictable reply and offered insightful experiences. From the complete list
of section 1.4 (Figure 1.3), the subset of respondents in this chapter is shown
below:

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<td>13.</td>
<td>AIP1, Fighter Pilot</td>
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<tr>
<td>14.</td>
<td>AIP2, Fighter Pilot</td>
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<td>15.</td>
<td>AIP6, Helicopter Pilot</td>
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<tr>
<td>16.</td>
<td>AIP9, Civil Aviation Pilot</td>
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<td>17.</td>
<td>AIP13, Accident Investigator</td>
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<td>18.</td>
<td>AIP14, ATC</td>
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<td>19.</td>
<td>AIP15, ATC</td>
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Figure 4.1: Selected Responders for the Scenario of “ Silence”

As we can see in the table of Figure 4.1, seven participants with different profiles
and backgrounds (military and civil aviation pilots, controllers, and an accident
investigator) were selected for the depth of their responses. With their
interpretations we move from the conceptualization of the scenario to the
operational assessment of silence, as they experience it while doing their job. More
details for these responders are included in the Appendix E.

4.2 Aviation and Silence in Interaction and Beyond

This section organizes the background of silence in aviation communication
as collected by the side informal discussions with the responders of this study, prior
to their replies to the specific scenarios. The systems approach used in this
dissertation describes flight cockpits with their information exchange as mission
critical operating environments. Even when mission critical systems fail, it is much more likely due to an accumulation of (in other contexts) minor malfunctions and trivial difficulties, as major technical or competence issues are taken for granted in complex systems\textsuperscript{21}. Several tragic accidents illustrate that when pilots or crew members fail to speak up and transmit safety-critical information the risk for life increases rapidly (Roitsch et al, 1978; Cookson, 2009).

Sometimes voicing opinion regarding elements from flight incidents (from blinking switches to checklist negligence or repetitive no-talk) has a follow-up after the flight is over, in the de-briefing phase when the pilot fills out the flight logbook\textsuperscript{22} and explains important phenomena observed during the flight (Konstantaras, 2007; p. 398-405). Accountability goes hand in hand with breaking silence, in this occasion.

In this chapter, the discussions with high-level practitioners point out a genre of silence; the flight communication model is dominated with communication issues concerning the channel of silence. Diverse studies (Cushing, 1994; Barshi, 1997; Loukopoulos et al, 2011; Dismukes et al, 2007; Gladwell, 2011, p. 206-261) indicate that miscommunication is a pervasive problem in flight operations and has been a decisive factor in numerous incidents and fatal accidents,

\textsuperscript{21} Beyond the aviation industry, miscommunication issues are prominent in other mission critical environments like medical practices (Gaba et al, 2003). Also, lack of a regularized communications system with pre-defined terminology was identified as a contributing factor in the nuclear accident at the Three Mile Island Nuclear Power Plant operated by Exelon, Dauphin County, PA in 1979 (Barrett, 1982).

\textsuperscript{22} The aircraft cabin defect log is usually filled by the cabin crew members and the aircraft technical log is filled in by the flight deck members. The two logs combined communicate flight realities to the next shifts, where as the two flight recorders – CVR for voice and FDR for instrument indications and parameters- are the real-time archive of the flight.
although of a low frequency when considered as a percentage of daily interactional transactions.

Until and when the controller-pilotdatalink communication becomes widespread, air traffic control communication depends primarily upon voice communication (and the periods of silence which communicates too) and is affected by various parameters. Controller-Pilot Datalink Communications (CPDLC) system aims to reduce the number of voice messages from air traffic controller by sending electronic messages that are displayed on a computer screen in the cockpit, using a keyboard of “words” (and not just letters)\textsuperscript{23}.

The responsibilities of the pilot and the controller overlap in many flight areas and provide backup and complementarity, as both parties are equally involved from different edges of the flight. Failure of speaking up (or reading back) or replying on time, ambiguous terminology and/or the omissions of key words or phrases might result to information misunderstandings. When single radio contacts are used for the oral transmission of essential information, then vulnerability to potential dangers is apparent (Job, 1994; p.180)\textsuperscript{24}.

\textsuperscript{23} The Controller-Pilot Data Link Communications for FAA is explained at [http://hf.tc.faa.gov/capabilities/cpdlc.htm](http://hf.tc.faa.gov/capabilities/cpdlc.htm). In Canada, airspace has undergone safety and efficiency enhancements with the completion of the national implementation of CPDLC in suitably equipped aircraft flying above 29,000 feet ([http://www.navcanada.ca/EN/media/Pages/news-releases-2014-nr10.aspx](http://www.navcanada.ca/EN/media/Pages/news-releases-2014-nr10.aspx)). Eurocontrol ([http://www.eurocontrol.int/services/controller-pilot-data-link-communications](http://www.eurocontrol.int/services/controller-pilot-data-link-communications)) is using it on a simulation basis. The Australian Civil Aviation Safety Authority ([http://www.icao.int/APAC/Meetings/2013_FIT_Asia2_RASMAG18/IP04%20Use%20of%20ADS-C%20in%20Australia.pdf](http://www.icao.int/APAC/Meetings/2013_FIT_Asia2_RASMAG18/IP04%20Use%20of%20ADS-C%20in%20Australia.pdf)) is evaluating that technology after 15 years of use in the oceanic air space.

\textsuperscript{24} Nine months after the fatal collision of two Boeings 747 at Tenerife’s accident on 1977, with 583 fatalities, the ICAO Air Navigation Committee took action, issuing three reports and implementing radiotelephony changes in 1984. Among the contributing factors the expression “at take-off” determining a position different than expected created a major misunderstanding. Twenty years later and further on, miscommunication still occurs and remains a contributing factor to aviation accidents.
There are several critical phases in cockpit-air traffic controller communication cycle or continuum (as analyzed in section 1.3.1). Silence is part of the interaction and voice should be used to formulate the signals of interaction (till the computerized data link will become wide spread). Phases of a flight in civil aviation include the briefing on the ground (for the parameters of the flight like network of towers en route, navigation altitudes, weather conditions, fuel load, navigation aids, expected baggage load etc). Then, the pre-flight ritual of walking around the aircraft for a visual check\textsuperscript{25} and the studying of aircraft flight logs (for potential unusual situations documented in the log, as it happened in the Falcon flight of section 1.5.1). Then the marking of checklists in the cockpit (communicating with ground control and crew) and door closing and cross checking. Getting clearance and starting the take off roll and landing gear up.

Then, communicating the banner of “seat belt sign” off (except during oscillations); flying to 20,000 ft (on average) and continue climbing. Then engaging the autopilot (from manual to automated control), and communicating with departing-intermediate-destination control towers (pilot non flying monitors

\textsuperscript{25} In October 2, 1996, the AeroPeru flight 603 with a Boeing 757 from Lima (Peru) to Santiago (Chile) the maintenance personnel forgot to remove the protective covers of the static ports (the external pressure-sensitive instruments used to sense altitude, wind speed, temperature, etc) after washing the fuselage of the aircraft. As a result, during the flight, essential indicators were measuring erroneous inputs that led to erroneous understanding of the flight parameters. It seems that the oversight could be prevented with the common (for crew members) pre-flight walk-around the aircraft. The crew did not walk-around that aircraft and having inadequate situation awareness in the flight from faulty indicators (as well as problems in navigation, standard call-outs, and in tactical decisions) they did not prevent the fatal crash in the Pacific ocean (with the altimeter erroneous indication of 9,700 feet altitude in the impact to the water) and 70 people on board lost their lives. The accident report from the Directorate General of Air Transport (of the Ministry of Transport, Communications, Housing and Construction) of Peru is available at Eurocontrol’s skybrary at http://www.skybrary.aero/bookshelf/books/1719.pdf.
the flight). Automatic recording of flight indicators and intra-crew interaction are
recorded in CVR and FDR.

When approaching the destination, topical awareness is exercised with
interaction with co-pilot and air traffic controllers. By disengaging the autopilot
(from autopilot to manual control), the pilot flying continues with landing gear
down. Obtaining clearance to land from the controllers and landing and aircraft
stopping or turning off active runway; and arriving at terminal (with constant
interactions with controllers). A debriefing phase is conducted if needed, as well as
completion of flight logs. Silence periods are required after the landing gear-up and
till the “seat belt sign off” and from the landing gear down till landing.

In the case of military flights, a mission is allocated, configuration and
flight planning is done on the ground, briefing is a crucial phase as tactical and
communication details are posed, then the pilot is doing a visual check of the
aircraft, climbs on board the fighter plane, is going over a checklist with the ground
engineer, get clearance to take off and start the mission. During the mission there is
intense communication with the accompanying fighter planes and the Center of
Operations.

These interactions are recorded in an FDR device, silence is imposed when
target is identified till the end of the fight or drill and then the fighter pilots
approach back to the base, get clearance and landing gear down to land. The first to
communicate is the ground engineer who is assigned to the fighter plane and gets
all the necessary remarks from the pilot. Debriefing is the last but very important
phase (on the ground); when all pre-flight arrangements are compared with the actual flight, as well as the communication interactions in order to evaluate an accomplished mission or erroneous situations.

Silence sometimes occurs from landing to de-briefing, as fighter pilots are inclined to share opinions when they are between each other. All fighter pilots who participated in this study consider (briefing and) de-briefing as an integral part of any mission in the (pre-flight and) post-flight phase. The de-briefing is an account of what happened in the flight and of “who needs to know what” in order to fix, arrange, prevent any occurrence. The debriefing is a meta-communication process which retracts the whole flight, provides a mechanism to evaluate human error and safety culture in a systemic way and cultivates collegiality and leadership.

These series of stages cover an approximation of a routine flight; the ideal flight is described in the flight manuals; implementing it while airborne is the actual flight; flying with no unresolved occurrences is the routine flight; and dealing with major events or conditions leading accidents is also part of the real flight situation (which includes all but the “ideal” flight, in the sense explained in section 1.3). So, periods of silence are part of the communication process but the duration of these periods, the way silence breaks into messages, and the consequences of different manifestations of silence are the objective of this chapter.

4.3 Using the Silence Scenario to Address Safety
In the following sections, the silence scenario presented in section 2.5.1 is used for the discussion with the informants-interviewees, who offer their commentary in writing. The point of view of different actors (pilots, controllers, crew members, accident investigators) determines various manifestations of silence and events in which silence was decisive for the conclusion of the flight or the safety of passengers on board.

Since the early years of (mainly) civil aviation, decisions whether and how crew members voice concerns involve complex considerations and trade-offs. Reluctance to speak up and the resultant silence has posed a serious threat to flight safety and many discussants comment on the level of flight risk which justifies the cost of speaking up. Barriers for voicing concerns could be relationship damage and contextual factors (such as familiarity with the people in the alarming situation). Silence, in the interpretation of the responder of this study, could be observed inside the airplane cabin, inside the airplane cockpit, between cockpits or may be assessed institutionally with the flight log reports where the crew has to fill any noteworthy information (for the airline and the aircraft manufacturers).

The scenario, I use for silence, originates from the research by Bienefeld & Grote (2012) who report that several accidents have shown that failure to speak up can have devastating consequences (the full narrative is in section 2.5.1). In the current study, silence acquires multiple dimensions which clearly extend the original position on silence. Despite the durable crew resource management (CRM) training, silence persists as a problem and still poses a risk to flight safety. In high-
risk situations (like flights), speaking up plays a pivotal role in conveying important information to mitigate errors.

Silence might occur in intra-team and inter-team communication and in ad hoc cases, where the perception of feeling safe to speak mediates the relationship between status and speaking up and between perceived leader inclusiveness and speaking up (Grote, 2014). Leadership inclusiveness describes the words and acts that leaders undertake in order to invite and appreciate others’ contributions and accommodate other’s choice to speak up (Nembhard & Edmondson, 2006). As shown in the responses of the current chapter, a leader could be a pilot-in-command (for example) who leads the crew and directs the interaction with controllers. A leader (as supervisor) could be a commanding officer in a fighter squadron or manager in an airliner. The silence behavior of subordinates in organizational settings is closely dependent on the supervisor’s attitudes to silence (Vakola & Bouradas, 2005). Supervisors create the micro-climate (a certain vocational sub-culture) to motivate subordinates to defend safety rules or to remain silent.

Silence and voice could also relate with the uncertainty of interaction, which in turn relates to safety. Grote (2014) argues that in certain circumstances of high-risk environments increasing uncertainty could forward. Not remaining silent empowers people to address concerns and doubts about certain actions for sounder decision-making, even in conditions of added uncertainty. In high-risk situations, flexible rule-making with degrees of freedom for the actors could raise uncertainty for the decision-maker but could be more appropriate and safety-increasing. The priority on safety of passengers and the aircraft may be a catalyst for both, voice and silence.
In the current study, the responders use the narrative of the silence scenario to offer their opinion about the crew members, to explain a similar experience from the controller’s point of view, and as a pilot who is expected to speak-up. The probing questions to elaborate initial responses concern the possibility of a fighter pilot mission supervisor (who assists the controller in military missions) and the potential training for coordinating silence and deal with authority. In fact, silence and voice could be problem-focused, suggestion-focused, and opinion-focused in different situations (Schwappach & Gehring, 2014).

Also, responders are asked to take the point of view of their role (and then add their personality), so that silence would emerge as a phenomenon with multiple aspects: silence from whom, addressed to whom, used by the controller or the crew member, perceived by the controller, or a crew member, an external (intercepting) pilot or the airline operator.

4.4 Pilot Silences with ATC Point of View

4.4.1 Pilot Initiating, due to Hidden Pressure, Sometimes Required

One of the most experienced air traffic controllers- informants in this study, namely AIP14, is speaking her mind for this scenario. AIP14 is a well respected controller working in a chief position in one of the busiest airports in Greece. While we had several face-to-face and remote discussions in the past three years it was clear to me that she understands aviation in its entirety as a “holon”, as explained in section 3.2.2; i.e. the aviation systems and subsystems, the multiple actors and public policies, the social conventions and operational hierarchy and decision making, as
well as of the information flow. All the other controllers were prompting me to ask her for any challenging question, as well for the policies regarding the unification of European Air Space (the Single European Sky initiative\textsuperscript{26}). Let us see what she had to say:

It happened throughout my long carrier as an air traffic controller to experience emergency situations or other situations needed to be handled according to the rules, after a pilot’s report, declaring a situation. In my opinion, when there is an imminent danger for the aircraft, a real emergency situation (i.e. high jacking, fire, fuel loss, engine failure), the crew member communicates this to ATC. In some other cases, where only indications in the normal operations of the flight was declared, the crew member was hesitant to speak up about the nature of the problem, in order the ATC staff to be prepared accordingly, in case the situation would turn worse.

AIP14 states that the controller is trying to be prepared for the current and next projected flight inquiry when explicit declaration of a situation is coming from the pilot, preferably in low-context language. Communication is initiated by the pilot side and may include an actual textbook emergency or indicators that may accumulate. The controller has more response resources on the ground but needs a clear assessment from the cockpit. Simultaneously the controller tries to be

\textsuperscript{26}Launched by the European Commission in 1999, it is the initiative of organizing airspace into functional blocks, according to traffic flows rather than to national borders. The European air traffic management (ATM) system currently handles around 26,000 flights daily, with a projection to double by 2020. With common rules and procedures at European level, its primary aim is to meet future capacity and safety needs through legislation. The Single European Sky second package (SES II) established goals in key areas of safety, network capacity, effectiveness and environmental impact. The Single European Sky transforms the role of EUROCONTROL, which could become the Network Manager of the European ATM network (description available at https://www.eurocontrol.int/dossiers/single-european-sky).
economical in effort and conversation, as multiple possibilities maybe expected in
the coming future foe each flight. Sometimes, when the situation evolves and the
crew member sends hesitation message with some uncertainty, the controller needs
to stay vigilant for a real emergency in terms of flight control, fire, and fuel or
engine loss. And why does she think that happens?

I suppose that beside the stress occurring from workload in the cockpit there
is always a “hidden” pressure related to the so called “fame of the
company”, in other words the crew members hesitate to frankly declare the
nature of the problem, just leaving the controller to suggest what is wrong
(in those cases we are always in a local standby phase). If everything ends
up well, we don’t get any further information, than simple phrases like “just
a small problem, nothing serious, only a small indication, etc.”

AIP14 values the strain crew members feel from their navigation workload and the
additional corporate latent practice to preserve the airliner’s fame. If
communication is not initiated by the crew to speak about the problem then the
controller starts prompting questions in order to suggest what is wrong. It is an
unorthodox practice as the controller remains occupied in a “waiting to continue”
mode. When the problem resolves a short message about “a small non-serious
indication” is the crew follow-up response.

I asked AIP14 to explain the implications further, and she is clear that it is
not the controller’s job to speculate for a flight problem, it is an asymmetrical shift
of responsibility; each part (pilots and controllers) controls its own territory,
manages its own topical situation and should provide input to the other about the
next step of the flight from its own oversight. Then they can start symmetrical
interaction to collaborate. That is why the one who has a potential problematic
situation declares it, and communication continues from there.

The cockpit is a stressful environment since human actors need to manage
sophisticated devices, interact and communicate, adhere to tight time frames, and
implement a flight that carries the responsibility of passenger lives and the aircraft
itself. When indicators of a potential problematic situation are evident the stress
factor increases. As cockpit members are the “spokespersons” of the airliner to the
air traffic controllers who represent the aviation authorities, their interaction has an
impact to the airliner brand, as competition in aviation is not only about customers,
but also means to maintain strong perceptions in the minds of the aviation
community members.

Aviation is a highly regulated environment\textsuperscript{27}, any problem report is an
operational disruption when the crew cannot deal with that internally. So, giving
hints instead of explicit language is a sort of transferring the load to your responder,
who is the controller in these cases. This hesitation to speak frankly has the form of
thinking aloud that maybe forgotten if everything goes well. Of course, there are
cases when the end of a flight is the start of a follow-up process to report minor

\textsuperscript{27} IATA’ s director general Tony Tyler is quoted saying: “Regulators are micro-managing our businesses, telling us how we may advertise our services, how long we must hold a reservation that has not been paid for and how we are to manage operational disruptions regardless of the cause. These regulations impose a huge penalty on the economy and ultimately raise the cost of air travel for all consumers” (see September, 20, 2013 at http://www.aviationtoday.com/the-checklist/IATA-U.S-Needs-to-Loosen-Regulatory-Grip-on-Airline-Industry_80223.html#U dM6qN0Ylx).
problematic issues as in the example analyzed for the Falcon VIP flight (of section 1.5.1). But why is this important, as AIP14 continues?

This can be proven very dangerous behavior as there is always a possibility an indication to turn into a disaster. I do not know about airlines’ crew training policy regarding this issue, but as it happens quite often with different companies, I believe that there is rather a fear among crew members to speak up in such cases without having in mind the consequences of this decision (to speak up freely about the “problem”).

AIP14 explains that the report-encouragement policy goes hand-by-hand with vigilance for the future. Bits and pieces of earning signals, communication and mechanical indicators can lead to disasters. Cloudy information from the flight deck and small-talk oriented conversation may cause inefficient interaction and insufficient information. Also, a process of outeraction develops when participants (cockpit crew to controllers) step outside information exchange interaction and negotiate availability to speak to each other (even in another frequency) and establish an attentional contract which binds them tightly together (as described in Nardi et al. 2000; Hwang et al, 2009). In this sense they find a way to manage their communication (in case needed, out of the routine) and not so much to exchange information.

The consequences of these interactions (and corollary reports) maybe long term if the airliner support and facilities chain does not hit a specific verbal comment to follow. Fear to speak up could also be a symptom of loose or
repressive organizational culture at an airliner level (with an ill-perception of human-error blame, see Dekker, 2011), or micro-culture inside the cockpit and the cabin. So, as AIP14 presents her reasoning about “the crew not-being silent” argument she is conscious on the regulated counterargument when, sometimes, silence is required. She prompts silence as a “magic” word (in capitals to accentuate the requirement) below:

Last, I would like to mention that during emergencies crew members have to focus on how to navigate the aircraft, so they need time and peace. SILENCE is the magic word imposed to the Controllers in order to give time to the crew to identify and solve the problem in the sake of the safety. So, SILENCE is sometimes necessary for pilots and controllers.

The rebuttal about “not being silent” is what AIP14 is clear to say during emergencies; that having silence intervals could be an operational requirement when real emergency occurs (“Mayday” opening call) or distress (“Pan Pan” opening call). An initial call incorporating the word “standby” would be a typical feed-forward in such occasions. In emergency cases or abnormal situations when normal standards may not suffice for a safe landing, as AIP14 elaborated in

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28 The Robert Zemekis Paramount’s mystery-thriller “Flight” (2012) uses one such abnormal situation scenario when an airline pilot miraculously crash lands his plane after a mid-air catastrophe, saving nearly every soul on board, despite that the investigation into the accident reveals troubling physiological conditions issues of the pilot (see more at [http://www.paramount.com/flight/](http://www.paramount.com/flight/)). In Greece, as HAF is felt to be part of the everyday lifeworld of the people, a national TV series of Errikos Anagnostopoulos called “Silence in the Air (Aerines Siopes, 2000-2003)” is based on the personal/operations life of some pilots of the 332 Al Weather Squadron of 114CW. Some actions in the 98 three-year episode series are inside the air base. In episodes #55-65 fighter pilots act or comment on non-standard situations (more at [http://www.impdb.org/index.php?title=Aerines_siopes](http://www.impdb.org/index.php?title=Aerines_siopes)). Silence is featured, as causing major incident in fighter training flights, as understanding your own error (and better not to speak till the de-briefing) or as feeling so comfortable with the other with whom you communicate without words. This narrative created a popular perception of the “silence” question in the broader audience.
further discussion, flight crews usually prioritize their actions in three steps: aviate (ensure the safe flight path and condition of the aircraft), navigate (continue the flight to the originally intended destination, divert if necessary, carry out an emergency descent or just place the aircraft in a safe flying position), communicate (declare an emergency as soon as possible and cancel it later if the situation allows).

She is considered a fair-minded flight traffic “supervisor”, as several of her trainees now colleagues agree on, and has capitalized silence as a “magic word” since controllers need to ensure that they facilitate the incoming flight with giving them time to manage the emergency (the controller in standby mode), free the airspace in their surroundings (calling the other planes to holding patterns) and impose silence (to the radio frequency or provide an alternative frequency). Of course, respective silence intervals may be needed for the controller to activate the necessary ground services that deal with emergency response and to keep a mind in “peace” to coordinate the rest of the incoming traffic, appropriately. What otherwise would be a controller’s guidance, in an emergency case could be perceived as communication noise from the pilot who dedicates effort to aviate, navigate and choose how to communicate (after a potential initial signal of standby). That is part of the controller’s assistance.

AIP14, in general terms, as an experienced controller has explained silence in three dimensions: when she is the receiver of the message, when it modifies the content of cockpit communication and when it is required in the manuals. Also, she
is quite cautious to respond to any signal initiated from a crew member reporting an actual emergency, or reporting situations that may escalate to an emergency. Lastly, since civil aviation operates in a business environment with organizational and managerial regulations, crew members are employees and are subject to managerial requirements and market needs towards their passengers and the other members of the aviation community or industry; they have their corporate fame to protect and their professional face to defend.

Communication theory includes silence in the nonverbal communication mechanisms, as communication without words (Burgoon et al, 2010). Silence emphasizes the vocal channel, but with no voice, in the basic model of communication as it may relay information and influence flight interlocutors at a greater extend in compare to verbal communication. Silence serves important functions in communication (Jaworski, 1997): provides time to think, hurts others, reduces anxiety, prevents communication and communicates emotions. It is noteworthy that when a situation is happening, unfolding or accumulating the pilot needs to explicitly declare the case; interaction has to start from inside the cockpit, as if it was a linear process, since all indicators and warning signals are there and there is no room for interpretation and perceptual errors. The crew members have the corporeal presence in the cockpit (and the cabin for the other crew members) and are able to observe and consequently communicate factual statements (Weinberg, 1958).
Another cockpit crew member would be the one who announces a minor problem in order to maintain a level of “authority” towards the controller; important situations i.e. high jacking, fire, fuel loss, engine failure are more likely expected to be announced by the pilot to form a distinct message relay in compare to minor indicators. If silence persists and is perceived as loss of communication, transponder switch-off or wrong setting then the controller is reactive to conclude a national security threat coined as “Renegade”\(^{29}\) and engage interception fighters. Thus, the role of the sender-pilot is a key starter in order for the controller to apply or evaluate the next steps, when a potential severe situation is unfolding.

AIP14 is extremely cautious in her wording “after a pilot’s report, declaring a situation... the crew member communicate this to ATC”, as typically, there is no systematic way to determine whether declaring an emergency was warranted by the circumstances and it requires priority handling. In general, all traffic in the system is handled on a first-come, first-served basis. Priority handling means no undue delay and not necessarily urgency or distress; it could be a medical transport mission or search-and-rescue operations or an emergency. When AIP14 is waiting from the crew member to break silence and declare the state of the flight, she wants to be able to distinguish between urgency and distress\(^{30}\) and avoid the phenomenon of indiscrimination in language (DeVito, 2012; p. 112-113).

\(^{29}\) As explained in the second paradigmatic flight of Helios 522 “ghost plane” on Chapter 1 (section 1.5.2).
In ICAO provisions\textsuperscript{31}, an urgency call is introduced with “Pan Pan” (expecting three repetitions), without requiring immediate assistance, and distress call is introduced with “Mayday” (expecting three repetitions) and demands immediate assistance; i.e. provide direct routing to an airport, reroute other planes to avoid delays and not use holding for the plane that receives priority handling.

Both pilots and air traffic controllers have responsibilities for the safety of an aircraft flight and passengers, concurrently. The pilot-in-command of the flight explains his/her intentions, deviates from the normal rules and clearances, and demands maximum assistance from the air traffic controller. After speaking with a large group of controllers, their bottom line was that \textit{“in an emergency the controller can break all the rules to assist the pilot”}. The controller is there to assist and not just to enforce the rules when emergency is declared.

On the other hand, examples of second-guessing a pilot’s decision to declare an emergency are not common and if there is no heavy traffic for ATC, nothing will happen. If traffic was really disturbed and controllers’ handling created a traffic accumulation around, combined with suspicion of an overstated declaration of emergency, then the occurrence would be subject to inquiry by the state authorities. Silence can hurt communication (Ehrenhaus, 1988), as AIP14 points out: \textit{“This can be proven very dangerous behavior as there is always a possibility an indication to turn into a disaster... just leaving the controller to suggest what is wrong”}. Silence should be broken from the pilot part in order to

\textsuperscript{31}Urgency is a condition concerning the safety of an aircraft or of some person on board or within sight, but which does not require immediate assistance. Distress is a condition of being threatened by serious and/or imminent danger and of requiring immediate assistance.
communicate an actual representation of reality through appropriate vocabulary (Devito, 2012; p.110-111).

AIP14’s handling of proper feedback depends of how silence prevents communication to happen, in order to avoid “a boy who cried wolf\textsuperscript{32}” phenomenon of false alarm or vigilance gap (Shuang et al., 2010; ADPC 2006; Roulston & Smith, 2004). During my duty as air traffic control monitor liaising between US Navy and Hellenic Air Force it became customary to deal with the so-called expected emergencies, when Boeing C-17 Globemaster III\textsuperscript{33} planes where flying to Souda Bay in Crete, after declaring an emergency three hours prior their landing, in order to expedite diplomatic clearances for landing. After the second repetition, those emergencies became anecdotic stories for the US Naval base personnel (it was a non-emergency but was declared as one).

As AIP14 recognizes “hidden pressures and fame of the company” could be additional factors when silence is occurring, even in cases that crew members think they want to speak up. Aviation companies’ philosophies can vary significantly and affect crew members decision-making. Crew members may be susceptible to social compulsion in the form of peer pressure, employment pressure and socioeconomic pressure, especially in the current era of economic turmoil. Main concerns are fears

\textsuperscript{32} It refers to one of the Aesop’s fables known for rhetorical storytelling and parabolic communication explaining the maxims of quality in communication: “a liar who cannot be believed even when telling the truth.” When emergencies are declared repeatedly and are not real cases then the expected response deteriorates if when the real emergency occurs. Sometimes it can be a side effect of personnel inaction after too many drills for preparedness or long lasting readiness shifts. Remaining proactive requires “stopping for real action (an action break)” and then continuing to stay vigilant.

\textsuperscript{33} As Boeing company describes it: the C-17 Globemaster IIIA high-wing, 4-engine, T-tailed military-transport aircraft, the multi-service C-17 can carry large equipment, supplies and troops directly to small airfields in harsh terrain anywhere in the world day or night. The massive, sturdy, long-haul aircraft tackles distance, destination and heavy, oversized payloads in unpredictable conditions. It has delivered cargo in every worldwide operation since the 1990s (http://www.boeing.com/boeing/defense-space/military/c17/).
of damaging relationships, of punishment, or operational pressures. In several cases, especially in the headlines of popular press, crew members opening up with problematic situations has been contrasted to a whistleblower’s culture that became equivalent to transparency, although quite different by definition (AHI, 2002).

A striking response in the discussion with AIP14 was that loyalty to the company or the organization does not mean enclosure, but defining the situation in reality and engaging both crew members and air traffic controllers for a safe flight. In such cases, her opinion is that speech really acts where silence shows unacceptable inertia. It is a transition from facts (the actual situation in the cockpit) and norms (the pilot has the power and control to communicate) to act in communication as described by Habermas (1998). In this interpretation, the safety imperative of the flight requires a pilot-initiated message in terms of jurisgenesis. The pilot’s talk has the communicatively generated power of a law for the controller, as both members have the rationality to reach mutual understanding. Then the controller is able to react appropriately according to the pilot’s requirements.

Aviation community creates a social network of competition in market terms and solidarity social “neighborhoods” in employment terms due to the intense nature of the work, the rotating shifts and the sense of belonging of its members (Christakis & Fowler, 2010; p. 214-217; Wellman, 1999; 1983). Microcultures or inner- cultures are developed in between the members of aviation community covering a punitive or motivating culture of an airline or a civil aviation
authority. Litigation is a practice to take into account in the mind of controllers, as their focus is in cases that emergency is declared and confirmed, and their behavior as receivers is affected by a propensity to blame. A typical example is that formal reports on incidents drop down when airliners are about to public safety statistics, and anonymous pilot reports freeze in periods of accident investigations or furious media coverage. There is a cacophony of overcoverage in media outlets regarding aviation accidents which creates a culture of fear for the lay person (Glassner, 1999; p.181-185)\textsuperscript{34}.

In Greece, where aviation is closely related with the everyday life of the people the private spheres of controllers and pilots contribute to the broader debate of the private individuals who come together with them in the public sphere (Habermas, 1991). Media coverage regulates and transforms the public sphere, as in Greece crashes for both Air Force and civil aviation challenges the airworthiness framework that the State regulates (Tsolakis, 2013; p. 202-204; Konstantaras, 2006; p.436-438). The media operates in the mode of a follower (reporting ongoing events, disseminating information to the public) and in the mode of the leader (for the social construction of the problem); in the latter mode, media reflect back to the public opinion when after a disaster, for instance, as news wave bursts based on “magnification of a single-perspective narrative” (Vasterman et al, 2005).

\textsuperscript{34} Aviation Safety Alliance currently consolidated in Flight Safety Foundation organized a 1-day conference on “Media Coverage of Aviation Accidents” with Barry Glassner as a key note speaker; airline safety and the media coverage of \textit{airline accidents} generated exaggerated fears of flying, was his topic. More can be found at \url{http://www.c-span.org/video/?156444-1/media-coverage-aviation-accidents}.\hfill\hfill
The single perspective narrative forwards the propensity to blame. The airliner or the State are sometimes inclined respond to the public opinion by pointing out an individual’s human error instead of projecting an error in reference to the system. When individual blame stays in the forefront there is a temporary sense of fulfillment for the public opinion, the airliner uses it as a motivational tool for silence, where as the aviation community individuals remain in the shadow of a “sword of Damocles”\(^{35}\) which echoes a public sentiment and individual fear (of partial just culture conditions for pilots or controllers). Beyond the notion of impending doom, aviation community members realize the risks associated with the profession and the media coverage of their responsibilities.

Immediately after, crew members adjust to the view of people, objects and events in the way they are talked about. It is a case of intensional orientation in communication theory. There could be a conscious reluctance to speak or unconscious reluctance to admit a difficult situation, a tendency to underestimate what is happening, when it is uncomfortable; this is what most controllers agree when they have experience from both small and bigger airports in cases like Greece with a dense network of airports\(^{36}\).

In AIP14 response “…without having in mind the consequences of this decision” silence has also another intriguing source; the potential of a human error

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\(^{35}\) It is a moral parable from Dionysius, the tyrant of Syracuse at the end of the 5th century, B.C. The glamour and prestige of the aviation profession (especially for pilots) comes with silence as protection of fame, with the risk of blame, and the actual risk of a fatal accident even when a flight is smooth till an emergency happens. As Dr. Daniel Mendelsohn, Charles Ranlett Flint Professor of Humanities in Bard College, explains in his position in National Public Radio “all Things considered”, August 19, 2011 (at http://www.npr.org/2011/08/19/139799434/sword-of-damocles-reference-sometimes-misused).

\(^{36}\) Hellenic Civil Aviation Authority oversees forty six airports all over Greece for a population of less than eleven millions (see more at http://www.hcaa.gr/content/index2.asp).
that is often a contributing factor in aviation accidents; either something is physically broken or an error occurred (Levenson, 2002; Dekker, 2005). That is why when flight status is reported the theory of e-prime applies; events are described more accurately without the verb to be using standardized abstract nouns (Klein, 1992; Wilson, 1989). So, when crew members think that a situation is evolving in the cockpit then silence (and peace of mind) is needed or they take silence as a requirement of the so-called sterile cockpit rule\(^\text{37}\) that reads in the following extract (from FAR 121.542):

> No flight crewmember performs any duties during a critical phase of flight except those duties required for the safe operation of the aircraft... Activities such as eating meals, engaging in non-essential conversations within the cockpit and non-essential communications between the cabin and cockpit crews, and reading publications not related to the proper conduct of the flight are not required for the safe operation of the aircraft. Critical phases of flight includes all ground operations involving taxi, takeoff and landing, and all other flight operations conducted below 10,000 feet, except cruise flight.

In several cases, silence is considered as not engaging in “non-essential conversation” and flight deck members can claim that. “Silence is the magic word imposed to the controllers in order to give time to the crew to identify and solve the

\(^{37}\) Eurocontrol’s skybrary explains: the Sterile Cockpit/Flight Deck concept involves the restriction of flight crew member activity to that which is operationally essential during busy phases of flight - taxi out, take off, initial climb, intermediate and final approach, landing, and taxi in. FAA has the Federal Aviation Regulation FAR 121.542 (from which the above extract is taken) often referred to as the "Sterile Cockpit Rule", and EU Commission has EU-OPS 1.085, a less explicit operating regulation, at http://www.skybrary.aero/index.php/Sterile_Flight_Deck.
problem in the sake of the safety”, AIP14 pointed out citing the “ASSIST”
document\textsuperscript{38} when an emergency was declared: acknowledge the call, separate the
aircraft from other traffic to give it room to manoeuvre, silence on the radio
frequency and provide an alternative frequency, inform those who need to know
(emergency readiness units and authorities), support the pilot in any way possible,
and time to give to the pilot to collect their thoughts.

When reversing the question, I ask AIP14 from the other side of the
communication model when she (as a controller) is a sender of messages for cases
she preferred to remain silent. Her recollection, during her steps as a young
controller, was to fall silent at times, due to natural fear from lack of experience.
For example, evolving from domestic flights to international flights air traffic
control, the matter of institutional rank and authority was an obstacle for her not to
speak up. The fact that she was a young controller, a woman in a men’s aviation
world and her inclination to feel confident and mature in the profession were part of
her thinking when she fell silent. As the shifts are quite organized in the sector, she
did not met any formal obstacle to speak but it was more her own process of feeling
capable to independently direct international flights and reply to unexpected
questions, after the familiarity of domestic ones. Her operational maturity started
becoming apparent in the pre-shift briefing in which controllers discuss the current
and expected air traffic and exchange ideas on the status of their control system and
any peculiarities they had to address.

\textsuperscript{38}The acronym (A- Acknowledge; S -Separate, S- Silence non-urgent calls, I- Inform supervisors, S- Support
the crew, T-Time) derives from the “Guidelines for Controller Training in the Handling of Unusual/Emergency
Gradually, she was able to reply to questions of others and explain the constantly changing European guidelines to which they had to comply. The strong foundation on the knowledge of the legislative framework and the way to apply it in pilots’ inquiries, and handling several emergencies were the indicators of her entering a stage of personal safety and competence. But authority in this sector was not because of the positions she took but because of the unusual situations she had to cope with in front of her peers on duty. Since silence is not a training item per se, she emphasized the management of emergencies during the flight when silence is kept by pilot and controller for a time, as pilot has to navigate the aircraft and then to communicate. In those times, anything else would be considered significant noise in the communication model. It is a realization of the maxim of quality and the principle of cooperation in communication.

4.4.2 Suspending Talk, Violating clearance, Apologizing, Collaborating

Let us now look at the response to the same scenario inquiring on “silence” from an air traffic controller, namely AIP15, with a different profile, being the youngest of all responders. She still considers the manuals as a primary resource but values observation of more experienced controllers when she is not in shifts. In the past months she worked extended shifts in the Athens Area Control Center - that is the first level of approach in Hellenic Air Space and Flight Information

Distress and urgency (as perceived by the pilot to the controller) are mentioned to ICAO ANNEX 10 VOL II - 5.3 Distress and urgency radiotelephony-5.3.2.3 communication procedures – “Imposition of silence: The station in distress, or the station in control of distress traffic, shall be permitted to impose silence, either on all stations of the mobile service in the area or on any station which interferes with the distress traffic.” See at http://www.icao.int/Meetings/anconf12/Document%20Archive/AN10_V2_cons%5B1%5D.pdf.
Region (FIR)\textsuperscript{40} and was on duty in the record day of 3,467 aircrafts (approaches to land) in a single day for Athens Area Control Center\textsuperscript{41}.

The controller AIP15 who narrates her example, in this case, has started working in a busy airport where lots of seasonal flights take place, as it is a high end tourist destination. Several of those flights are charter flights, low cost carrier flights or flights with crew members in the last phase of their on-job training or domestic flights that connect different islands. Thus, the culture associated is more service-oriented, for the passengers to arrive and the airliner to depart, than safety-oriented. Air traffic controllers have the local knowledge to be aware of the detailed configuration of the airport, which they were able to cross on foot as part of their familiarization and orientation in the job. Lastly, the small scale creates a community atmosphere for pilots and controllers to develop closeness and mutually appreciate their roles, even when they do not have personal relations.

When discussing the same scenario of section 4.3 regarding the phenomenon of silence, AIP15 relates it with interpersonal communication in the flight deck when silence was attributed to the chain of authority inside the cockpit, as explains in her testimony in the context of multiple factors present and the realities of air traffic control restrictions:

\textsuperscript{40} Flight Information Region (FIR): An airspace of defined dimensions within which flight information service and alerting service are provided. A three-dimensional area, in which aircraft are under control of usually a single authority. Internally an FIR is divided into several geographical areas called sectors. Sometimes one or more FIRs have a combined upper area control. It is a Eurocontrol definition at http://www.eurocontrol.int/lexicon/lexicon/en/index.php/Flight_Information_Region

\textsuperscript{41} On July 28, 2014 when I last visited Athens “El. Venizelos” airport, I was able to take a note for the upcoming report. This number of flights in a single day corresponds to the (approximately) 14\% of the total number of flights in the Eurocontrol Air Space of thirty-eight countries (explained at http://www.acac.org.ma/ar/Workshop%20Presentation/Microsoft%20PowerPoint%20-%20Eurocontrol%20Overview-Stefania%20Gazzina.pdf)
It is still a fact that crew members, due to their fear of being punished, or humiliated in case of speaking up, do not raise their voice to their superiors when there is a doubtful situation during a flight. Consequently, incidents or, even worse, accidents may occur because of the silence of lower at the hierarchy members of the flight crew.

AIP15 is moving one step back from emergency situations and notes that crew members have a fear of being labeled or viewed negatively (humiliation factor) and even get disciplinary punishment when they voice their opinion in front of a superior crew member. It starts simple, in much more mild instances that she labels as “doubtful situations”, a term mostly associated with technical parameters in a flight (e.g. altitude) that might be perceptual errors or interpretations of flight logs. That means that, in such cockpits, silence treatment is cultivated early on and with non-severe actual conditions from those in higher rank or the organizational operation chart. AIP15 goes on to relate an example from her own professional life:

While I was working in Thira Island, at the Control Tower, giving clearances to the aircraft take off and land, there was an incident which was caused by a misconception of what I said to the pilot and at the same time by the hesitation of the co-pilot to stand up to the pilot questioning his experience and knowledge. The aircraft, after it was given the route clearance, asked permission to taxi. I gave it taxi clearance with clearance limit the holding point of runway 16L.
I must point out that runway 16L was seldom used, due to the fact that the direction of the wind blowing at the area was mainly north. As a result, the pilots and co-pilots of many airlines were not familiar with the procedures of that runway. As a consequence, at the case I mentioned before, the aircraft, even though it was cleared to stop and hold its position at the holding point of the runway, eventually entered the runway 16L.

Thira tower is a service-oriented tower operating with the goal of increasing capacity due to the number of incoming flights that operate on a seasonal basis. Clearances are expected to be arranged in a flowing manner; as a result misconceptions about the use of the main runway, the waiting spots (as holding points for the next clearance) the use of auxiliary routes (like the taxiways in which the aircraft moves in a driving mode with its own means). The clearance that AIP15 gave was a conditional one, to move to a certain point to wait and not a final clearance to depart. The specific runway 16L was in use, weather permitting and traffic demanding and was not expected by the crew as a routine default choice.

Physical configuration of the airport and knowledge of the operating status, in each period, is one of the advantages of the controller (towards the pilot) as she is fully familiar with the site (even walked through the whole aerodrome). The co-pilot who holds the flight manuals seemed to have received the actual conditional clearance when the pilot was expecting the final one; but he hesitated to provide his input. AIP15 goes on to explain:
When that happened, it was summer and high season for Thira, due to the
tourist “invasion” arriving by thousands. That day was very busy at the
airport and there was very little time for me to watch the aircraft movement
in the ground. However, the moment the aircraft entered the runway
violating my clearance, I raised my eyes towards it and the first thing I did
was to give it the instruction to immediately vacate the runway via the first
intersection to the right. Another aircraft was at the final of the runway and
had already been cleared to land.

The high season instance and the fact that Thira is one of the world most popular
destinations with visitors that amount one hundred times its population gets
everyone is a rush. AIP15 accepted that she had marginal time to visualize the
physical movement of the aircraft till the spot where it exceed the holding point in
the runway 16L. That was a critical moment as she has given final clearance to
another incoming flight to land and the first aircraft had to empty the runway,
under her instruction.

It was a “first do and then repair the instructions” instance to avoid a
vehicular-like collision (when two planes move as vehicles with their power in the
taxiway and collide). How did she explore the situation further?

After vacating the runway, I told the pilot that I never gave them permission
to enter the runway and that I had to file a report because they violated their
safety and the safety of the landing aircraft. When they came up to the
Tower to apologize both the pilot and the co-pilot, and after my shift was
finished the pilot told me that he thought he heard me clearing them enter the runway. At that point, the co-pilot admitted that he could have spoken to the pilot when they were wrongly entering the runway, because he was sure that the aircraft was never given permission to get in.

According to the co-pilot, he hesitated speaking up because the policy of the airline was to cover up in the past similar incidents caused by the same first commander who was thought to be the most experienced of the airline.

AIP15 explains that the pilot-in-command made a severe mistake (not only violate the instruction but also not asking for repetition from the controller and not reading-back the conditional clearance). This type of action demanded reporting from the controller’s part. Admitting their mistake as team (pilot and co-pilot) went to apologize as they know that miscommunication should be resolved as they will be in the same airport multiple times. The informal out-of-shift conversation disclosed that the co-pilot had perceived the conditional clearance to the holding spot and not to the runway; but the policy and atmosphere in the cockpit made him hold his voice. Flying with the most experienced pilot in the airline was a professional fence so important that he was willing to discuss with a third party like AIP15. She was surprised from how talkative the co-pilot was:

The co-pilot was afraid of being humiliated by the first officer and even losing his job in case of a negative commentary of the pilot about his performance during the flight.
It was almost a confessing moment for the co-pilot, as fear of punishment (not getting promoted or having other adverse personal consequences) or fear of being labeled or viewed negatively was like a risk of stigma to him. Another factor that plays a role in this reasoning is the use of retired air force officers in managerial positions, a fact that sometimes enforces hierarchy in non-productive ways. Simultaneously it shows a confidentiality bonding that exists in aviation community, especially in a small country like Greece, since when something happens it is a “family matter” that need to be discussed, as confirmed by other pilots with whom I have interacted. So, AIP15 makes the main point why silence was deleterious:

If I was the co-pilot, I think that I would definitely speak up because the environment that both pilots and controllers work in is critical and everyone participating should be 100% accurate and certain of what is told, so even lower officers should raise their voice to the pilot and ask the Tower once more to repeat the clearance. As a result, the safety of their passengers, themselves and other aircraft would be undoubtable and never at risk.

Putting herself in the position of the co-pilot she is definite in her criticism and certain to speak up due to the severity of efficient reception of messages in aviation and the collaborative work needed to protect one another. A middle route to go was to ask for a repetition, so no one would have felt insulted to humiliate the other. In the end, safety goes beyond uncertainty.
In this case, intra-crew relations having a top name pilot with a less experienced co-pilot made the co-pilot to stay shy and silent. Pilots and controllers are equally involved to the ATC system and any factors contribute to achieve effective radio communication; factors that are not considered in isolation. Flight communication is effective when the receiver interprets the message as an active listener of the transmitted message. Active listening is the process of sending back, as immediate feedback, to the speaker the semantic message that you think the speaker meant both in content and feelings (Gordon, 1975). It is a process of the pilot/controller communication loop that connects communication with human factors: perceiving the message, reconstructing the information contained in the message, and linking the information with an objective or an expectation in the coming operating future (like a route, an altitude or time). That is why, although pilot-controller communication is one-to-one or two-to-one (at a fraction of time), the controller-cockpit feedback is considered a one-to-two or one-to-many communication so that more receivers can sustain the integrity of the communication loop; the other crew members are also receiving these messages.

AIP15 is pointing out a clearance misconception, as there was a limit to a holding point and not an unreserved clearance. Because of the heavy and diverse traffic of that airport confirmation repetitions are often omitted in the shake of time and radio-communication capacity. The use of “runaway 16L” may explain the misconception as an issue of situation awareness (Endsley & Jones, 2012; Dominguez et al., 1994). The pilot seems not to have a mental picture of the
location, flight conditions and intentions for aircraft within an area in relation to each other (like incoming traffic and airspace reservations). After the clearance violation, AIP15 used eye communication for a positional situational awareness that asks for the mental picture of the traffic situation in the physical space, with unexpected progressions in mind (the other incoming aircraft). Familiarity with physical space beyond the radar screen prevented any further event, but initiated an institutional communication channel for reporting the incident.

The ties and dependability developed in the aviation community made it important for the pilot and co-pilot to apologize with their physical presence. The co-pilot admitted that he was hesitant to speak what he heard from the clearance, as he seemed to have been in the same position in the past; he had chosen to contrast the pilot-in-command but he was humiliated and lost face. The airline policy to protect the “experienced pilot as a corporate asset” was either communicated during the pre-flight briefings or circulated as practice in grapevine communication (Crampton et al., 1998). The co-pilot’s statement seems to introduce an ethymeme in his mind (Katz, 1992), as resident in his memory, based on his empirical corporate reality regarding the cockpit insights:

The pilot-in-command does make mistakes (even if he has the command).
Mistakes are undermining the airline’s reputation (so individual blame is preferred than organizational one).
Airline’s reputation depends on the pilot-in-command face (it should be protected by the other crew members, for his shake and the company’s).
That syllogism stays in the co-pilot’s mind while functioning with goal to avoid potential negative evaluation that will threaten one’s career. After all, the co-pilot works in the private competitive sector of the aviation industry, in which employment security is market-driven. Moreover, the co-pilot in the story is willing to disclose those almost esoteric thoughts in the discussion with AIP15. It is a case of intensity in silence analogous to verbal language intensity (Bradac et al, 1979). The choice to remain silent is not because of neutrality when receiving that incoming message, but because of the perception of the imposition of silence.

AIP15 positions herself in the inquiry by combining a utilitarian and deontological point of view, consistent with the nature of her profession and the content of her training.

If I was the co-pilot, I think that I would definitely speak up because the environment that both pilots and controllers work in is critical and everyone participating should be 100% accurate and certain of what is told.

Being in a supervisory position, since air traffic controllers work for the Civil Aviation Authority\(^2\) of the Greek State, she is definite to voice her say for an accurate message feedback. It is a discourse case of the greater good for the larger number of people and simultaneously the moral obligation of the professions, as safety prevails. And voicing opinion is more a token of teamwork than a challenge.

\(^2\) Hellenic Civil Aviation Authority was founded in 1926 as an independent branch of Transportation Ministry in Greece. Its mission is the organization, development and control of the country’s air transport infrastructure, as well as the study an laying of proposals to the Minister of Infrastructure, Transport and Networks concerning the overall policy formulation in air transport. Coincidentally, FAA has an institutional history starting on 1926 and grows as an independent branch on 1958 (more data about the chronology is available at [https://www.faa.gov/about/history/brief_history/](https://www.faa.gov/about/history/brief_history/)).
to authority; it would just be an inquiry to the Tower to repeat the clearance. Feedback confirmation will close the loop.

In the form of controlling the reply to the silence scenario, I have continued the conversation with AIP15 after reversing the question. I asked her whether or not she had experienced silence in her own controlling role either as a choice or as an imposed one. How she proceeds in her response allows a small room for contradiction that is rather justified by the nature of cooperation with military between military and civilian air traffic control. She begins by setting her context:

The airport in Thira was used both by the Civil Aviation and the Military Aviation. During military missions, air traffic controllers and fighter pilot supervisors are working side-by-side in the Control Tower. In summer, we used to give priority to the civil aircraft and if we could find some time between the arrivals and departures we were providing service to the military operational flights. The civil air traffic controllers, me included, were not trained to handle military traffic and mainly it was at our own discretion to study the military manuals and “be trained” by the military controllers. Consequently, if there was a mission supervisor at the Control Tower and there was no other civil traffic, they were exclusively in charge of giving instructions to the fighters.

The situation in several Greek islands of the Aegean is a bit hybrid, as airports operate quick response alert readiness of stationed fighter planes, as well as host numerous flights for visitors and tourists. Military controllers work in the same
control room as the civil aviation controllers and summer schedule prioritize civil aviation flights, with fighter planes in-between commercial departures. Training is conducted in different aviation schools and only informal on the job training is realistic from a military controller to a civilian one. When the airport participates in national or international drills there is an additional high rank pilot in the Control Tower that serves a mission supervisor. Thus, the whole setting in the Tower changes in military-civilian co-working environment. AIP15 goes on to describe her experience in Thira’s aerodrome:

> I was one of the controllers who was fascinated by the fighters and had the interest of studying their manuals; however I was not supposed or authorized at any time to speak to the military superiors about their way managing the military traffic. The only case that I could speak up was when there was other civil traffic in order to make sure there was enough separation between the fighters and the civil aircraft. If I believed that the minimum separation between military and civil traffic would be reduced I made a coordination with the military supervisor so as to prevent any possible incident. In every other case, I have to admit that it was by all means a matter of rank and authority that we could not have an opinion or responsibility of whatever happened.

AIP15 is an enthusiastic controller fascinated by aviation and its elite part, the Air Force. The nature of Greek geography and border line with thousand of islands in the Aegean with a dense network of airports and military bases has elevated the
HAF forces in the mind spirit of laypeople and aviation professionals in Greece. In the co-working experience that AIP15 mentions, her major goal was to ensure that the civil aviation routes are not mixed with fighter jets’ routes. Safety and the promotion of local economic activities require keeping these flight routes separated and the aircrafts intact\(^43\). Even smaller incidents (before escalating further) need to be avoided as they affect the sense of security which is part of economic and tourism climate. And it is not an issue of managerial authority but of distinguished professional responsibilities. Coordination was feasible as both parts apply public policies in aviation.

Established conditions of co-working for civil and military flights generate a division of labor and job descriptions that define rank and authority in rigid terms. Separation in flight routes, missions, and service in the air demanded a separation in the air traffic control duties for military and civil flights. Although, AIP15 could sound more idealistic in the first part and her enthusiasm for the appeal of fighter aviation is there, she is clear about the different layers of responsibility. You can speak up for your own (civilian) traffic but cannot be involved in military missions. Consequently, it sounded contradictory in the start but it is a different assessment of authorization and ranking in compare to the pilot- co-pilot hierarchy.

The pilot-controller communication loop mentioned earlier in this section connects communication theory with human factors through a correction-

\(^{43}\) Vertical and horizontal flight separation standards are laid down by national authorities to facilitate the safe navigation of aircraft in controlled airspace. Observance of these standards ensures safe separation from the ground, from other aircraft and from protected airspace. National separation standards are based on the provisions of ICAO Doc 4444 (Procedures for Air Traffic Management), especially Chapter 5. Differences from these standards (if any) are published in national aeronautical information publications (extract coming from http://www.skybrary.aero/index.php/Separation_Standards).
confirmation process. Personal bias or error is introduced in the pilot-controller communication loop. Crew resource management approaches emphasize the relevance of the context and expectation in every communication occurrence. And expectation may have an impact to the effectiveness of communication with a positive or a negative bias; the decision whether to remain silent or not has to do with the concept of missed clearance in the message and the question of authority evolved in a restrictive conflict insight the flight deck. The narrative that was the result of conversation with AIP15 identified the concept of preparedness for the unexpected, for the non-routine use of the specific airport in an alternative runaway.

Also, although the controller is not expected to know the situation beyond what is communicated and what is indicated in the screens, AIP15 went beyond the highly mediated environment in the Control Tower and activated the direct visual channel that positions the aircraft in the physical space of the runaway and not just in a screen. The controller has more resources to administer and has to be able to instruct beyond the daily repetitions, as local situated knowledge is involved for the specific location. An expectation error occurred when the cockpit members thought that they heard the clearance, each one differently. Still their communication has a repair attempt by apologizing, as a gesture of professional courtesy, although a report was filed. Lastly, the co-pilot felt he should not challenge the authority and experience of the pilot, recognizing a corporate practice and the potential of a trainee-level humiliation for a different opinion is posed.
Since the potential risk of error was more than a probability in this flight case, we need to have in mind the assumption of local rationality; experts even so as practitioners typically do what is reasonable to them according to their understanding of the circumstances (Woods & Cook, 1999). Only what was is communicated or not communicated can show their understanding of the circumstances.

4.5 Pilot Silences from Fighter Pilots Point of View

In this section the same silence scenario is posed to fighter pilots with experiences in attach and fighter planes, as well as helicopters. Since fighter pilots in Greece conduct their duty in the Air Force and Army aviation (the Navy is using reconnaissance planes and helicopters, and firefighting aircrafts operate through the Air Force) and they work in pairs and then in larger groups closely together their responses include specific cultural references for their respective sub-cultures. Silence occurs inside their cockpits in two seat aircrafts or as members of helicopters crews their communicative behavior resembles to interaction between “the father senior pilot and the son trained pilot”, an association they develop since their early years of study and evolves towards their years of seniority. Several studies (Triandis & Suh, 2002; Ashman & Telfer, 1983; Reinhardt, 1970; Fry & Reinhardt, 1969; Retzlaff & Gibertini, 1987) have investigated the high need for achievement, as a motivator for fighter pilots, connected it with the variable of
dominance and the military value system with adoptive traits due to the nature of their missions.

The sense of mutuality, the value of respect, the exercise of leadership, as well as the peculiarity of the Army (with norms of conventionalism and abasement) in compare to the Air Force (with norms of deference and succorance) are cultural determinants and motivating components of how they conduct their flights with their senior officers in the same aircraft, in dyads or quadruplets. In the sections below, fighter pilots explain mutual silence and mentoring with the senior instructor (4.5.1), the leadership and airmanship culture (4.5.2), the dialogic communication in checklist marking and the stance towards authoritative passengers and officers.

4.5.1 Instructor knows better, Mutual Silence, Mentoring

A fighter pilot at the rank of colonel of Hellenic Air Force, namely AIP1, offers additional insights from the point of view of Air Force flight missions (with A-7 squadrons44 and NATO Reconnaissance in AWACS45 aircrafts). He believes that Air Force works because of the groups of people that are calibrated in sophisticated team work after intense training. AIP1 goes back to his early years in

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44 A-7E Corsairs were the attack planes used (among others) by the US Navy in the Desert Storm campaign against Iraq on 1991 (details available at http://www.defensemedianetwork.com/stories/gulf-war-20th-desert-storm-was-an-heroic-moment-for-a-7e-corsair-ii/). Then Hellenic Air Force has used them in three combat wings in Greece. When I was serving my duty in 115CW A-7s were the stationed in three squadrons there.

45 AWACs acronym stands for Airborne Warning and Control System aircrafts are modified Boeing 707s airliners used to locate other aircrafts, while being airborne and adjust to reconnaissance conditions. The E-3AWACS Component is NATO's first integrated, multi-national flying unit, providing rapid deployability, airborne surveillance, command, control and communication for NATO operations (more at http://www.e3a.nato.int/ and at http://www.boeing.com/boeing/history/boeing/airborne.page). They operate for NATO in Germany, Italy, Greece n Turkey and their multi-national crew comes from 17 NATO countries.
fighter planes when pilots are attached to their flight instructors, with a catalytic instructor-trainee relation that is embedded in a deep hierarchical structure.

AIP1 discuss his recollections commenting on the silence scenario. The description is about a common training mission in which the trainee pilot has the first experience of touch-and-go missions several times in the same day in a two-seat training aircraft\textsuperscript{46}. It is a supervised flight that emphasizes the pre-flight briefing and tactical design of the mission taking special care for the fuel configuration and familiarization with as many airports as possible. Souda Bay in Crete is an important destination for these flights; it hosts the 115 Combat Wing of HAF with two fighter squadrons of F-16s aircrafts, the US Naval Support Activity in Greece\textsuperscript{47} with reconnaissance planes RC-135s among others installations and a civil aviation airport.

He begins by setting the flight context of a training flight that started as a routine mission:

In a T-2 flight the mission was to fly from Kalamata to Souda Bay with a touchdown and then immediate take-off to return to Kalamata. The plane was equipped with a TACAN\textsuperscript{48} beacon-transponder which could project a

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\textsuperscript{46} T-2C Buckeye jet trainer aircraft was produced for the U.S. Navy by North American at Columbus, Ohio. T-2C trainers were used by the Naval Air Training Command to conduct basic jet flight training for future Navy and Marine Corps aviators. The trainer established an outstanding record of safety and reliability while providing training for more than 11,000 students to pilot 18 different models of Navy jet aircraft. Buckeyes also were purchased by Venezuela (T-2D) and Greece (T-2E). Data available from Boeing at http://www.boeing.com/boeing/history/bna/t2.page

\textsuperscript{47} 115 Combat Wing of HAF is described at a http://www.haf.gr/en/structure/units/ata/units/115pm.asp and US NSA Souda Bay in Crete at http://www.militaryinstallations.dod.mil/pls/psgprod/?p=132:CONTENT.0::NO::P4_INST_ID,P4_INST_TYP E:6095,INSTALLATION

\textsuperscript{48} TACAN, stands for tactical air navigation, is a polar-coordinate type radio air-navigation system that provides an aircrew with distance information, from distance measuring equipment (DME), and bearing (azimuth) information (at http://www.globalsecurity.org/military/library/policy/ navy/nrtc/14090_ch2.pdf).
measurement of forty-degree azimuth\textsuperscript{49} error lock-on. Due to the nature of the TACAN signal, it is possible for the TACAN azimuth to lock on in multiple times the 40° from the true bearing with no warning flag appearing. The pilot should crosscheck other navigation aids available to verify TACAN azimuth. The weather was cloudy with low visibility from 16,000 feet till the absolute low altitude. We have executed approach and descent with full TACAN, with no visibility towards the runaway or the mountain in the southern part of the airport, in IFR\textsuperscript{50} conditions, and without cross-referencing the TACAN indicators.

One of the first training flights for the young HAF lieutenants in Greece is the flights from Kalamata where they start having their professional flight practice, before being assigned to fighter squadrons and choose their fighter type. In these missions a flight to Souda Bay where the world-leading US Air Force is stationed in Greece is of an increased mental load for the new-coming pilots as they imagine it as showcasing. T-2 is a standard aircraft for such training and the use of TACAN transponder is a navigational tool appropriate for initial pilot or initial pilot

\textsuperscript{49}Azimuth in this case is the horizontal direction expressed as the angular distance between the direction of a fixed point (as the observer's heading in the flight route) and the direction of the object (on the airport ground, when other concrete fixed points like mountains are around). Data from \url{http://www.airforce.com/PDOP/}. So, azimuth (Az) is the angle measured along the horizon from North. With North being 0 degrees, East would be 90 degrees, South 180 degrees, West 270 degrees and finally North could again be described as 360 degrees (extracted from \url{http://www.planetary.org/blogs/guest-blogs/jason-davis/3450.html}). When there is radar fixed point on the ground then erroneous indication is possible.

\textsuperscript{50}Instrument flight rules (IFR) and visual flight rules (VFR) are one of two sets of regulations governing civil aviation aircraft operations; Federal Aviation Regulations (FAR) defines IFR as: “Rules and regulations established by the FAA to govern flight under conditions in which flight by outside visual reference is not safe. IFR flight depends upon flying by reference to instruments in the flight deck, and navigation is accomplished by reference to electronic signals.” Visual flight rules (VFR) are a set of regulations under which a pilot operates an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going. It is also referred to as, “a term used by pilots and controllers to indicate the type of flight plan an aircraft is flying,” such as an IFR or VFR flight plan (data from \url{http://shebleaviation.com/study-materials/FAA-H-8083-15A-Instrument-Flying-Handbook.pdf}).
orientation; it is an effective position locator when it receives a point of reference from the ground. But low visibility, the mountain, and lack of confidence to instrument indicators led the flight out of the routine. AIP1 goes on to reveal his seemingly reasonable uncertainty:

While descending there was no communication between myself and my instructing officer, as I wanted to follow the required process religiously, being anxious as to whether the indications were correct or not (without being cross-checked). I wished we would ask for a full TACAN-Ground Control Approach, having the support and instructions of a ground radar. I did not say a word as I thought that my instructor knows better and I focused on implementing the descending process; in my mind I was too young, just out of the Air Force Academy, how could I know it all?

It was a series of touch-and-gos (consecutive lands and take-offs) and silence was important for AIP1 to keep his concentration and follow the descending steps thinking of a training combat mission scenario where communication is muted/sterilized for the period “combat in- combat out” (descending-touchdown and then take off and stabilize position). TACAN operates with two reference points and they were missing a clear view from the ground. He started a “what if” inquiry which conflicted in his mind with the relation of instructor-trainee which is close to father-son relation in the Air Force; “you don’t question your ‘father’ in his instructions,” AIP1 said in our conversation. In HAF’s practice senior instructors assume responsibility for and stay with a small group of junior pilots,
for certain periods; in this sense a strong affiliation is created as if they were taking private classes. He goes on to describe communication interaction with his pilot instructor:

But when entering to the second phase for the go-around I decided to ask my instructing officer: how do you know that there is no false or erroneous information to the navigation display equipment? With a voice full of relief he replied that he had exactly the same strain in mind, because of the way we decided to descend but he did not want to admit it to me. I took my lesson and since then and for the past twenty-five years of my Air Force duties I have always been talking through for any doubt I had, when according to my judgment, the safety of the flight mission was at stake. My choice has been, primarily, with the criterion of flight safety and in a secondary manner the potential consequences in my career path.

The fact that they have completed one descend (successfully but with uncertain minds) and they were going to repeat encouraged him to pose the troubling navigation question. TACAN navigation needed point A in the aircraft and point G on the ground. What was different here, for AIP1, was that the instructor pilot had exactly the same doubt in the conditions they were flying. He was more authoritative by position but, being in the Air Force (unlike what is customary in the Army and less in the Navy), was also able to adjust and be more productive in his training, gaining also the respect needed from the trainee; a mistake admitted and repaired is a lesson learned. AIP1 went on with his flying instinct and made a
lifetime decision to speak up when his critical ability drives him to reach safety which is non-negotiable.

The TACAN radio facility in this usage created a feeling of blindness for the two pilots, as they did not have an instrument to compare flight indicators with actual position locators on the ground. Military discipline and protocol, as well as the strong feeling of “flight instructor that knows all” that is embedded in Air Force culture prevented the trainee pilot to voice a question. Immediately after, since this mission has several phases with the “touch-and-gos” AIP1 had the eager question that his training forces him to pose; a repeated practice in Air Force missions learned from the first years of the flights school is that you need to ask as many questions as possible during the pre-flight briefing or even during the flight with the flight instructor.

The first descend was “voiceless” as an application of the sterile cockpit rule explained from "combat entry" to "combat exit", as explained in the introduction (Chapter 1, section 1.3). But the inclination to resolve the doubt triggers the survival instinct that pilots develop via real-life mission training\(^{51}\) out of simulators. The reply was enlightening as the instructor pilot opened up to confirm the doubts, as his own. AIP1 has identified a case of mutual silence in communicative behavior in the same scenario. It relates to the cognitive bias of an implicit personality theory, in which a trainee co-pilot’s followship is attached to the instructor pilot who has the leadership and the experience which make him

\(^{51}\) Expressing the thoughts for that question resembles the use of verbal language as triggering instincts to solve “evolutionary significant problems”, in Pinker’s approach of the language instinct (1994).
untouchable, especially since we speak about military aviation that starts with a boot camp mentality (Eden, 1992).

In AIP1’s narrative, it is evident that the flight had a detailed briefing preparation from the trainee pilot, where as the instructing officer may have considered it a routine flight, in a familiar destination. Military chain of command was a restricting factor for their communication, especially because the trainee pilot was just out of the Air Force Academy with the mindset of connecting the commanding officer with authentic knowledge. The Air Force culture, especially in flying personnel, is adjustable to a more flexible code of not “who says” but “what you say”. That is a bypassing route that enforces trust in the chain of command, sometimes more efficiently than mere ranking.

I had the same experience as an airman and then a petty officer-programmer in my service both in the Greek Pentagon (with brigadier generals and higher ranks) and in Air Force Bases (with active fighter pilots). In a retrospective evaluation, I could agree with the numerous discussions I had with different commanding officers of mine when I asked them to comment on what is different in the Air Force. They claimed two reasons; pilots value each single day, because it might be their last and the sophisticated mix of pilot-aircraft union helps them to understand human complexity and the complexity of the real world.

On the other hand the instructing pilot had the primacy effect of “just another training flight to Souda” with the self-serving bias of controlling the situation. Even when doubt came in his mind the attribution of control and
hierarchy did not allow him to communicate symmetrically with the trainee. The resolution came when the question posed confirmed the realistic nature of the situation. As AIP1 explained in my probing question, the instructor’s acceptance of the doubt and risk and his recognition of a flaw in the flight design during the debriefing phase of the mission (upon their return), reinforced the instructor-trainee relation into a mentoring relationship in the years to follow (Ragins & Kram, 2007). Furthermore, the situation was a very good reminder of how relevant their safety training was and that established a paradigm in his future behavior; safety is first, both for the personnel, the plane and the mission.

AIP1 reply was about intra-cockpit communication in a two-seat fighter plane. In order to control his reply, I posed the question of silence from the point of view of military controllers and whether they tend/want to speak up or not. AIP1 pointed out another hybrid case differentiating from previous responders. In HAF missions there is an air traffic controller and a Tower Supervisor who is a higher rank experienced pilot. The controller is dealing with the basic air traffic control and the supervisor is there just in case an incident occurs to facilitate approaches, take-off and landings but with no authorization to intervene expect for the cases that he is asked for mission assistance from the fighter planes that are airborne.

The Tower Supervisor is not a substituting pilot and still responsibility lies on the actual flying pilot who needs to take the final decision, as also Kochan (2009) has emphasized for the pilot as decision-maker. Despite these strict divisions of roles, AIP1 recalls interventions in traffic management issues from
higher ranking officers that were functioning as supervisors, using the military hierarchical power and not the actual position description\textsuperscript{52}. This supervisory position rotates in each squadron and contributes to an increased mission awareness and effective briefings: the today’s supervisor is the tomorrow’s mission chief and vice versa.

4.5.2 Safety Culture, Trust, Situation Awareness and Leadership

The last responses discussed in this chapter covers the responses of two other fighter pilots that offer a more institutionalized point of view of silence due to their extensive experience in international missions (for the first case) and fighting helicopters (for the second case). Posing the same scenario regarding silence the two pilots were able to recall latent voice episodes (Bienefeld & Grote, 2012), i.e. ambiguous situations in which as crew members had felt that speaking up was necessary for flight safety and how they have seen that evolving during their career. As they have been serving as Chief Training Officers and Squadron Commander they have been in both in upward and downward voiced communication directed to lower or higher level of hierarchy, respectively.

In this fourth discussion, conversation takes place with \textit{AIP2}, a HAF fighter pilot at the rank of Brigadier General with twenty years of operational experience

\textsuperscript{52} Similar events were projected in the “Silence in the Air” (Anosis SA, 2000) series of the Greek national TV channel “Mega TV” were mentioned in footnote \#14. The stereotypical scenes were describing interventions in the work of female controllers or engineers. The series was another example of the strong affinity that Greek society feels with their aviators that defend the Greek FIR, and how their Air force routine governs everything else in their life.
on board of T-2s, A-7s, and Mirage 2000-5\textsuperscript{53}, which are considered the elite unit of HAF. AIP2’s approach on silence is stated below. What is different here? The conceptual understanding of human behavior in a certain organization setting which encourages collective orientation:

In my opinion this is not an issue for the crews and not an issue driven by the particular human behavior. This is an issue solely driven by the safety culture level of the organization itself. At low levels, (i.e. pathological and reactive) the lack of trust among professionals on the possible consequences of their actions encourages the ‘not speak up’ behavior. At higher levels (i.e. calculative, proactive and generative) of safety culture the increasing trust encourages communication and a ‘good’ CRM behavior. As a fighter pilot for more than 25 years, I found myself in all different organizational safety culture levels and therefore I also found myself in all different behaviors (i.e. hiding, fear, not speaking up, speak up).

AIP2 speaks about organizational safety as a cultivation process which advances with the experience of events and the training patterns, from a low level that is apathetic to a higher level which is constructive. His personal path went through similar evolution while he was adding flying experience and theoretical foundation in different schools. The perceived behavior generates a ladder of confidence over time (and with service) which is compatible with trust and covers the states from hiding till the tendency to speak up. What is he suggesting to accomplish that?

One solution could be to lead by example and this lead approach should be a top-bottom approach. The experienced aviation professionals should be the first ones that report their slips, lapses or mistakes experienced during their execution of their duties and then they should ask from younger professional to follow up with their own perceptions about their human performance. This will promote over time trust, airmanship, higher safety culture levels and a speak-up policy. This is his second contribution to suggest an effective strategy to break silence barriers with the confidence to speak up; leadership by example. The leading aviator knows how to learn from his mistakes and the mistakes of others by reporting his own first. AIP2 makes two important points: (i) institutional commitment to encourage speaking for safety and (ii) the quality of leadership which may expedite the movement to the ladder of speaking with a trusting atmosphere.

AIP2 with taking an educational, managerial, and organizational point of view emphasizes the collective orientation of group work that cultivates behavior beyond the individual. He takes the incidents of silence as symptoms that derive from deeper causes, not just the particularities of attitudes of different individuals in the aviation vocation. Safety culture is the goal but not a static one, as it develops and evolves with time, with training, when incidents or accidents occur, and with interpersonal and organizational trust. Two are the key factors in his analysis to prevent silence from happening: safety culture as explained and
imposed by effective crew resource management, as a form of organizational communication, and leadership in taking the example from top to bottom.

Fighter pilot culture in HAF was formulated in the past thirty years with the daily real-life training in interceptions over the Aegean Sea, NATO tactical schools and missions, the relevant accomplishments in drills and international flight schools, the paradigm of self-improvement in international standards, and the application of meritocracy in their selection process. Apart from that, their presence in the Greek periphery outside the main cities has sculpted ties with the everyday Greeks who approach fighter pilots as defenders which provide in national security and territorial integrity, including the Greek Exclusive Economic Zones. These are perceived ingredients of a micro-culture as a subset of the broader military culture which has historical roots since Greek antiquity. This aspect of culture communicates respect and pride to the insiders and the outsiders. It is a concept necessary in order to explain group and organizational communication in AIP2’s terms.

Culture is crucial in communication theory, as it is infused in contemporary analyses on all academic levels, including the Air Force Academy (Jandt, 2004). This type of connection coupled with social factors has created an elite culture, in a positive manner of higher skills and commitment to duty with acceptance of a life-risk as if it was an ordinary attribute. HAF’ fighting personnel (and their mechanics) has gained this status after several pilot sacrifices on duty and captivated the admiration of the people (Tsolakis, 2013; p. 202-204, 274-275). Despite the elite characters in HAF’s culture, when one speaks with pilots they don’t account and do not project themselves for a superior culture relative to other sub-cultures (Berry et al, 1992). The modesty that pilots manifest in their routine life and contacts with the lay person amplifies the public image and pride of their service (as they are not perceived as just professionals).

They know their differences but they value their everyday interaction with others and also retain homophily ties among their colleagues from the same year in Air Force Academy and the same training squadron. Being in Air Force Academy together, assigned to the same squadron together, service in the same combat wing together, standing by in readiness together, short-term stationed in another base together, fly in dyads or quadruples together or fly in a two-seat aircraft are landmark events in the life of pilots in HAF.

Secondary, but collaborative, experiences are the flights with ground engineers (who oversee the aircraft) together and with controllers (who oversee navigation with them). In all these stages, the use of pronoun “we” might sound
unstructured during the years in HAF Academy but is enacted with the sense of “we-ness” (Handelman, 1990; Sturken, 1998; Turner, 1969; p. 96) and a conception of community (Bruhn, 2005; p. 29-30, 118-120).

Both pilots and controllers cope with flights and crisis together, in the phases mentioned above. It is a lifetime bonding, as fighter pilots responders, confirm in our discussions. When pilots change “mates” or partners in one of the above phases it takes them some time to adjust in the new sub-culture; although it is part of their pre-defined career path that type of bonding is recreated.

Culture consists of relatively specialized practices and elements of a lifestyle or professional lifeworld that are passed through communication (and not biologically) from one generation to another. Hofstede (1980; 2009; Hofstede & Hofstede, 2005) spoke about a collective programming of mind for thinking, feeling and acting; Hofstede proceeds to analyze culture at an organizational level when he introduced the dimensions of culture\textsuperscript{55} that are evident in groupwork where sub-cultures exist: power distance (to explain perceptions of authority), individual and collective orientation (towards the teamwork needed for any flight mission), masculinity (that may explain gender differences in aviation industry), uncertainty avoidance (that may explain lack of decision making), long-term orientation (that may explain actions without situation awareness), and indulgence

\textsuperscript{55} At an organizational level Hofstede’s dimensions are broken down to means-oriented vs. goal-oriented, internally driven vs. externally driven, easygoing work discipline vs. strict work discipline, local vs. professional, open system vs. closed system, employee-oriented vs. work-oriented, degree of acceptance of leadership style, degree of identification with your organization. Hofstede’s theory and applications are further explained at the senior’s site at http://geert-hofstede.com/organisational-culture-dimensions.html.
or restraint (that may explain the human drives of airmanship and the sense of freedom in the air).

Based on its institutional configuration, HAF as an Air Force is a knowledge-centric organization which applies managerial patterns, interpersonal ties and knowledge exchanges of the most effective organizations. Taking the aviation professionals as an organizational category (Merrin, 1996), several subcultures exists in a form similar to communities of practice for air traffic controllers, pilots and crew members, and micro-cultures develop for fighter pilots and personnel of military aviation. In Wegner’s et al (2002) analysis, communities of practice are groups of people like the above who share an interest or a passion (aviation is a passion for aviation professionals, as almost all responders stated) for something they do (their part in flights) and learn how to do it better (understand the role and challenges of the other in the flight) as they interact regularly (even outside the conventional work schedule). Lesser and Storck (2001) describe a community of practice as a social entity with, informally bounded members, who share and learn, based on common interests through their mutual engagement.

Furthermore, this entity develops a social learning engine which enables the members to collaborate, share ideas, find solutions, enrich their tacit knowledge and create adaptive solutions, like heuristics. Previous studies on managerial aspects of communities of practice support them as a dynamic communication

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56 A typical example of the immediacy and efficiency of HAF (despite the economic crisis period) was the accomplished coordination and precision accomplished in the recent national drill “Iniohos 2014”, functioning with the “hot seat” principle for a fighter jet to land, refueled, reequipped and take-off again during the 4 days of the most competitive aerial drill in Europe. Another 800 fighter jet take-offs (day and night) were reported for HAF (at http://www.haf.gr/el/news.asp?id=8703).
resource, which operates beyond typical frontiers, based on internal mechanisms of communication but also based on leadership and trust (Loyerta & Rivera, 2008; Roberts, 2006; Chalmers & Keown, 2006). The shared practice of constant improvement and learning the flight generates the norms in the sub-cultures of this community.

These micro-cultures are bounded by the rules, routines, behaviors and attitudes, as cultures within cultures (Hayward, 1997). Safety culture that AIP2 states is one of those “cultures within the culture” and is inextricably linked with the organizational culture at an occupational or operational level. Safety Culture⁵⁷ (in this case micro-culture for fighter pilots or controllers) is the way safety is perceived, valued and prioritized in an organization. Organizational, occupational, and (very often) national cultures are positive, negative or neutral determinants of a certain safety culture. Its collective orientation in underlined with the inquiry "how does this organization/group behave when no one is watching?" Safety regulations are implemented successfully when a “just culture” reporting environment within aviation organizations, regulators and investigation authorities is attained. Operating in just culture conditions means that individuals do not take a blame for “honest errors”, but are held accountable for deliberate violations and punish gross negligence. The resultant effective reporting culture depends on how those organizations handle blame and punishment and the gravity they attribute to human

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error (a mistake), at risk behavior (a chance of harm to occur), and reckless behavior (an action that knowingly puts themselves or others in harm).

As safety culture aims to locate erroneous situations where ever they happen, it is communicated via CRM, starting from the cockpit and to the crew, as explained in the start of this chapter. CRM is a process of enculturation, using all available resources for flight crew personnel to assure efficient operation, error reduction and stress avoidance. CRM was developed in light of the new insights from aircraft accidents after the introduction of flight data recorders and cockpit voice recorders into modern jet aircrafts; information gathered has suggested that technical malfunctions, failures of aircraft handling skills or a lack of technical knowledge were only part of the causes. But, the inability of crews to respond appropriately to the situation in which they find themselves was another important parameter. That means than human fallibility is recognized and routine errors are not punished but used for a systemic review of the flight operation in the organization (Leveson, 2012; Loukopoulos et al, 2009). In such an environment the organizational response via CPM is to reduce the likelihood of error, to trap error before it affects operations, and to mitigate its consequences when error really occurs.

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58 Flight Data Recorder (FDR) - device used to record specific aircraft performance parameters. The purpose of an FDR system is to collect and record data from a variety of airplane sensors onto a medium designed to survive an accident (ICAO Annex 6 “Operation of Aircraft”, Vol. I).

59 Cockpit Voice Recorder (CVR) - a device used to record the audio environment in the flight deck for accidents and incident investigation purposes. The CVR records and stores the audio signals of the microphones and earphones of the pilots’ headsets and of an area microphone installed in the cockpit (ICAO Annex 6 “Operation of Aircraft”, Vol I.)
We now finally continue to the social point about leadership. AIP2’s recipe is to cultivate responsive leadership, especially because he speaks from the inside of the Air Force. In organizational communication it is accepted that you cannot lead with your feet on the desk (Fuller, 2011). Leadership emerges as the process of influencing behaviors and establishing directions to be followed, on the one hand, and empowering others, on the other hand. The leader should listen effectively and encourage the others to speak and overcome their silence (Johnson & Bechler, 1998). Knowledge, approachability and dependability are substantial traits of leadership and start from reporting your own slips or mistakes (Hackman & Johnson, 1991).

AIP2 states that trust (like respect) relies on mutual give-and-take (Fuller, 2011). The leader has the ultimate responsibility for forming a strong bond of trust with the younger professionals to inspire them to “follow up their own perception about their human performance,” as AIP2 emphasizes from his vast experience in active (not desk) leadership roles in HAF. Controlling the natural fear of flying and building confidence is a self-assessment process for younger fighter pilots (and not only). They evaluate their own performance through the constant mission training in dyads, in two-seat fighters, in quadruplets and in flight simulators/emulators when they change their flight status. In most cases this self-assessment process is conducted during the readiness phases (for day or night missions) and while on board the cockpit for a quick response alert for five minutes; both cases are usually repeated every day and every week and fighter pilots are thinking aloud with
themselves. Each mission has rigorous briefing and de-briefing and posts a major objective and alternative goals (to pursue when the main objective is unreachable), during the tactical design and preparation.

In further discussion, when the question is reversed about his personal experience to speak up in his own roles, AIP2 is quite consistent in his narrative:

I preferred silence only when I did not have Situational Awareness (SA).

The rule of thumb is: The one who has the SA is the one he finally speaks and makes the decision. The others follow the command. In general terms the one that has SA has the authority whatever the rank.

The flying conditions in HAF missions where being airborne is the typical case, unlike other Air Forces which fly mostly in international missions, are intense and multiple inputs are present in every mission. The coordination of these multiple stimuli determines the perceived definition of the situation while flying, in a dynamic way. The ones who acquires the situation and connects it with the tactical design and the coming actions of the near future during the mission is the one who speaks, if even he is not the first in rank at any specific moment. In the next moment the message is relayed and observed using the mission command and the broader chain of command.

In any flight formation, cohesion is sustained in order to fulfill the mission goals successfully. When probing for this question, I have asked AIP2 to remember incidents from his long experience in interceptions and dogfights against Turkish
fighter planes flying over the Aegean Sea.\textsuperscript{60} It is quite striking that he confirms that situation awareness was the key issue even when quadruplets or double quadruplets were in defensive missions. These formations had to follow their readiness briefing and the burst of communication with intra-formation signals and real-time transmissions from National HAF Operation Center: the pilot who has the best grasp of the current situation is speaking up and the others follow.

The next step is to apply the rules of engagement which are a responsibility of the mission chief, as is a matter of judgment, decision-making and compliance. For AIP2, “SA-first” sentence was a feed-forward in his briefings and a closing statement in his debriefing and an ethical responsibility to be a responsive leader that empowers others, even in such an operational environment where rank has to comply with operational competence (Bennis & Nanus, 2003). This is the airmanship culture, as AIP2 puts it.

\textbf{4.5.3 Conducting Checklists, Morals, VIPs, Arbitrary Non-Reporting}

The closing report concerns a pilot of Hellenic Army Aviation at a rank of a Colonel, namely \textit{AIP6}. He is specialized in Chinook\textsuperscript{61} helicopters and serves with close

\footnotesize{\textsuperscript{60} The Hellenic National Defense General Staff is monitoring all violations of National Airspace & Infringements of Air Traffic Regulations (ICAO) inside Athens FIR. All violating aircrafts are identified and intercepted according to the relevant rules and procedures of international law. The listing is publicly available at \url{http://www.geetha.mil.gr/index.asp?a_id=2779}. A detailed explanation of one of these cases that escalated to a crisis is analyzed in Katerinakis, T. Drexel Graduate Portfolio (2009), regarding the Imia crisis available in Drexel Hagerty Library at \url{https://idea.library.drexel.edu/handle/1860/3297}. In 2013, during the national military drill “Parthenon” HAF has implemented 800 take-offs in a day over the Aegean Sea.

\textsuperscript{61} The Chinook is a multi-mission, heavy-lift transport helicopter further explained from Boeing at \url{http://www.boeing.com/boeing/rotorcraft/military/ch47d/}}
cooperation with Apache attack helicopters. He experienced a chain of command established without flexibility, a tradition of hierarchical organization and ethos that goes back to ancient historical warfare of the epic works of Homer, Thucydides, Xenophon and others, as described in Pressfield (2011; p.12-15) and Rich (1995; p. 45-48).

When transferred to helicopters he found it revitalizing being always on the run, with multiple readiness alert missions, both for the military and civilian purposes like distinguished guest transport or search and rescue flights. In the most common current operational formation, Chinooks fly with three (pilot and co-pilot and one flight engineer) or five crew members (pilot and co-pilot, two flight engineers and a crew chief). Also, they need to adhere to generic air traffic control and to the command control of the Army Aviation that is separate from the Air Force’s air traffic control. When the silence scenario is set for discussion, AIP6 had four different real stories to share:

There were times, as a young UH-1H helicopter co-pilot, when I was trying to read the checklist steps and the “full of confidence” pilot in command, was completing all procedures by memory. Sometimes, I tried to remind him of something he has failed to check, he answered with arrogance ("I already checked it"-though it had not been checked). Such situations, lead me into silence or at best to reluctance.

What is the point he is making for team work here? AIP6 as a young second pilot was following the procedural steps by the book, in order to facilitate the pilot-in-

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62 The multi-mission AH-64D Apache Longbow helicopter is the next-generation version of original AH-64A Apache further explained from Boeing at http://www.boeing.com/boeing/rotorcraft/military/ah64d/.
command and have a point of reference for the standard procedures and for the
airworthiness of the helicopter. If a checklist entry is not really operating (and for
that reason checked) then the crew needs to evaluate the condition with
predetermined criteria about what is not working. The pilot-in-command had
already constructed a routine in his mind to check the listed indicators and controls
by heart.

As AIP6 was a member of the same crew in multiple missions (that was the
quantifier “sometimes”) he noticed the deviation; items that the pilot missed from
his memory, so check marks that were not representing the observed condition.
Then as he wanted to avoid an incomplete checklist and the phenomenon of false
memory for the pilot-in-command he pointed out the missed entries. The pilot did
not want to admit it and adjust in the next mission but posed the arrogant remark “I
have checked it” knowing that it was not truthful as AIP6 was monitoring the list.
“If I have the right with me and speak up, I expect at least a reservation from the
pilot, but not a definite negation of reality. So, do I insist?” AIP6 was thinking
aloud when I moved the conversation on. That was a motivation pushback for the
young officer who wanted to cooperate effectively in that crew.

Following the checklist is a default standard operating procedure that is
expected in any flight; it is the foundation of pilot standardization and cockpit
safety (Degani & Wiener, 1993). Also, checklists are a major defense mechanism
against equipment failure and pilot error but have cognitive limitations when
checklist responses become automatic and not actually crosschecked as verbal communication instructions (Dismukes et al, 2007; p. 306-307).

The “challenge-verification-response,” mode when the pilot flying configures the aircraft from memory and the co-pilot uses the checklist to verify the accomplished entries breaks automaticity and checking becomes more deliberate (Dismukes & Berman, 2010). Chinnok helicopters have a long serving period of reliability but also a rich history of incidents worldwide and their checklists are well adjusted to project realistic conditions. A “flow-then check process” asks for scanning the cockpit panel in systematic flow, setting and checking each item in turn and then the associated checklist. The flying-pilot who was the pilot in command devolved the checklist to “check only”. This fact increases the importance of not just marking the checklist. On the other hand, flight realities report incidents where confidence is overestimated by experienced pilots who take it in the form of explicit pieces knowledge that if missed can be repaired by the available manuals (Doak & Assimakopoulos, 2010; Loukopoulos et al, 2003).

The so-called arrogant behavior from the experienced pilot maybe a decision to follow tacit knowledge in his memory in compare to the one verbally offered. Reading the checklist and following the checked notes implements an intra-communication mechanism that verifies the situation. It is a sort of a dialogic interaction with repetition and confirmation which facilitates the checklist monitoring; one says or asks the other performs the action and the former checks the mark. The motor movements of the use of hands to touch, or point to
appropriate controls, switches, and displays (from the flying pilot) while conducting the checklist (from the non-flying pilot) is a good practice to avoid interruption gaps in fulfilling the checklists.

From a CRM point the focus is on coordination, social interaction, and combined performance in the flight cockpit crew (Foushee & Helmreich, 1988). Moreover, co-pilot’s reluctance to challenge the flying pilot when conducting checklists is consistent with flight simulator studies conducted to prevent undesired aircraft state (Orasanu et al, 1998). Also, in most cases, the checklist philosophy of use is the outgrowth of the airliner culture in civil aviation and the camaraderie in military aviation; the Army aviation is less tolerant to assertiveness from a junior officer in compare to the Air Force (like in 4.5.1 and 4.5.2 for AIP1 and AIP2, respectively).

The set-up redundancy embedded in the dialogic format of a checklist monitoring streamlines efficiency and supports crew collaboration. The two-layer redundancy includes: (i) the configuration of the aircraft from memory and then verification in the checklist and (ii) pilot-co-pilot monitoring while conducting the checklist procedure (mutual redundancy). Army aviation is not so accustomed in the use of monitoring checklist as a communication tool (but more as a “to do list”) due to the persistent hierarchy, the nature of their equipment and self-sustained warfare. The status difference and the unwillingness to accept what was missing create a safety flaw and discourage the young new pilot, as AIP6 was. When I followed-up in his narrative, he noted that in the following round of personnel
evaluation that pilot was transferred in back-office work covering an administrative position (not only because of such events).

In another instance, AIP6 describes a self-censored occurrence which was self-imposed. The pilot-in-command thinks one way as superior even when the map shows otherwise:

I demonstrated similar reluctance to mention a derogation of the preplanned flight path (tactical flight below 200 feet), as the pilot in command was one of the most experienced in the unit and in accordance with the "morals" of the time he was not seeking the help of his copilot. The result was a wrong track for some miles until I find the "courage" to say the derogation in accordance with what I was reading on the map.

What happened in this event? AIP6 was holding himself not to speak up as he was flying with one of the most experienced pilots in his unit who has the ethos of the speaker, as the higher ranked officer. The informal expected practice was to wait until asked, as a moral obligation in the micro-culture of this unit. As the error was derogation from the flight plan it could affect the operational capacity of the crew members to complete the mission. AIP6 decided to speak up when the diverted route became evident and the factual reality on the map provided no room for other interpretation. The map was the encouraging tool for a confident assertion to speak up.

Army aviation is organized in more inelastic and conventional personnel relations, in which rank has the authenticity of the insignia and no dialectic inquiry
is accepted. This fact creates an informal code of practice for accepted behavior; another micro-culture enacted inside the helicopter cockpit. When the derogation was realized as happening, it was the opportunity for AIP6 to voice his opinion from the map. Again rank superseded reality. In my conversation with AIP6 it seems that he was not attributing the no-talk to the superior officer but to the censorship of self, as it happens in instances of negotiations (Schafer & Crichlow, 2002). The micro-culture of groupthink of their unit (the Army Aviation battalion where the helicopter functions) was perceived that way as a result of in-group pressure (Janis, 1983). Moreover, it seems that this censorship was creating mission doubts even to the pilot-in-command as he was not receiving the cooperation he was expecting from the lower rank co-pilot that was AIP6.

AIP6 was certain as he told me that they discussed the whole incident during the mission de-briefing and the experienced pilot prompted him to speak up earlier rather than later. The pilot-in-command was not asking and AIP6 was not telling, till after the fact.

In another case AIP6 is moving up as a pilot-in-command and is in the position to accommodate everyone to speak up, by having the rank to determine communication flow. But what happens in the VIP mission?

Later, as a more experienced pilot in command of CH-47D, under the pressure of a VIP transfer mission, I did not mention to the landing area ground staff the inadequacy of the field due to dust from the downwash, because of the field was not been prepared wet, as stipulated in the
regulations. The result during landing was a limited brown out conditions experience.

Moving upwards in the rank, AIP6 became the experienced pilot-in-command who seemingly had no reservation from others in the crew. But he had a very important passenger in his VIP transfer mission, in a flight out of his military context. It was a head of state from another country in an official visit in Greece who wanted to visit the territory of Mount Athos close to Thessaloniki area, as AIP6 remembers in our discussion. The extraordinary focus in this flight transformed it to a mission of service and not of operations. The VIP was accompanied by the Chief of Hellenic Army who gave the order for this transportation flight.

So, AIP6 was flying an extraordinary transport mission for which he was paying attention to the service aspect. The landing area in such flights needs a wash-up to facilitate visibility from the dust and create a comfort feeling for the passengers. In helicopter flights, depending on the number and configuration of helixes and the configuration of the landing area, the landing spot is chosen or adjusted to minimize the risk of foreign objects damage from foreign objects debris which is quite common in such cases and is regulated in flight manuals. In this flight, AIP6 found out that the landing field was inadequate not so much for the helicopter but more for the sense of comfort for the passengers. Still they experienced reduced flight visibility due to airborne particles without any other

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63 All major manufacturers issue special reports regarding foreign object debris (FOD) at airports or landing spaces. FOD includes any object found in an inappropriate location that -- as a result of being in that location -- can damage equipment or injure airplane or helicopter and their personnel. Usual recommendations are sweeping and washing, use of magnetic bars, rumble strips and FOD containers. This is an example from the Boeing company at http://www.boeing.com/commercial/aeromagazine/aero_01/textonly/s01txt.html.
consequences at the time, except for a brief comment from the Army Chief who has noticed the light brownout\textsuperscript{64}.

The pressure for time and service due to the “civilian” nature of the flight prohibited AIP6 to speak up although he was the chief pilot; and as he pointed out, in our discussion, he would expect another crew member to provide a reminder but they did not have time for a thorough briefing. Social pressure and the change in the mission standards because of the distinguished visitor made him to remain silent even when he had the full authority and responsibility for the flight. It is a perceived conflict between efficiency/passenger comfort and safety event since a shift from military operations to VIP transfer disturbed his attention (Bienefeld & Grote, 2012).

In his concluding example, AIP6 received silence from his crew in a potential mechanical failure. There is a division of labor among crew members, with special care for in-flight engineering and weaponry use. But each crew member has the obligation to check and report to the pilot flying the helicopter the situation in his area of control. So, what is he adding about silence?

The worst happened when a flight engineer did not report to me, until the end of the flight, a “chip detector” indication on his ramp control panel about a gearbox, because "in his point of view", it was a false indication and he did not want disrupt the mission. In any case, in accordance with the

\textsuperscript{64} NASA’ helicopter brownout research describes helicopter brownout as a dangerous phenomenon when helicopters land in dusty, wet or toxic environment “whereby sand or dust particles become swept up in the rotor outwash and obscure the pilot’s vision of the terrain. This is particularly dangerous because the pilot needs those visual cues from their surroundings in order to make a safe landing.” (Data from http://halfdome.arc.nasa.gov/Research/Programs/brownout.html.)
operator's manual, the pilot in command should be updated instantly on the indication and perform the proper procedure.

As helicopter pilots may fly in a short (often) unscheduled notice for multiple missions beyond their original training, AIP6 has experienced several manifestations of silence, with diverse or mild consequences. This is the worst case as silence had a bad timing and lack of reporting during a flight mission. The flight engineer located an indicator flashing detecting a potential electrical circuitry problem. Instead of reporting it to the pilot he kept to himself to examine it technically but without reporting it arbitrarily.

The most striking for AIP6, as the pilot-in-command, was the flight engineer who assumed the responsibility to decide (with his own point of view) that it was a “false indication”; the flight engineer was withholding substantial information. The flight manual demands intra-cabin real-time communication and more importantly for mechanical issues which may jeopardize the airworthiness of a trusted piece of equipment. It is clear that the engineer realized his mistake (while doing it), as he was anxious to report his decision in the end of the flight during the debriefing phase, as AIP6 noted in our further discussion.

It was an erroneous behavior and action (not to report and to decide on the severity without reporting) synonymous to poor individual performance (of the flight engineer) which could have an impact to the collective operational goals of the mission. Unlike other errors, which are mostly a post hoc social judgment which cannot be defined in advance of happening, the flight engineer distorted the
decision-making process of the pilot-in-command as AIP6 was governing the helicopters based on insufficient information on their situation. In several cases, since military officers cooperate in multiple obligations and missions in pairs or small groups and roles change, there is a potentiality of gunnysacking (Bach & Wyden, 1968); past grievances from one mission may conflict with current grievances for another. Silence in these cases is used to avoid conflict but undermines safety.

Safety is not inherent in any system, neither flights. People have to create safety as they operate a system with multiple purposes; the flight engineer disrupted the dependability bond which holds the crew together (regardless the chain of command). AIP6, commented to me, “how could I fly safely when I know that my crew may know something that he is not telling me?”

In this case, AIP6, did not restricted the crew members to speak up, the flight engineer showed lack of situation awareness at a macro-level (after understanding the conditions, but not projecting the future actions appropriately) by interpreting the elements in the helicopter within a volume of time and space of the mission, applying individual judgment beyond the comprehension of their meaning and the projection of their status in the near future. It was a violation of standard operating which was reported as silence and could be distracting in this case. AIP6 was definite that speaking up should be based on observed reality and SA and not on rank and authority. AIP6 was more concerned about the gap trusting
organizational culture which he was trying to cultivate at a battalion level and at the micro-level of his crew.

His decision was to make it clear on his briefing that he valued the opinion and assertiveness of the crew members; but, the crew has the operational duty to convey the information about what they monitor to the pilot flying who is in command and has the responsibility to take the final decision. AIP6 did not want his crew to feel an unnecessary institutional gatekeeping barrier (rank should not be an open “gate”) which would interfere with their operations, in the original sense of Lewin (1947).

4.6 Summarizing the Chapter of Silence

This chapter presents the multidimensional concept of silence as understood and used from several aviation professionals who discussed their experiences. Experiences regarding silence usually mark their perception or the context of their work and are determinants of their decision-making. This chapter offers a structured approach to look at silence in an applied domain. Different interlocutors, in this study, perceive silence differently in their roles and connect the phenomenon with diverse practices, regulations, incidents and concepts. Respondents comment on silence occurrences on the basis of what they understand to be the case on the “inside of the evolving situation” (Dekker, 2002). Participants in flight situations conduct their flights “as thousands they have flown before, until the moment when thinks start to go wrong” (Dismukes et al, 2007, p.6-7). Even in case of accidents the crews and the controllers could not anticipate the outcome of their flights.
There are several critical phases in cockpit-air traffic controller communication cycle or continuum and silence is part of the interaction. The start is the briefing on the ground, the pre-flight ritual of walking around the aircraft till communicating the banner of “seat belt sign” off, and communicating with intermediate control towers. When approaching the destination, topical awareness is exercised through interaction with co-pilot and air traffic controllers. That means that silence flows in the conversation patterns used during flight communication and has an interactional effect for the work of both pilots and air traffic controllers.

Two flights constructed a system of reference regarding silence for all responders who were on their duty when the accidents occurred. Silence was a latent phenomenon before take-off and in the landmark of the Falcon “VIP flight”, had a deeper content in organizational reporting. Breaking this silence connects with the increasing trend of scapegoating for human error which has consequences in aviation safety. Silence was a dominant phenomenon in the Helios 522 “ghost flight” redefines what it means to communicate in a timely manner, without waiting silent for feedback.

Air traffic controllers brought up a categorization which prioritizes in-flight activities and no-talk periods with distress or emergency situations. But there are also instances when silence is the magic word to keep. Sometimes silence is the result of an informal grapevine micro-culture of humiliation which interferes with safety culture of the airliner.
Moving on to fighter pilots culture and expertise, mutual silence is described with the implicit personality in a relation of closeness and mentoring which may have a downside. Silence could be a result of lack of situation awareness or could also cause incomplete situation awareness. Also, silence could create operational barriers in checklist automation, could challenge the chain of command, or could be a result of a perceived conflict between efficiency/passenger comfort and safety.

Silence is taking turns with interaction in emergency situations to protect the peace of mind necessary to deal with the mission critical environment, human lives and integrity of equipment. Thus, aviators and controllers agree to proceed or take the next turn from a period of silence, in order to receive something that pilots say, something that pilots say or do, or something about how or why they say or do it. That is why silence needs to complement itself with vocal communication. In the next chapter voice succeeds silence.
CHAPTER 5: THE VOICE OF CHOICE

The core communication-related category emerged from the GT approach of Chapter 2, with the labels of silence and voice (section 2.3.3). In this data analysis chapter, voice is explained in its synthetic nature as complementing silence. Voice consolidates hesitation, paralanguage, direct language, and native language codes.

5.1 Organizing the Chapter of Voice

Chapter 5 has a slight different structure in comparison to Chapter 4, as it includes three scenarios regarding the voice category: hesitation in the non-verbal but vocal part, language and familiarity relationship which, then, directs the study to the mother tongue issue. Communication forwards to non-verbal channels with notions manifested in the responders’ replies, introducing paralanguage and hesitation as a means of interaction (section 5.2). Then the Helios 522 flight (from the introduction, in section 1.5.2) is analyzed in terms of non-verbal and verbal communication signals in conjunction with the pair of F-16s that were scrambled, and insights from the accident investigation (section 5.3).

The next section (5.4) uses the hesitation scenario as developed in three parts in section 2.5.2 (captain reports, captain acts, first officer’s comments). Four different responders (two pilots and two controllers) follow with detailed commenting on their communication concepts and attributes (sections 5.4.1, 5.4.2, 5.4.3, 5.4.4).
Then the scenario of language directness and familiarity is introduced, along with relevant communication concepts. The scenario develops in two parts (5.5.1) and the responders argue on both parts (section 5.5.2 with a controller, section 5.5.3 with fighter pilot, and section with 5.5.4 helicopter pilot). In the last part of the chapter (section 5.6) the concept of mother tongue in aviation communication is presented, in the context of language and communication in aviation. Selected responses are presented to show converging topics, with a preliminary analysis only. The concluding remarks (5.7) summarize the major topics and introduce several concepts that extend the current dissertation.

In Chapter 5, like Chapter 4, I selected the responders who were able to connect the scenarios with insights from their personal experiences when doing their job. From the complete list of section 1.4 (Figure 1.3), the subset of participants in this chapter is shown below:

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<tbody>
<tr>
<td>20.</td>
<td>AIP1, Fighter Pilot</td>
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<tr>
<td>21.</td>
<td>AIP6, Helicopter Pilot</td>
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<tr>
<td>22.</td>
<td>AIP7, Fighter Pilot</td>
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<td>23.</td>
<td>AIP9, Civil Aviation Pilot</td>
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<td>24.</td>
<td>AIP10, Civil Aviation Pilot</td>
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<tr>
<td>25.</td>
<td>AIP13, Accident Investigator</td>
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<td>26.</td>
<td>AIP14, ATC</td>
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<td>27.</td>
<td>AIP15, ATC</td>
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<td>28.</td>
<td>AIP23, Fighter Pilot</td>
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<td>29.</td>
<td>AIP24, Civil Aviation pilot</td>
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<tr>
<td>30.</td>
<td>AIP25, Civil Aviation Pilot</td>
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Figure 5.1: Selected Responders for the Scenarios regarding “Voice”

As we can see in the table of Figure 5.1, eleven participants with different profiles and backgrounds (military and civil aviation pilots, controllers, and an accident
investigator) were selected for the depth of their responses. With their interpretations we complete the conceptualization of the transition from silence to vocal messaging, as it happens while respondents exercise their roles. More details for these responders are included in the Appendix E.

Similarly to Chapter 4, Chapter 5 connects the narrative with concepts of communication theory, concepts of occupational and organizational culture, and groupwork, with the respective citations which would be included in the literature review, otherwise. This style matches the discourse analytic approach better, it enriches the contributions of the study, and it extends the philosophy of a GT approach in the flight realities of the participants by putting more emphasis in the original data.

5.2 Communicative Transactions of Paralanguage and Hesitation

This section organizes the background of paralanguage and hesitation in aviation communication as collected by the side informal discussions with the responders of this study, prior their replies to the specific scenarios.

The communicative direction of the current study considers the cockpit (with the co-present controller inside) as the kernel which transmits messages (nontalks are included as silence periods in an integrated flow of interaction). Communications behaviors involve verbal messages, gestures, vocalizations, other vocal expressions and their combinations which develop in packages of micro-structured momentary communicative events, like those observed in aviation where seconds and instances correspond to instrumental time for the flight situation. All
parts of the system of messages work together, similarly to the information richness analyzed in the pioneering psycho-anthropological work of Pitteneger (Pittenger et al, 1960).

Since no visual contact is feasible in the cockpit-controller interaction the use of paralanguage, i.e. the vocal but non-verbal aspect of communication is channeled through the same verbal contacts (Argyle, 1988, p.71-84, 104-120). Therefore, aviation communication uses voice, its sound, echo and surrounding noises to carry verbal and non-verbal signals, not only in real-time but also retrospectively, via the recording conversation and noises (and flight parameters) stored in FDR and CVR recording/indication monitoring devices (explained in Chapter 4, section 4.5.2).

When comparing routine cockpit interaction and crisis interactions significant differences in meaning are communicated depending on where the speaker put stress in the message. Also, paralanguage cues include the pitch, voice qualities like volume and rhythm, pauses and hesitation and vocalic while crying, whispering, yelling, etc. (Trager, 1958; 1961). Paralanguage cues, in certain contexts, are an indication of an emotional state or personality, especially if sender and receiver speak the same language or share a mother tongue. And since emotions are not just reflections but also include the “cognitive representation of behavioral reactions” they relate to the evolution of communication patterns (Salem, 2009, p. 153-156). That is why, aviation communication is rich in the use of voice mechanisms (including language and paralanguage) which are part of
sense making process when low-context language has to convey the standard of the routine, the pressure of the emergent, the agony of life risk or the moral judgment in applying fighting rules of engagement or aviate in free-fire zones when the pilot has the sole authorization for weaponry use.65

In-flight interactions follow the conventional principle of transactional communication about the elements and signals in messages (Devito, 2011, p.12-15); i.e. the transactional nature includes (i) communication is an on-going activity with its elements in constant change, (ii) there can be no source without a receiver and no message without a source (interdependency exists), (iii) communication is influenced by the individuals’ interpretations, although they have a strong standardized foundation, and (iv) every participant is both a sender and a receiver. So, speaking, listening, and refusal to communicate is itself communication.

5.3 Verbal and Non-Verbal Communication Blend

AIP13, one of the accident investigators-discussants for this study presented on Chapter 1 and Chapter 4, underlines the communicative nature of the flying activity of the agonizing fighter pilots who were scrambled66, in the Renegade process, for Helios “ghost plane” flight. Observing in more detail in the encounters

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65 The descriptive narrative of the interplay of emotions, actions, improvisations, and operational decisions from Lt. Heather “Lucky” Penney, is a really picturesque example of such communication patterns. She was one of the first two combat pilots in the air from Andrews Air Force Base in the morning of September 11, 2001, after the hijacked plane attacks. Her recollections and sharing of the developing situation awareness, different styles of communication, small-talk, personal relations and trust even in the higher offices are compatible with the current analysis (despite of some criticism she has received). See more at the video interview http://www.c-span.org/video/?300959-1/major-heather-penney-september-11-2001 (August 11, 2011).

66 Scrambling aircrafts means to get them into the air as quickly and as possible and into formation to defend, interdict, intercept, etc. In HAF quick response alerts, two minutes and five minutes are typical time frames. Quite often when in scramble there is no time for mission briefing but just the order and rules of engagement are exchanged in the life vests room. Originally, during WWII in the Battle of Britain, scrambling aircraft was referring to immediate take-off in order to avoid a catastrophic attack on them in the ground.
of the F-16’s pair with the “ghost plane” the study identifies the manifestation of non-verbal communication (aircraft-to-aircraft and pilot-to-aviating purser communication), the emotional parameters communicated in the Renegade process, and the verbal- non-verbal communication mix in the declaration of emergency from two different channels.

AIP13 visited the two F-16 pilots in their home Air Force Base (111CW) to discuss their experience instance-by-instance algorithmically. Due to the accident investigation, their discussion took the form of a detail account (in protocol analysis terms). This approach is described in the accident report (HAAISB, 2006, p. 6-9) and a special book (Tsolakis, 2013, p. 408-409). I asked AIP13 to elaborate further in the report’s description in order for me to trace the communication signals. I have also used the extended testimonies during several trials in Cyprus and Greece, as well as reports publicized by the HAF’s General Staff regarding the interception phase.

The original pilot and co-pilot of the Helios flight were incapacitated and fell unconscious. The autopilot was engaged with the programming to the destination airport of Athens. The autopilot led the aircraft to pre-determined

67 The Helios 522 flights crashed in Greece’s mainland, so the relevant judicial took place in the company’s headquarters in Cyprus and in the Greece where the tragic accident actually happened. For this study, I was able to use the judicial proceedings that are part of State Archives, after then the end of the trials in the Supreme Court on February of 2013.

68 Eurocontrol’s skybrary explains that: “An autopilot is a device used to guide an aircraft without direct assistance from the pilot. Early autopilots were only able to maintain a constant heading and altitude, but modern autopilots are capable of controlling every part of the flight envelope from take-off to landing. Modern autopilots are normally integrated with the flight management system (FMS). The FMS is an on-board multi-purpose navigation, performance, and aircraft operations computer designed to provide virtual data and operational harmony between closed and open elements associated with a flight from pre-engine start and take-off, to landing and engine shut-down.” (See at http://www.skybrary.aero/index.php/Autopilot and http://www.skybrary.aero/index.php/Flight_Management_System).
patterns around the Athens Control Area, in Greece’s capital. What did the leading intercepting pilot, namely AIP23, do next to communicate (with explanatory text in parentheses added)? The passage below comes from the discussion with AIP23:

When the two F-16’s flew around Helios flight in loops and maneuvering dangerously close with shaking movements and oscillations (considered “aircraft body movements”) as prescribed in the interception protocol to “gain attention” for almost twelve minutes but no signal received from the Helios flight (recorded also in the F-16 aircraft camera). The leading pilot for the pair of F-16’s (flying side-by-side to Helios) continued with hand gestures (as radio communication was with no reply) for which he perceived feedback visually by the purser who (with limited oxygen) was attempting to regain control of the aircraft from the autopilot.

The two F-16s flew around the Helios plane in a reconnaissance mission to obtain information by visual observation and “attract” any signals to and from the Helios flight. The interception is a second step, which theoretically may escalate till a “shooting down”. Shooting down is ordered when there is a threat for a populated area or critical national infrastructure on the ground cannot be excluded as risk, in

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69 As the manufacturer, Lockheed Martin Corporation explains “the F-16 Fighting Falcon has proven itself as the world’s most capable 4th generation multi-role fighter, serving as the workhorse of the fighter fleet for 28 customers around the world, for more than 40 years with constant upgrades (4,500 aircraft and 55 repeat buys have been supported). More at [http://www.lockheedmartin.com/us/products/f15.html](http://www.lockheedmartin.com/us/products/f15.html). Scrambles are typical missions for F-16’s.

70 The internationally established International Civil Aviation Distress Frequency to be used for Distress and Safety by Search and Rescue is 121.5 MHz (see [http://www.skybrary.aero/index.php/Distress/Emergency_Frequencies](http://www.skybrary.aero/index.php/Distress/Emergency_Frequencies)). This flight was not responding despite the attempts as it was committed to the frequency of the departing airport.

71 DNA testing of genetic material of the cockpit debris and oxygen masks after the crash appear to confirm the presence of the purser later identified as Andreas Prodro mou in the cockpit (HAAISB, 2006; p.69; Tsolakis, 2013, p.394-395).
case an aircraft (its crew or passengers) does not signal any response or any other plausible/legible message.

AIP23 continued from his fighter jet wing gestures to his own hand gestures in order to “elicit” a signal of understanding. So, the two F-16s took off as a dyad with AIP23, as the pair leader and the other F-16 in support and targeted flight which would radar-lock in the tail of the Helios plane. The F-16’s radar searches and tracks the sky in a zig-zag scheme, the radio beam reflected by Helios plane, Helios indicator was shown on radar display and circled around to lock for weapon routing, if decided according to the Rules of Engagement of the Renegade response protocol.

The F-16 radar tool functions in a situation awareness mode towards the intended target as well as the visual display, and affords the operational capacity for the pilot (Endsley & Jones, 2004, p. 115-118; Dominguez et al., 1994); the pilot operator has the training to rely on the automated radar tool and the judgment to avoid misuse and disuse of automation, following the terms of Lee and See (2004). Since the time of their scramble, the pair of F-16s is in a monochronic time orientation as they observe the situation with a schedule of one thing at a time and the next flight action (on time slot scheduled) depends on the outcome (and response from Helios and from their commanding centers) of the current one; it is an instance of a chronemic communicative dimension in the micro-environment they were flying as described by Hall (1963).
Their operational clock has several measures of time. Helios airplane was flying almost three hours running out of fuel, the two F-16s were flying with different manoeuvres (the second in a more stable and conservative way) in order to save fuel. The replacement dyad of Mirages 2000-5 was in readiness to scramble and continue the Renegade interception if needed. The time for the Renegade shoot-down was counting down in reference to the Prime Minster and the HAF Chief. The survival time of the person in Helios pilot seat was also limited (as depending on the supply of oxygen which was running out, even the F-16 camera recorder overflowed during the flight time).

All these determining measures of flight time were counting down as sand glasses, for the F-16 pair, as if they were having a mission briefing while flying. That was the description in original military classified (and then released) de-briefing reports to the HAF General Staff, prior to the start of HAAISB accident investigation and are not included in the report. Of course, this realization of time restrictions communicates a volatile situation awareness state, for both but for AIP23 in particular, in a dynamic micro-environment of continuous adaptation.

AIP23’s approach, was a practice of an unusual artifactual communication using the plane as a communication tool (by virtually waiving the F-16 wings as communication illustrators), and an emblem in kinestics (Knapp & Hall, 2010, p. 359-379, 199-229) in non-verbal communication which invalidated the initial working hypothesis of a hijacking. The non-verbal interaction of signals (waiving hands with visual contact) formulated a short verbal message from AIP23 in
cooperation with the information to Athens Area Control Approach and the Chief of the Air Force (see below, with explanatory text in parenthesis added):

The man in the cockpit shows signs that he has seen me… Now I can distinguish a second person sitting the co-pilot seat (with flight attendant’s attire) and pointing down. I can see that person in the pilot’s seat is trying to hold the controls and stabilize the aircraft. There is an open book beside him.

AIP23 tries a glance before attempting contact and conveys a message with positive interpretation (of no attack, just before the crash) by forwarding verbally the non-verbal reactions he has noticed, after his eye-contact with the person on the captain’s seat. AIP23 and the person in the captain’s seat were two physically distributed pilots-in-command with a sense of co-presence in their parallel routes.

The cockpit-by-cockpit communication (from the Helios to the F-16), the proximity of the two aircrafts communicates immediacy of action, similarly to the proxemics dimension of Hall, 1996, p.181-191) via the visual channel seems like a manifestation of one of the facial feedback hypotheses (McIntosh, 1996); the facial expression action of the struggling Helios purser with the flight manual had an impact to the physiological arousal of AIP23. AIP23 was able to conceive the pressure and determination of the person who was making the effort to disengage the autopilot and aviate the Helios plane (when all the others suffered from hypoxia and were incapacitated).
The person in the pilot seat of Helios flight transmitted a signal of his
desperate effort to regain control of the flight, although most likely unintentionally,
when he used the assistance of the manual. As AIP23 spotted the manual, it became
a central marker reserving the cockpit as territory, in the way territoriality
communicates possessiveness (Moore et al, 2010). Therefore, a relief sign was the
feeling for the Athens Control Center and the National Center of Air Force
Operations centers when they realize that that there was no eminent terrorist threat
and the risk of out-of-flight civilian casualties was reduced, when the plane was
directed out of the densely populated neighborhoods and public beaches in the
seaside of the capital city of Athens. The tragedy which was about to happen would
affect everyone on the flight, but not others, so that the number of casualties would
be as reduced as possible.

The next point that connects the Helios ghost flight with verbal
communication is that two distinct sequential messages for an emergency (the crash
which was approaching) were declared for that flight, in completely different
channels. The first one was spoken by the person in the Captain’s seat but not
transmitted outside the cockpit (comments added, HAAISB, 2006, p. 168-169):

CVR Time: 08 54 18’’
MAYDAY, MAYDAY, MAYDAY, HELIOS AIRWAYS FLIGHT 522 ATHENS (…unintelligible word)
CVR Time: 08 55 05’’
MAYDAY (very weak)
CVR Time: 08 55 09’’
MAYDAY (very weak)
How could we know that? Is anyone listening? It is an extract from the transcript of
the flight as recorded (internalized) in the CDR. The message is an explicit
declaration of an emergency during the initial descent of the flight. But the
microphone key was not pressed for the VHF radio to transmit. Thus, the message
being sent did not reach the intended target, as no appropriate channel was used and
no one is listening. The person-sender was close to oxygen starvation losing his
breath and with poor situation awareness due to his physiological condition. The
stress and pitch in the tone of voice relays the message of the critical moment of the
last surviving cabin crew member who was seating in the Captain’s seat. This
message does not have any informational content till the moment of the crash, and
is now acquired as hindsight for the accident investigation.

The other emergency message about the Helios flight was transmitted from
the outside of the flight, from AIP23 the leader of the two F-16s which was flying
cockpit-to-cockpit, side-by-side of the Helios flight (as close as fifteen meters,
around fifty feet; it was a “breath’s distance” in their culture as the two pilots
pointed out). AIP23, in his agonizing effort to communicate (even if he would just

72 VHF, stands for very high frequency, is conventionally defined as the portion of the electromagnetic
spectrum of frequencies between 300 and 30 megahertz including any radiation wavelength between 1 and 10
meters. VHF signals are usually used for television and radio transmissions. As Eurocontrol skybrary explains:
“Aircraft Communications, Addressing and Reporting System (ACARS) is a digital data link system for the
transmission of messages between aircraft and ground stations, which has been in use since 1978. At first it
relied exclusively on VHF channels but more recently, alternative means of data transmission have been added
which have greatly enhanced its geographical coverage. There has also been a rapid trend towards the
integration of aircraft systems with the ACARS link. Both have led to rapid growth in its use as an operational
communications tool.” (See more at
Communication frequency is crucial because it restricts the channel of signals which should be open to all
airport traffic. In ICAO Doc, 9870, “Manual on the Prevention of Runway Incursions” the provision explains:
4.2.6 “All communications associated with the operation of each runway (vehicles, crossing aircraft, etc.)
should be conducted on the same frequency as utilized for the take-off and landing of aircraft”. Further details
are provide in Appendix A, §1.5.” (See at
receive a signal) has approached a proxemic distance of face-to-face-interpersonal communication as described by Hall (1966/1990). He flew beyond the vertical and horizontal separation standards to facilitate in the attempt to clarify the situation, with any mode of communication he had available. The Helios flight crashed with an impacted on hilly terrain at 12:04:32 p.m. and the emergency message signals were explicit. The leading F-16 pilot AIP23 declared (as recorded in the video archive of the F-16 flight camera, explanatory text in parenthesis added) the emergency for the other aircraft:

Mayday-Mayday-Mayday: the civil aviation plane crashed on top of a mountain

Mayday-Mayday-Mayday: the civil aviation plane crashed on top of a mountain

Standby, Standby: I will give you the coordinates

Standby, Standby: the airplane crashed outside any residential area

(Continues with a pause for silence of about a minute to breathe and then a repetition and confirmation of the geographic coordinates of the crash location)

It was a feed-forward in a continuum (for almost five minutes) until the moment of the emergency from the F-16 pilot for the irreversible route to crash. Although the message was explicit and was transmitted and received from various Control Centers, the intensity of the moment to become aware as an eye-witness of not just another crash but one hundred and twenty one people deaths (most likely at the
moment) was compacted in this moment of breathing. It was an unrepeateable communication moment for all the receivers in Control Centers who perceived and decoded the emotional state of the pilot (Burns & Beier, 1973; Beier, 1973).

In general, fighter pilots are trained in emotional discipline, self-awareness, and control and are tested periodically, physiologically and psychologically; but instant emotional gales for incoming stimuli are encouraged as a blow-off externalization process (at least in the culture of HAF). Parenthetically, when I brought the topic of the emotional stability of a fighter pilot and their mission for an informal comment during discussions, AIP7, a Major General in the HAF, commented on the culture of self-preservation through the group of pilot colleagues (explanatory text in parentheses added):

A fighter pilot leaves everyday for his\textsuperscript{73} base to takeoff (in real-life defense drills in flights) without knowing whether he is coming back or not. When a colleague pilot dies on duty or drill a teardrop comes in the eye till the formation lands back in the base. We learn it the hard way in the HAF Academy, not because we are trained to, but because we realize it on practice: every year we call-over the classmates who did not survive the flight training. Then life goes on and airmanship lesson is cultivated.

The value of human life and the collective orientation and the strong sense of belonging in the group (even post-mortem) transcend individual achievements and

\textsuperscript{73} Although without restrictions in the past years, female fighter pilots are in the margin of 5% in HAF. The intensity of training and lifestyle, the family-oriented society and the national exam competition to enter the Hellenic Air Force Academy are (among others) factors that have contribute to such numbers. Thus, the use of grammatical masculine gender pronouns, for fighter, pilots are not considered discriminatory. It is indicative that the popular drama series of the Greek Mega TV “Silence in the Air” (Anosis SA, 2000) featured two airwomen characters in military duty: an air traffic controller and the chief engineer.
personal ambitions among fighter pilot who were classmates or fly together (for a while). Small interconnected pilot networks starting from dyads who fly together, participate in the same briefing and missions, then in the same quadruplets and so on (in single or two-seat fighter planes), and micro-cultures formulate and the bonding is tight. Death rituals are enforcing airmanship culture and awareness. I have experienced such instances during my military duty in 115 CW/Base operations Directorate, in Greece, when two different pilots who I have scheduled to fly in two different regular training days did not return. Silence was shadowing the base till the time their formations returned. In the next day I had to participate in the honoring squad, as the Tactical Chief of the Air Force (who supervises operations) was there to participate in the mourning ritual in an expected leadership act from his side.

Coming back to AIP23’s actions after his verbalization for terminal emergency declaration, there was no doubt for the unfolding tragedy and the search and rescue response alert services were energized by HCAA. Instead of just verbalizing the message aloud, the pilot’s inhale-exhale rhythm coupled with the falter (for some seconds) and pause was a clear closing statement. It was his own moment of silence, mourning for the people who crashed in Helios flight, and with a transient self-blame thought that he could not help them, although the Renegade mission was accomplished. The cockpit-to-cockpit flight of two co-present pilots on a captain’s seat became their bond, taken into account what AIP7 stated above. Silence and paralanguage were eloquent in transmitting the message.
AIP23 commented, in the same discussion with AIP13 for a dilemma from the other side of the coin: “I cannot forget the flight I was flying side-by-side, as I was seeing everything, communicating with the person in eye-contact but could not do anything to assist him practically and save them. Sometimes I am thinking aloud in the night, would it be possible to intercept and shoot down the plane with all those people, in case I was not able to communicate at all?” Self-efficacy as belief in personal abilities, aspects of fear, and trust in effort and command are enduring balancing attributes in the pilot culture. Still, the decision-making function is a floating inquiry, at a micro-level of what pilots evaluate with their sense till the tactical level of operation and the macro-level of public safety policies like the Renegade protocol. Lastly, HAAISB was already en route since they were engaged in the likelihood of a major accident from the early stages of the Renegade response process. AIP23’s interception and messages was a feed-forward call for them for the “future” accident before it actually occurred.

The silent Helios “ghost” plane communicated to an additional recipient through the co-present F-16 pilot AIP23. The hilltop in Grammatiko area where the crash took place is known as “Black Mountain”, a pre-existed name which became symbolic of the catastrophe and the subsequent heavy particles and other chemicals scattered around and now under special environmental treatment (Tsolakis, 2013, p. 417-421). The trace of the debris and the semiotic content in the Black Mountain still communicates the haunted story.

5.4 Using the Scenario of Hesitation
The vocal but (still) nonverbal dimension of speech channel of communication has to do with how one says something and not with what one says. Among the voice qualities, prior to actual talking the language, pause and hesitation are perceived and understood in the broader verbal interactions. Adjustment is necessary for both sender and receiver ends to communicate. That is why a second scenario from an actual reported flight situation in order to investigate the transition from silence to language, via paralanguage.

In this scenario (laid in three parts as explained in section 2.5.2) we move from non-verbal instances of hesitation as an indication of bypassing in cockpit – controller interaction or as a contributing factor of aviation accidents. Let us summarize how the scenario unfolds with the captain of the anonymous report, his actions and the reaction of the first officer\textsuperscript{74}.

Captain: On takeoff the Tower Controller called us and sounded as if he had something to tell us, but did not know what to say. We both noted a tone of concern and hesitation, in his voice as if he was still unsure of something at that moment. We had to make an immediate decision.

The civil aviation pilot (the captain) reports that he has ended the taxiway movement, continued to the runaway to take-off and starting rolling to develop the necessary speed. The call from the air traffic controller was made with a pause and murmuring the call sign (which identifies the aircraft in their interactions; it is usually the carrier name with a number). Although the message was incomplete the

tone was thought-provoking and timing was critical as they have started the 
speeding up for the take-off process. They still had some a route to go and they had 
to decide with no other input, just their airplane data (fuel to avoid fire risk and the 
remaining distance to be safe). What did the Captain do (in summary, below)?

The Captain continues: I elected to initiate rejected takeoff procedures.

During deceleration the Tower Controller said, “Disregard.” The sound of 
one’s voice, the tone and force, all convey a message. I did not like the 
message I was receiving and could not gamble that he was trying, but 
unable, to warn us of something ahead. I would take the same action again.

The Captain decided to take the incomplete call as a reason to reject the take-off 
and started the deceleration in order to stop the aircraft. At that point the call from 
the controller completed the message of hesitation with a “disregard”, as it was 
nothing to talk about, to ignore the call. Uncertainty was something he could not 
evaluate, in case it was a warning for a potential problematic situation ahead (they 
were cleared to take off and the call would project a reason to revoke that 
clearance). In the original Callback report the First Officer who was able to receive 
the same incomplete call from the controller comments below. What is their 
evaluation (in summary, below)?

The First Officer’s reports: I believe the rejected takeoff was the right thing 
to do. When you get a call from Tower at that point in the takeoff roll, the 
first thing that pops into your mind is “something’s wrong.” So the Captain 
did what was prudent and safe by rejecting.
The First Officer is fully confident for the action of the Captain. It is a reaction consistent with the spiral of silence theory in communication, in which voicing agreement is more likely than disagreement in a controversial issue after evaluating potential consequences, as most respondents in this study agree for the choice of the captain (Windahl et al, 1992). It seems that, since the flight was actually accelerating to take-off a call from the Tower breaks the sequence which seems to be uneventful. The potential of any unexpected event is a call for being prudent than being sorry.

The hesitation scenario summarized above is the discussion topic for the discussants who shared their experience for this study. The inquiry was to evaluate the hesitation issue, to explain their action as if they were pilots and suggest ways to repair hesitation and other interference for the First Officer. Sometimes, hesitation is also embedded in intra-plane communication between the cockpit and the cabin. Overemphasis in the sterile cockpit rule (the philosophy of which was explained in section 1.3), unfixed team formation and separate briefing for the pilots and the cabin crew could result to ineffective communication between two crews (Chute & Wiener, 1996).

5.4.1 Safety First with Clear Short Messages

The start is the fighter pilot at the rank of Colonel of Hellenic Air Force, namely AIP1, who was presented in section 4.5.1. AIP1 has active experience in national fighter missions in HAF, in international reconnaissance missions for NATO where he needed to take-off and land in most of the seventeen countries
which consists the operational branch of NATO. He is also informed about the incidents reported in the Flight Safety Directorate of the Hellenic Air Force General Staff, as well as for the NATO incidents. So, what is his take on the hesitation scenario?

Since takeoff is a critical phase of flight, I find the performance of the controller very negative. He should have said a clear message using Standard Terminology without any hesitation. The crew had to take a quick decision depending on the speed, runway conditions and, runway remaining distance. There was no time to explain or to ask. I have never experienced something like this (Poor Communication in takeoff roll). If I were the pilot, I would have also rejected the takeoff. Firstly, because the speed was well below the critical V1 speed; secondly, because of the long runway remaining distance. So, safety first! Then, to explain to the passengers and to the company.

AIP1 is quite definite about the responsibility of the controller which is negatively characterized because of the unclear message and the incomplete standardization format of his vocalization. The crew approaches a point of no return (after a certain distance and acceleration to take-off), so decision is immediate and uncertainty is an obstacle. The unexpected call from the Tower created a chain of thoughts for the value of orality as information, at this point critical (Turner, 2010).

The incomplete sentence was as starter of a message with a high informational value, due to the fact that clearance is the terminating message and
clearance was given to take-off. The value, in risk terms, of the conditional “what Tower could have said or mean” generates a potential safety threat which cannot be evaluated. Going from the oral start to the complete information which would be so important to be talked in the post-clearance phase, the pilot has to decide with a risk he cannot take. The cost of incomplete information accumulates to the cost for a safety related risk for which there is no time for evaluation and control. Thus, almost automatically, the pilot’s thought is ‘what it means to reject take-off’ in terms of technical feasibility: speed (V1 is the target speed after acceleration to take off), fuel, runaway length, weight and the institutional parameters of losing a clearance, bypassing Tower’s instruction (compliance challenge), and having to be accountable to passengers (marketing and public relations challenge) and the airliner itself (organizational culture challenge). As many challenges there may be, safety is the first priority. What is AIP1’s suggestion?

There is a way to repair hesitation only if there is enough time for effective communication. I haven’t trained specifically for this and there is no way to train crews for everything that could happen. On the other side all crews and ATC controllers know that takeoff is a critical phase and should avoid unnecessary messages. Clear short messages inside and outside the cockpit are necessary. That is the reason pilots use single words like “ABORT, REJECT, CONTINUE, etc”. There is no time for the brain to analyze the situation and react. You hear this word you perform the check list immediately.
AIP1 has the pilot’s point and more specifically the Air Force pilot who is trained in every day duty to respond to flight inquiries, alerts and scrambles in predetermined short time. Since time is limited and non-existent when the airplane is on the move, repair is not possible (without a serious of turn taking which starts from repetition). It is another indication of the clear affordances of time, in aviation Gibson (1979); flights cannot be understood without the possibilities or impossibilities of action which time permits or constraints. Time is a parameter of the operating environment, a contextual element of the communication context of the flight which dictates some course of action like the rapid decision making (here) or directs to certain restrictions of action. It is not an issue of specialized training, as training in the end is a learning process of making decisions in unexpected circumstances and not having practiced every single potential event or incident.

It is part of the sterile cockpit principle, as no interaction is expected in the post-clearance phase. Breaking that practice magnifies uncertainty as risk. A clear short message, in AIP1 mind, with a verb in imperative mood (like abort, reject, continue which he emphatically capitalized) which would have an absolute negation (like discontinue, accept, go) would create the intended reference and avoid the problem of uncertain reference (in Cushing’s terms, 1994; p.18-19).
Analogically, short or one word replies facilitate the confirmation messages from both sides\textsuperscript{75}.

\subsection*{5.4.2 Pilot Interpretation and Controller’s Bad Moment}

In the same scenario of hesitation, the study incorporates the evaluation of an experienced civil aviation pilot, namely \textit{AIP10}, who has personal involvement in quality assurance and control issues. He was responsible for the single-day transition of one of the two major Greek airliners from the old Athens Airport to the new “Eleftherios Venizelos”\textsuperscript{76}, in Greece, during which he coordinated massive communication. As one of the experts with a thorough consideration of aviation professionals (both pilots and controllers), he suggests the supremacy of the pilot’s decisions, is accommodating about verbal messages principles that affect meaning making, and explain why a take-off continue could be possible. His passage is below:

Obviously, it's a miscommunication in terms of controller’s bad training, limited experience or just a "bad moment". In aviation, we never start transmitting a message unless we think about what we are going to say. I haven’t experienced similar case, but from the description, the pilot must be found to a really difficult position during a critical phase of flight. Take-off

\textsuperscript{75} In the flight US1549 (Accident Report, \url{http://www.ntsb.gov/doclib/reports/2010/aar1003.pdf}, Jan 15, 2009), a critical interaction was: NY TRACON: "Alright cactus 1549. It's going to be a left. Traffic to runway 3-1." US1549 (replies): "Unable." A simple non-explanatory and clear cut word conveyed the dramatic situation.

\textsuperscript{76} The Airports Council International (ACI) evaluation over 450 airports in 44 European countries (\url{http://www.aci.aero}) granted the 2014 award, in the ’10-25 million passenger’ category, to Athens International Airport “Eleftherios Venizelos”\url{http://www.aia.gr/traveler/}. Athens secured this award due to its high economic performance in a very challenging context, its excellent work in redeveloping its traffic base while keeping a strong focus on the quality of service.
Cancellation is an uncommon event, at that stage. Quite in more rare occasions is due to harsh conditions (short runway, plane loaded till the margin, wet runway etc.). It is a pilot’s decision which has to be justified to the airliner afterwards.

AIP10 seems to be more accommodating and open in his interpretation, as errors do occur regularly. It may be a bad moment and not a generic attribute of the controller’s function. The aviation environment requires precision, accuracy, efficacy, and predictability. So, a message is transmitted only when it is complete, in order to be meaningful. Take-off and landing are among the essentially busy phases of flight - taxi out, take off, initial climb, intermediate and final approach, landing, and taxi in. no post-clearance interaction is expected at those times. There are occasions when technical parameters or the physical environment demands a cancellation. As it affects instructions, schedules and corporate brand any cancellation should be justified to the airliner.

The pilot found himself in a situation with hardly any degrees of freedom, since uncertainty increases complexity and creates interactional problematics and unsettled questions regarding the actor’s (here controller’s) knowledge and intentions (Mortensen, 1997). But, AIP10 is adding some criteria in his reasoning on the pilot’s action:

Considering the conditions and by setting the safety factor above all, the captain acted by rejecting the take off, something that possibly I would do.
But it depends on the exact concern feeling, formed by the incomplete message, and how the personality of the pilot perceives this message. AIP10 accepts the likelihood of the same action from his part but there may be a rebuttal in the safety argument. Not all hesitations are the same, not all pilots perceive signals, indications, and contexts of messages the same. When I probed to him to explain further the personality of the pilot concept, he said, that pilots are like doctors in emergency departments; doctors sort patients for treatment priority and allocation of resources by applying “triage” (Iserson & Moskop, 2007). The way that pilots perceive incoming signals demands the abstract thinking, immediacy, and priority handling of triage to select and prioritize the next actions, in AIP10’s view.

AIP10 feels that triage, as an occupational skill, should be part of situation awareness response for the pilot. The context determines, to a large extent, the meaning of verbal and non-verbal behaviors. The meaning of a given signal, like the incomplete call of hesitation from the controller, depends on the other accompanying behavior with a time factor (before or after). Furthermore, it depends on the interaction which preceded the clearance (and the post-clearance incomplete message), the overall situation awareness for the flight and the trust developed for the controller or the aerodrome. Trust in this occasion starts as the belief that the other (the pilot) will take into account what one (the controller) is saying (Lin, 2001). But, how pilots can overcome hesitation or its consequences?
In the pre-flight flight deck crew briefing there are several textbook cases to abort a take-off. Hesitation is not written in those cases but there is a bottom line to cover any other case. The sentence is: “apart from above, a take-off can be aborted in any other case considered necessary.” The decision is the sole responsibility of the pilot who has to declare STOP. The first officer, by the time captain chose to act around safety for which he doubted most, ought to help in the procedure. Typically, the relevant training requires, in case there is no complete ATC message, to continue the take-off procedure. AIP10 explains that the flight preparations start with a pre-flight briefing where several reasons and causes to postpone a take-off are tested, for the most part before the inquiry to get clearance and before the clearance is given. Hesitation is not an expected reason as it is not supposed to happen. But, the pilot has the ultimate authority to decide about the airplane and the flight, according to the interpretation of the situation and the surrounding conditions. If so, stop can be declared even if the decisive experience from the pilot’s point of view is idiosyncratic.

The First Officer was compliant in his comments and, since he was also a recipient of the incomplete call he has the responsibility to assist, if he hears otherwise or speak up in case of a disagreement. Although the letter of the briefing dictates the authority of the pilot, AIP10, emphasizes the collaborative environment where flight deck cooperation is beneficial and appreciated. The controller is part of the team, AIP10, explained in further discussion, so one incident should be kept
in a symmetrical not spontaneous reaction (a random event to be discussed, not disciplined) and explained in the controllers debriefing. AIP10 redirects the corporate pressure for scheduling and dependability; the take-off time slot is important to adhere and, if not, the company wants a written explanation.

So, in their training if no new information is conveyed by the controller after clearance (incomplete information equals to zero information), the take-off continues (as prompted from socioeconomic parameters of the operational environment and regulations for efficacy); the only reservation is the aviation instinct of the pilot (captain) to overcome the clearance and abort, if he considers so (it is the so-called “buoyancy” in the classic description of Langewiesche, 1972, p.56-60\(^7\)). Hesitation added a pragmatic dimension from intended speech to a speech act to abort take-off, due to the inferential nature of the interpretation of the incomplete message based on background or contextual assumptions and general communicative principles (Grice, 1989).

### 5.4.3 Prudence, Fear and Situational Awareness

The report in the scenario was from the pilot (Captain and First Officer points’s of view). As hesitation came from the controller and most of the pilots, in further discussion characterize the incident as “unacceptable”, it would be important to pursue the evaluation for two different air traffic controllers that were included in Chapter 4.

\(^7\) [Buoyancy is] perhaps the most hard-to-get-at skill in the whole art of flying - the sensing of 'lift,' the gauging of the firmness of one's sustentation, the 'feel' a pilot must have for his ship's angle of attack, the ability to know how close the ship is to the stalled condition: This is what pilots used to call the flying instinct (extracted from the pioneering work of Langewiesche, 1944, reprint 1972; p.56-60).
The first one is AIP14, the most experienced controller who participated in the discussion in section 4.4.1. AIP14 comments refer to her experience on hesitation, to her evaluation on the pilots’ decision/reaction, and to her insights for air traffic controllers training connecting it with safety at a European level. The following passage is addressing those topics:

The take-off is a very critical phase for the flight safety. I experienced such cases some times in my career but not harmful ones. The hesitation in this example is rather due to lack of situational awareness of the controller. The pilot did the right thing in order to safeguard the aircraft. Probably the first officer wouldn’t do something else, as there was a feeling of uncertainty and hesitation in the controller’s voice, so he said that the pilot was prudent to reject. The hesitation repair depends on the time limits and the evaluation of the danger by the decision maker (i.e. during takeoff if there is something at the end of the runway the pilot may judge more unsafe to reject the take off as time is very limited to react under high speed).

AIP14, unlike other professionals in civil aviation who are categorically denying their own incidents, is open to admit that she has experienced hesitations during her long career, but with no consequences for the flights involved. Instead of feeling it as her human failure she prefers to search her human sense making at the time of hesitation. She attributes hesitation to the lack of situation awareness from the

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78 It is interesting that the EU Performance Scheme (Com.Reg. N° 691/2010) for the period 2012-2014 introduced reference goals for cost-efficiency, capacity and environment. Safety was not included in the first reference period but will be in the second reference period beyond 2014. Most likely, because Eurocontrol aimed to document the utility and benefits of the policy for trans- border ATC and not because it is underestimated. See more at [http://ec.europa.eu/transport/modes/air/single_european_sky/ses_2_en.htm](http://ec.europa.eu/transport/modes/air/single_european_sky/ses_2_en.htm) (and in Chapter 5).
controller, giving the fact that clearance was already given (and the “Disregard” message confirmed that non anomaly was there). She accepts the pilot’s decision since the pilot is responsible for his own aircraft and the co-pilot did not have any other input but the hesitation cues.

The pilot’s decision does not happens in a vacuum, as conditions, time constraints, and speed are decisive factors even when then end of the runaway is not exactly clear and the airplane may take off any way. The perceived changes in the tone of voice became part of controllers’ updates in training, starting from cases where the controller misinterpreted the change of pitch from a pilot, did not prioritize the flight, and accident occurred\(^\text{79}\) (Fegyveresi, 1997) and going to non-verbal fillers of hesitation identified by Jones (2003) and Howard (2008). But what do controllers learn in training for instructing in critical phases of a flight? AIP14 emphasizes the role of the facilitator and the decision-making authority of the pilot:

During my training as a controller, I have learned how to deal with cancel take-off and how to instruct a pilot that there is an imminent danger for the safe continuation of the procedure, due i.e. the presence of an obstacle in the runway, or a runway incursion. At this very critical moment pilot has the full responsibility to evaluate in seconds the received information and act accordingly, if time permits so. If the aircraft speed is still low, the take-off cancellation can be safely handled but if it is near the

\(^{79}\) Refers to the NTSB Accident Report on the Avianca (Airline of Columbia Flight), Boeing 707-321B, HK2016 due to fuel exhaustion, January 15, 1990. Crew language proficiency was identified as a contributing factor in the accident, as priority status was not confirmed. See more at [http://www.airdisaster.com/reports/ntsb/AAR91-04.pdf](http://www.airdisaster.com/reports/ntsb/AAR91-04.pdf)
critical level or above this, then it is too late to stop the aircraft without serious accident to occur. Pilot has the final decision based on the quick evaluation of received information by ATC. Controller’s stabilized voice can be proven helpful but this is not easy all the time, due to the human nature and the stress occurring in such dangerous situations. As all communications between pilots and controllers are recorded there is an additional fear for not being compliant with the standards phraseologies or the rules, thus imposing more stress (voice uncertainty, low voice, fear, sweating, hand trembling, heart bit etc).

As the discussion with AIP14 was repeated several times and I asked her to elaborate further, she stresses the fact that training, for controllers, is focusing on the disruptions that they are aware and oversee when they are about to give clearance for take-off; i.e. obstacles in the runaway like FODs (from section 4.5.3) or a completely unexpected intrusion in the runaway and they do not interfere in flight parameters that they cannot control or are out of their reach and the crew is observing. The airplane in the runaway rolling to take-off is a critical moment for the flight. The pilot has full responsibility and evaluation time hardly exist, so a message is spoken only if there is substantial content that affects the specific phase in the specific timing.

Parenthetically, as AIP9, one of the pilots mentioned in Chapter 4 (section 4.5) and in section 1.5.1, puts it ‘I am alone with my soul and my aircraft when in take-off and mostly when I am about to land. I feel the plane as an extension of my
"muscular system". There are two aspects for the pilot to process the handling of a takeoff cancellation: (i) the technical conditions and flight parameters and (ii) to leave room for decision making when an unexpected input (if it comes) in case substantial information is transmitted from the controller. The final decision connects the pilot’s competency of adjustability, the ability to attune to constraints, with the affordances of aviation with pilot as an agent, merely the conditions of the environment to which the pilot is attuned (Greeno, 1994).

That is why the concepts of counting down time tolerance and instant safety risk evaluation when information change are among the skills acquired and maintained with deliberate practice; such practice may lead to the view of pilots (especially fighter pilots who attune to a burst of communication signals and dynamic mission changes) as expert performers (in the way described by Ericsson, 2006).

AIP14 makes two other important points here; she mentions the impact of a stable controller’s voice as a stabilizing factor for the pilot and accents the relationship of hesitation with the fear of recording⁸⁰ (Nevile, 2006). Flight crews and air traffic controllers operate in a discursive space which is completely mediated, highly regulated, intense and, as main actors, come from different organizational structures and cultures. For the controller, the captain is a listener in a state of excitement conscious and stimulated from the importance of the moment.

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rolling for takeoff. In the post-clearance phase any message is an interruption of the ongoing expected sequence of event (till the actual takeoff) and is important both for emotions and for making sense (Salem, 2009, p. 155-158). The incomplete hesitation call from the controller was an interruption which generated mistrust in terms of uncertainty. Trust is rebuilt while interactional exchanges develop in predictable patterns.

So, as AIP14 notes, a stable voice with a routine volume intensity, rate and highness/lowness of your voice is helpful to improve trust; this way the controller “talks the talk” repeating a familiar pattern in oral communication which accentuates an empathic emotion. But, as AIP14 admits, controllers are only human and human nature has a non-predictable complexity when emotional situations arise from stress and fear. So, it is not realistic to expect ideal controllers’ reactions, although training and deliberate practice is always in place.

There are also cultural dimensions in hesitation talk (controller) and hesitation listening (pilot, although sometimes is reversed), as described in the scenario. Two dimensions are more relevant; the concept of tolerance to ambiguity (e.g. what could it mean for the flight if the controller’s call is completed while at take off? Should we proceed or not?) for how people are capable to operate even when clarity of what is expected is not there, and uncertainty avoidance (e.g. Are we able to decide what to do with the take off or do we need to wait for more information?), about how people are able to make up their mind with insufficient information (concepts negotiated by Hofstede, 2009; Hofstede & Hofstede, 2005).
There is some cultural variability on how aviation professions deal with such concepts as, on average, they follow distinct sub-cultures. Controllers operate in coordinated groups and need to project the “wider picture” of the air traffic they are managing (Porterfield, 1997). Pilots (mostly civil aviation ones), on the other hand, are quite more independent individuals using the airplane in the epicenter of a symbolic world which directs to their assigned destination (Cushing, 1994). When the airplane arrives safe then they continue to the next manifestation of departure-arrival, where as controllers continue immediately to receive transitional or incoming traffic, in the next moment after a previous clearance.

The second point that AIP14 makes has to do with the inherent fear of accountability, due to the recording devices which enable backtracking of their interactions. The regulatory constraints for aviators are a function of the technological configurations and limitations they use and the significance of effective communication for safety (Howard, 2008). As flight speech is expected to be scripted from the initial to the closing interaction, in the hesitation scenario the controller was experiencing a symptom of miscommunication which AIP14 associates with a professional accountability fear (due to the growing litigation investigations in the sector, as analyzed by Michaelides-Mateou & Mateou (2010); it is not only that the rushing controller is likely to deviate from some standard phraseology, but it cannot stay in closure since their communication is monitored and recorded.
Controllers know what happened in such hesitation cases and want to use it as an example of empirical informativeness, with selective attention to orality to get information versus recorded data, as Turner (2010) analyzes for the use of organizational records. Air traffic control involves both pilots and controllers on rather equal contribution, for its operation. The workload of both parties requires a filtering process; crew members tend to hear primarily communication that start with the call sign of their aircraft and controllers tend not to hear and respond to pilot confirmations (readbacks) while issuing clearance/instructions for another airplane. That type of filtering is suggested to happen according to the flight phase, in order to maintain situation awareness and more effective listening.

AIP14 mentions that the stressful factors a pilot might experience are valid also for the controller. It connects back to the established safety culture, since air traffic control is in all cases a State-governed organization in which accountability chain, just culture and blame culture have bureaucratic and organizational challenges to be aligned. AIP14 has a suggestion with which she tries to accomplish an institutional response in order avoid “blame culture” and avoid personifying the situation regarding human error, as show below.

Frequent meetings with pilots would create a better understanding of each other’s working environment and would help to estimate the workload situations. Although we tried to organize this in our place later on was not easy to continue due to several reasons. Deviations from standards procedures should be kept at minimum. It is important to remember that
human error is in our nature and so unavoidable. TRM is important to better coordinate team during emergency situations.

As workload is a shared reality for both pilots and controllers but not always perceived that way, as they are two different sub-cultures. The establishment of periodic meetings favors the contact hypothesis (Pettigrew & Tropp, 2008).

Exposure and positive attitudes are linked together in inter-cultural communication. When I asked, AIP14, about the reasons they did not continue the meetings she mainly stated difficulties in scheduling and normality; when no incidents happen there is no specific motivation for busy individuals to participate in meetings. The safe route is to use the explicit knowledge which comes from the standard operating procedures (training and manuals).

As air traffic control has a socially-organized workplace in groups, team resource management (TRM) is an effective way to go forward in further coordination. AIP14 stresses that during emergencies (and not only) the optimal of available resources is accomplished at a group and not at an individual level. The air traffic controllers’ team is another sub-system with information with floating information, equipment and people to cooperate.

5.4.4 The Ears and the Eyes of the Pilot on the Ground

Putting the same scenario forward, another controller from section 4.4.2, AIP15, describes her case in a realistic, down-to-earth approach. AIP15 perceives her role
as informative and trusting for the pilot and points out a clear way to deal with errors.

There are several cases where ATC hesitate on the microphone during passing a message to the Captain. That could happen because the ATC may be too stressed with complicated traffic, or even tired and anxious to cope with it. We are trained to keep a calm, strict and precise tone of voice in order to achieve a sense of safety to the aircraft. We are supposed to be “the ears and eyes of the pilot on the ground” and our job is to provide them with such information and clearances that are absolutely safe for their cruise. I did not have such experience of a colleague being unsure of what he/she conveys to the pilots. I am of the opinion, and that is something rather common, that even a wrong clearance or instruction should be transferred to the pilot with preciseness, calmness and certainty. Afterwards, the ATC may correct his/her previous clearance without putting any additional pressure to the pilot due to his unsure tone of voice.

AIP15 seems to consider a hesitation mistake not so rare (although she did not have such experience herself or a known colleague), and can be justified from the controller’s operating environment, although their training is to insulate them to stay unaffected and calm, with steady regulating voice to inspire a sense of safety. As she mentions, the controllers extend the pilots senses from the air to the ground, as nerves in an almost neurological bond. A common analogy used from most

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81 The brain, spinal cord, and nerves make up the nervous system. Together they control all the workings of the body. When something goes wrong with a part of your nervous system, you can have trouble moving, speaking,
controllers, I spoke to, is the pilot is the brain in the sky that needs nerves on the
ground to land, and in takeoff the brain is on the ground and the pilot has the nerves
till the actual take-off.

Hesitation on the microphone seemingly connects a mental reservation to
speak-up after several interruptions of the surrounding interactions from other
flights (young controllers feel it as a public speaking drama for them, in the start);
it is a case of fragmented attention of the professional-self of the controller who
knows that transmitting confidence is a reception of trust for the pilot, similar to the
controller’s own confidence to automotive tools and channels in his work (Lee &
Morray, 1994). Pressure from air and airport traffic which demands repeated
interactions and a deluge of data to get responded with sequential information in
strict order (each airplane needs to follow a certain sequence of steps, one after the
other, in order to arrive to the desired position to move, take-off and land).

The controller has to change turns, from one flight to the other, and then
come back to the one that is waiting, then to the next and so on (nested loops). It is
a case of conversation persistence because the controller cannot stop till resolving
or waiting previous calls (Huthby, 2001, p.164-166). Beyond that, complexity
arises because there are interdependencies between flights which share the airspace,
runtime, taxiway resources, and above all the time slots to avoid delays and
prioritize routes. Controllers, often (as much as pilots do), with the multitude of

swallowing, breathing, or learning. You can also have problems with your memory, senses, or mood (National

That kind of complexity is eloquently described in the article on the “Cancellator”; i.e. a flight information
system they operate when they need to decide “which flies, where” after repeated cancellations due to harsh
weather conditions. The multiplicity of parameters requires the use of “heuristics” as working solutions and
channeled data, signals, stimuli, and reminders are having symptoms of information obesity, as described by Johnson (2012; p.66-69).

AIP15 is arguing on two other very important points; the cooperative role of the controller as an alter ego of the pilot on the ground and the traceable way to repair (and finally correct) errors. She is aware of the air traffic management framework where flights operate and adds that the controller has the role of a safety monitor on the destination point of the flight (and not so much from the departure point of the flight; after take-off the flight distances itself from the departure point and communication frequency gradually). The controller is on the ground, has more independent variables to configure and control by position, and is expected to relay dependability and safety with the tone of voice. The incomplete message of hesitation is an indication of powerless language which detracts from the controller’s ability to show control over the situation (a pattern analyzed by Lisca, 1992).

Pilots and controllers are users in the computer-supported and technologically-mediated collaborative environment of aviation, where communication from one component to the other (and the liveware) generates the flow of information and coordination described by Suchman (2009; 1997; Suchman et al, 1999); it is an example of the “holon” (the subsystems are wholes, and

83 Of course the departure point of contact is not underestimated, since several of the parameters and handling decided and done at take off are decisive about the next phase of the flight. In the case of the ghost plane Helios 522 the manual switch position, the master caution alarm and the radio frequency set to Larnaca (among other variables) were determinants of the tragedy. The re-enactment flight supported the validity of those conclusions (HAAISB, 2006).
simultaneously parts of other wholes) mentioned in section 4.4.1. Pilots and controllers function at the two ends, on the air and on the ground and the flight connects them.

Thus, AIP15 incorporates an ideal role implementation for the controller, with the use of a rhetorical conduit metaphor, as a direction of problem-solving technique in flights and meaningful in any context (Lakoff & Johnson, 1980, p.10-13); controllers are “the ears and eyes of the pilot on the ground” and the division of labor for the role in air traffic management demands from them information and clearances as definite and non-negotiable inputs (Neville, 2004, p.197). If the controller voices an erroneous clearance or instruction it still has to be precise and definite, so that it is understood and then corrected with a new message which will be in a low-context and explicit expression.

AIP15 believes that the sequential nature of pilot-controller interaction guarantees consistency when an error is clear and its repair (with a new message is clear). The controller voices the incorrect message based on the situated understanding of what is happening at the time of the erroneous message with the “local” certainty and rationality (Dekker, 2002; 2012).

If the message is precise and calm in tone, it does not add uncertainty for the pilot. The next message which corrects the previous erroneous one is a chunk of a new episode in pilot-controller interaction that is context-specific and not concept-dependent (if looking for the error blame leads to conceptualize the situation which caused the error, from the controller’s point of view). The approach
that AIP15 introduces, accounts for the fact that safety in not inherit in the aviation system but people create and implement safety; the pilot will be able to perceive the new message without uncertainty, as the point is not to correct an error with an erroneous non-verbalism like hesitation. This strategy of correcting the error with a clear new message facilitates also the auditing trail (using the recordings), if there is a need to reconstruct the expressed interaction (from an accident investigator’s point of view) and adds on to the transparent interactional behavior.

Understanding the pilot, as AIP15 continues, hesitation would create a dependability gap which demands conversational persistence about the “why” of the mistake:

If I were a pilot, I would be terrified if I was given the impression by the ATC that he/she is not decisive about the message or the clearance. I would think that something goes wrong and I would be concerned about the safety of the flight. Furthermore, I would be persistent with the ATC to give me more details about the situation and I would ask if there is anything wrong. Depending on the phase in which the flight and the pilot function a discussion on causation will not be constructive, since the next step is evolving and the pilot needs guidance to continue and not being engaged in un-necessary discussion. That is why AIP15 suggests the explicit statement to correct the previous message which will restore credibility in the eyes of the crew, as they understand that controllers keep an eye on them to ensure safety navigation in their control area. AIP15 is consistent in her practice (recalling her reply on the first officer’s no-talk from
section 4.4.2) when telling that the first officer would continue to clarify hesitation in order to assist the captain who is preoccupied with the actual navigation, depending on the takeoff phase and time constraints (see below).

I believe that there could be a way to make things better after a hesitation message on behalf of the controller. The controller can correct his/her previous uncertain message by him/her being more decisive about the next message. This could reverse the unpleasant feeling of the pilot that the person supposed to "keep an eye on him", the controller, is not sure of the progress of the flight. The only case where the pilot should ignore the controller is when TCAS system (Traffic Collision Advisory System) is activated, giving instructions to the pilot in order to avoid a collision. In any other case, the first officer should clarify the message conveyed and ask more details from the controller.

Lastly, AIP15 adds a technical enhancement that would justify a deviation from a clearance, as a pilot action. If the traffic collision indicators which operate in the airplane activate the Traffic Collision Advisory System\(^\text{84}\) inside the cockpit then the

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\(^{84}\) Eurocontrol’s skybrary explains in an enhancing safety chapter (boldface added to show the ATC involvement and the importance of the visual channel): the **Airborne Collision Avoidance System II (ACAS II)** was introduced in order to reduce the risk of mid-air collisions or near mid-air collisions between aircraft. It serves as a last-resort safety net irrespective of any separation standards. ACAS II is an aircraft system based on Secondary Surveillance Radar (SSR) transponder signals. ACAS II interrogates the Mode C and Mode S transponders of nearby aircraft ('intruders') and from the replies tracks their altitude and range and issues alerts to the pilots, as appropriate. Non-transponding aircraft are not detected. ACAS II works independently of the aircraft navigation, flight management systems, and Air Traffic Control (ATC) ground systems. While assessing threats it does not take into account the ATC clearance, pilot’s intentions or autopilot inputs. Two types of alert can be issued by ACAS II - TA (Traffic Advisory) and RA (Resolution Advisory). The former is intended to assist the pilot in the visual acquisition of the conflicting aircraft and prepare the pilot for a potential RA. If a risk of collision is established by ACAS II, an RA will be generated. Broadly speaking, RAs tell the pilot the range of vertical speed at which the aircraft should be flown to avoid the threat aircraft. The visual indication of these rates is shown on the flight instruments. It is accompanied by an audible message.
pilot bypasses any other communication and has to apply those instructions to avoid a projected collision. This is an automatic anti-collision system in which inter-transponder communication between aircrafts in proximity is established and provides instructions to avoid a collision and keep the necessary separation distances. The use of those automatic anti-collision systems was an early suggestion in the industry in the 1960s and 1970s and has initiated a discussion about refinements and training after several accidents. In any case, beyond the actual exchanges messages several flight parameters and standards (like the phase of the flight, speed, fuel, weight, weather conditions etc) are determinants of the pilot’s decision in hesitation and assess if there is even time for intra-crew coordination (for the first officer to talk and confirm) or a clear repair from the controller. For another time n interactional collaborative accomplishment should lay the ground for an optimal decision making process by the pilot-in-command, in due time.

5.5 Directness in Language and Familiarity Relationship

Modern aviation operates in an environment organized, constructed, regulated, and smoothly-operating through human communicative action. Aviation professionals, particularly crew members and air traffic controllers, have a common understanding of the cooperation and coordination needed to pursue safety, efficiency in their work and their industry. Aviation communication typically

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*indicating the intention of the RA. A "Clear of Conflict" message will be generated when the aircraft diverge horizontally*

*85 Indicative cases are the Japan Airlines near-miss incident (2001), the Überlingen mid-air collision, between a Boeing 757 and a Tupolev Tu-154 (2002), the Gol Flight 1907 collision with an Embraer Legacy 600 (2006).*
involves a complex interplay between individual cognitive factors and social interactive factors (Cushing, 1994, p.3-4). The cognitive mental processes of the speaker or hearer include the interpretive model of the situation, the assumed values, the judgments and beliefs where as interactive factors include standardized definitions and protocols, cultural requirements and hierarchical perceptions, among other elements. Both kinds of factors are indispensable when communication messages are verbalized and exchanges through the use of language.

Voice has a natural almost biological appeal; it is convenient and, thus, preferred both in human-to-human and human-to-machine communication. Verbal communication uses the vocal signal system with words, both oral and written words. In the current last part of Chapter 5, the study moves to verbal communication using language, as the collection of symbols put in words, and words in order with syntactic rules to convey meanings in a structure appropriate for the aviation context, its requirements and particularities.

The way aviation professionals communicate verbally has several attributes of a “private language”, with expressions for what can be known only to the speaker and the close group of similar speakers, unlike the analysis of Wittgenstein (1967). It is private, because of the connection that pilots have with their flight missions and the internalized sub-culture of the aviator, in which sensation for the aircraft and sensation for being airborne is included. Avgerou & Conford (1993, p. 96-98) used a systems view of language, as an information carrying
mechanism, containing: (i) pragmatics as social context, assumptions, expectations and beliefs that concern all those involved in communication, (ii) semantics as the meaning and knowledge of the signals, words, signs and their interpretations, (iii) syntactics as the logic and grammar used for the construction and transmission (communication) of words and (iv) empirics as the codes and the physical characteristics of words in various channels of communication (e.g. pronunciation, and proper spelling are included).

In aviation communication, pragmatics and empirics affect situation awareness; pragmatics aligns the intended meaning of the speaker with the perceived meaning of the receiver. As Grice (1989) explains, the receiver is inferring a hypothetical meaning from the speaker and uses the psychological and social context to validate it. This context, in aviation, has very much to do with the situation awareness developing from both sides. In their turn, syntactics and semantics comply with the requirements of control and maximization of efficiency and safety. The order of words in message call has to be maintained; e.g. the standard format to call the air traffic control tower is “who you're calling, who you are (callsign), [and then] where you are, and what you want.” “Three zero Tower” is a call from the Tower to the station “three zero” (call sign) and the response “Tower three zero, go ahead” confirms that the ground station “three zero” is ready to hear the Tower. The order of words is standardized and conducive to “who is calling (to) whom”.
This call was the daily first greeting call in the start of each shift when I was the liaison officer between HAF and USN responsible (among other things) for security clearance, take-off and landing, and freight monitoring for every incoming and outgoing flight in Souda Bay, Crete, Greece. I was in the ground diplomatic station, but the pilot-controller communication had an additional portion of a speech act (confirming a physical act in the cockpit), in the form of a restricted register (Ragan, 1997). E.g. “turn left to two five zero” contains an instruction (to turn left) and a value (to the direction of two five zero). This is a simple standalone unit of information with a parameter and its value in a specific talk turn; if more than one unit are put one after the other then a complex expression in formed, if needed for a specific sequence of actions in one call. The controller calls a prompting speech act and the crew confirms (reads back) and performs the act as manifested in the radar screens of both parties\textsuperscript{86}.

These units of information qualify as information artifacts (of an oral document status in the end of the flight) with the materiality of their substance in navigating, the institutionalization of their context in aviation talk, and the structure embedded in their vocalization (Turner, 2010). Moreover their orality is

\textsuperscript{86} Air traffic control standard international practice is to monitor airspace using two radar systems: primary and secondary. Primary detects and measures the approximate position of aircraft using reflected radio signals. It does this whether or not the subject wants to be tracked. Secondary radar, which relies on targets being equipped with a transponder, also requests additional information from the aircraft - such as its identity and altitude. All commercial aircraft are equipped with transponders (an abbreviation of “transmitter responder”), which automatically transmit a unique four-digit code when they receive a radio signal sent by radar. The code gives the plane’s identity and radar stations go on to establish speed and direction by monitoring successive transmissions. This flight data is then relayed to air traffic controllers. However, once an aircraft is more than 240km (150 miles) out to sea, radar coverage fades and air crew keep in touch with air traffic control and other aircraft using high-frequency radio. A comprehensive description from BBC news at \url{http://www.bbc.com/news/world-asia-pacific-26544554}. 
materialized in the FDR and CVR devices with limited historicity due to the recording loop, unless an accident happens.\textsuperscript{87}

An example of the semantic dimension in “air speak English”, or aviation parlance as Cushing (1994; p.10-12) calls it, is the verb “\textit{hold}” that means to stop what you are doing where as in plain (and colloquial) English\textsuperscript{88} it can also mean continue or maintain what you are now doing\textsuperscript{89}. That is why aviation discourse highly regulates symbolic action which has to be coordinated, between crew members and air traffic controllers, as the major partners. Aviation discourse has contextual particularities which turns this subset of English as a language for special purposes in Ragan’s terms (1994). When the grammatical structure of the sentence matches the speech act with immediacy for a statement, a command or a question then language is identified as direct in a natural way.

\textsuperscript{87} Black box flight recorders usually comprise two individual boxes: the Cockpit Voice Recorder (CVR) and the Flight Data Recorder (FDR). Popularly known as ‘black boxes’, these flight recorders are in fact painted orange to help in their recovery following an accident. The CVR would be better named the ‘cockpit audio recorder’ as it provides far more than just the voices of the pilots. In fact, it creates a record of the total audio environment in the cockpit area. This includes crew conversation, radio transmissions, aural alarms, control movements, switch activations, engine noise and airflow noise. Older CVRs retain the last 30 minutes of an aircraft’s flight. A modern CVR retains the last 2 hours of information. The newest data records over the oldest data (endless-loop principle). The FDR records flight parameters: pressure altitude, indicated airspeed, magnetic heading, normal acceleration, microphone keying etc. Microphone keying (the time radio transmissions were made by the crew) is recorded to correlate FDR data with CVR information. The FDR retains the last 25 hours of aircraft operation and, like the CVR, operates on the endless-loop principle. As FDRs have a longer recording duration than CVRs, they are very useful for investigating incidents and accidents. Material (boldface highlight the recording memory storage) from the Australian Transport safety Bureau at \url{http://www.atsb.gov.au/publications/2014/black-box-flight-recorders.aspx}.

\textsuperscript{88} There is a full collection of definitions on the verb in Encyclopedia Britannica’s Merriam Webster’s dictionary, particularly in the transitive and intransitive form at: \url{http://www.merriam-webster.com/dictionary/hold?show=0&t=1409498055}.

\textsuperscript{89} The ambiguity of the verb “hold” contributed to the accident of Air California Flight 336 Boeing 737-293, N468AC, John Wayne Orange County Airport, Santa Ana, California, February 17, 1981 (NTSB/AAR-81-12). The airplane landed with gear up when attempting to execute a go – around to avoid an airplane on the runway. See more at \url{http://libraryonline.erau.edu/online-full-text/ntsb/aircraft-accident-reports/AAR81-12.pdf}. 
5.5.1 Directness and Familiarity Scenario

In order to investigate further the directness of verbal aviation discourse between controllers and crew members (the pilots mostly) another scenario is employed, in order to identify the relation of direct language with cultural or linguistic factors. The scenario is formulated from preliminary discussions for the conduction of the major flight phraseology survey (IATA, 2011). It is posted below, in two parts, in the form of a narration from a civil aviation pilot, namely AIP25:

Of course, if I know the ATC person I may bypass the standard phraseology and say “Eh, John this is Tom; what happened, did you hear me? Do you mean it or I have to wait for descent?” If not I may just stay to wait in patterns, especially if I do not have a series of corresponding flights in a sequence. I know that safety is the primary concern but we are also professionals who communicate in discussion terms. I feel it as more natural.

AIP25’s narrative introduces familiarity, as a reason for bypassing the standard phraseology, to speak in natural language terms and not in the restricted register vocabulary of air speak English. It seems that he was waiting for a reply in the inquiry of the final approach to land and since there was a delay to get a reply he could choose to fly in a holding pattern, if there is no immediate other flight to catch to a new destination. He acknowledges the importance of flight safety but supports the idea of a more tolerant behavior for professionals who know what they
are doing even with a non-standard phraseology that sounds natural. Since AIP25 has to work long hours and for years in a mediated and regulated technological environment, human contact was of great value. The question regarding this scenario is asking about the balance between direct and informal language for efficient communication and about the potential authoritative mindset that pilots show over the controllers. The second part of the scenario is below, with the pilot AIP25 concluding:

> It took me, I could say, more than 1,000 flying hours to start feeling safe about myself and specific travel routes (when the weather is in general terms “stable”). I try to include in my social relations people from ATC, as well as other aviation professionals in order to develop a level of familiarity for their personalities.

With the accumulation of expertise in flight hours, travel routes and self confidence, as AIP25 mentions, one should feel comfortable professionally (more competent and experienced), in order to start looking aside of the typical ruling path and, in this case, happened after 1,000 flight hours. The pilot feels also the need to understand controllers better, starting from a social aspect to facilitate him conclude on typical personality characteristics of the air traffic controllers as professionals in a community of practice (as explained in section 4.5.2).

A community of practice is a social unit with members (pilots and controllers in this case) who share and learn, based on their common interests in aviation safety and their mutual engagement (often times out of their work
schedule). Being a community it enables the members to collaborate and augment their tacit knowledge and workable practices, as in Lesser & Storck (2001).

**5.5.2 Phraseology, Professionalism and Cultural Familiarity**

AIP15, from the young controllers’ generation, has also replied in previous scenarios (from chapter 4). She discusses her views and relationship-building mindset below.

I am quite strict about using non standard phraseology even if the controller knows the pilot personally. The pilot above implicates that he may have better service by the controller he knows if he speaks to her in an open language. However, this is not the case. Phraseology in our field exists in order to avoid speaking in an open language and avoid misunderstandings. There may be a more familiar tone between two people knowing each other, only when they want to send greetings or call one another with his/her first name in order to say good morning or hello.

AIP15, although in her first years in the profession (or even occasionally because of that) is categorically definite about the use of standard phraseology, despite a potential personal connection with the pilot. Being in Greece, a small country with a dense network of airport where the likelihood of repeated flights is high and with not more than three domestic airliners, it is almost inevitable that controllers and pilots gradually acquire familiarity. But, AIP15 is clear on that since it part of her credibility; she does not accept the implication of alleged preferential service to the pilots she knows (in compare to those she does not know).
Language is one of the tools controllers use in their professional life and reflects attitudes, commitment and responsibility. Standard phraseology helps lessen ambiguity of spoken language and facilitates common understanding. Non-standard phraseology might be simplified but the meaning may change completely in its intended message, especially when standard key words like the call sign (e.g. “US 1549”) or numbered locations (turn to “two three zero” or “Aircraft go on to 6,000 feet”) are replaced with non-standard colloquialisms (like “this is me, Tom”) or do not explain what is the reference of specific numbers in the message (which aircraft is mentioned or numbers denoting an altitude, a heading, an airspeed). Non-standard phraseology, where names are involved, shows familiarity indeed and may shape attitudes (Vanlear, 1991).

But that type level of familiarity is not compatible with a common level of situation awareness when radio communication is spoken in a shared service line, the party-line communication channel\(^{90}\). Since it is not only important what the controller’s say but also how it is said, AIP15 admits that familiarity could be expressed with the use of paralanguage with a speech mannerism or tone of voice adjustment without creating unnecessary distractions. A named “hello/goodbye” greeting is a level of professional politeness that she would recognize\(^ {91}\). She continues to say:

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\(^{90}\) The “party line” refers to the open radio channel through which all aircraft in a given airspace communicate with air traffic control (ATC), a system that allows pilots to hear both their own clearances as well as those of the other aircraft. The downside of that is that it increases the workload of pilot workload and multitasking.

\(^{91}\) It is indicative that in the Malaysian Airlines Flight 370 from Kuala Lumpur to Beijing that disappeared on 8 March 2014, the phrase that was released from the Malaysian authorities was a sign-off "All right, good night" from the cockpit to the controllers; later it was retracted as "Good night Malaysian three seven zero". The
In any other case, the standard phraseology should be applied putting aside any acquaintances. It is not a matter of authority but safety. Open language does not and should not imply faster service. The controller should be the same to every pilot keeping their professional relation above every personal relation.

AIP15 concludes that standardization is in the essence of the aviation professions and especially in “Tower communications” where a restricted register exists. As Ragan (1997) puts it, users of restricted registers must comprehend and produce utterances compliant with the requirements of a very specific situation. After all, open language (in forms of plain language) does not imply faster service but rather more uncertainty and communication noise.

AIP15 moves on to comment on the development of personal (but not inappropriate) relationships with pilots in shifts. Professional awareness of the other’s work (the pilot) generates interactional trust and resists to preferential treatment, while professional dependability is enriched with personal familiarity. AIP15’s position is below:

I agree with the opinion of the above pilot, as I usually do the same thing.

For example, when I travel by airplane, I intend to fly inside the cockpit in order to get to know the pilots, their personality, their procedures on board, how they understand the messages of ATCs, the time needed for response to formality difference (use of call sign with a greeting and no confirmation) of the two greetings has raised additional questions (e.g. is it a deliberate transmission or not, who is speaking from the cabin, is it a farewell for the flight etc) in a case that is still under international investigation. After a formal request from Malaysia the Australian Transportation Security Board is leading the search of MH370 in vast areas of the Indian Ocean (. More at http://www.atsb.gov.au/mh370.aspx/).
them, their use of language and phraseology. This is very helpful, because if you know the pilots culture could mean that you can interact in a more effective and efficient way. Professional dependability is enough but it would be an additional advantage if there was a personal familiarity. To be more specific, by familiarity, I do not mean using open language or chatting on the frequency, but getting to know better pilot culture, education and role in several situations.

AIP15 offers an important point, here, that is very important for the controller to understand the work and the mindset of the pilot, in the realities of their actual “doing the job” (as she accepts pilots would do for the air traffic controllers). She discloses an unconventional small-scale practice of asking to travel inside the cockpit (when she has a travel arrangement) in order to become more familiar with the pilot operations, procedures, time management, and conversational style.

When I probed further to her to explain her “intrusion” in the cockpit, she has explained that in domestic flights that last less than an hour (quite common in the Greek FIR) she is just asking that from the crew in the take-off and landing process. In other flights of Greek airliners abroad there is a special request from the professional association of Air Traffic Controllers to HCAA and it is feasible only if (and at the time and for the interval) the cockpit crew finds it acceptable and not disturbing. So, it is not an intrusion but an institutional provision but only when cockpit members allow it (and they are not obliged to).
This way AIP15 becomes familiar with the working culture and training background inside the cockpit and understands better what to adjust on her part. She is a woman in air traffic control and likely to be more expressive and accommodating in conversation, especially when non-routine situations occur, as several of her colleagues observed in their common shifts. This is consistent with the conversational patterns of behavior that are gender related, as Giles and Street (1985) exemplify in their research. In this manner, AIP15 formulates her personal familiarity, not to shift interactions to open language or start chatting, in order to ameliorate her communication as a controller to the cockpit. Thus, professional dependability coupled with that concept of familiarity generates a collaborative scheme in their work.

This familiarity disposition that AIP15 explains is compatible with the cooperative behavior which (on average) are intrinsic in how the airport tower works with the air traffic controllers (Tavanti et al, 2006). Air Traffic control systems have a “socially organized character” (Bannon & Shapiro, 1994) and controllers have a strong sense of a community of practice in the larger context of interaction with their environment as human beings (Marti & Scrivani, 2003). AIP15 commentary is a profound manifestation of personal responsibility and (collective) work ethics with remarkable self-motivation dimensions.

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92 To add a personal experience in the air traffic control gender discussion, after the first month in my duty in NSA Souda Bay, I have noticed that two navy women were in night Tower operation shifts (from 7.00pm till 7.00 am in the next day) quite more frequently than that men. I have also noticed that in several emergency landings the Base operations office was asking those two operation controllers to take the microphone. It turned out (after several discussion I had with different members of the NSA command) that the intonation and pitch for the voice of those controllers had a relaxing and mitigating impact in these extreme situation, unlike their male colleagues whose voices did not make any difference.
5.5.3 Minimizing Mistakes, Helpfulness, Personal-Professional Separation

In professional and institutional communication, interlocutors are inclined to follow a collaborative scheme to ensure comprehension, at a certain level of mutuality which is decisive for their work. AIP15, as stated in section 5.5.1 is actively seeking both the (pilot’s) context and the level of understanding needed for her work. Both pilots and controllers communicate with a background of shared knowledge about the English language and the special purposes register of it; about the communication conventions of the pilot-controller confirmation and correction process; and about the operating environment with certain conditions and navigation demands.

In this model of collaboration (Clark & Schaefer, 1987) pilot and controllers start with a fiduciary acknowledgment of accepting the information they exchange as appropriate; i.e. as complete, accurate, and timely (but in a real-time evolution). They must both agree that they share the same mental situation model before they continue to the next communication transaction (Billings & Cheaney, 1981). That type of harmonization and shared understanding includes persistent confirmation and correction from both sides; i.e. the receiving station (pilot or controller) repeats a received message or an appropriate part thereof (like numbers or directions) back to the transmitting station (controller or pilot) so as to obtain confirmation of correct reception (a readback process). The transmitting station, in turn, repeats the appropriate part of the readback to confirm the correct reception of
the readback. So, if A transmits to B, B confirms a readback to A, and A confirms or corrects a hearback to close the communication loop.

In these terms, I went to seek the insights of a fighter pilot with multi-cultural mission experience to expand on the same scenario of non-standard phraseology from the pilot AIP25. AIP1 was the one, with a great deal of experience in NATO reconnaissance missions just after the fighter pilot practice, had the opportunity to fly over and contact diverse air traffic control towers in the seventeen European countries (and US bases) which participate in NATO operations. His comments refer to the efficiency of directness and informality and the potential of a power game between controllers and pilots.

The scenario under discussion is the narration of AIP25, about the communication with non-standard phraseology, when the pilot and controller have some type of familiarity (as described in section 5.5.2). AIP1 disagrees with AIP25 as shown below:

I don’t agree with the aforementioned comment. When standard phraseology is used then the communication mistakes are minimized. More effective in my experience is when the sender’s message achieves the desired purpose. In order to achieve that, you need to give all relevant information, with Standard Terminology, checking for possible ambiguity. If you start using words like “do you mean it?” then you are close to a dispute.
AIP1 emphasizes his disagreement with the AIP25’s prompt on the use of plain or colloquial English, despite the fact that AIP1 comes of a background with strong personal relationships in the pilot sub-culture. Standard phraseology limits the margin for inferential extensions, for loss of reference, and minimizes mistakes as it is predictable. Effective communication is accomplished when the message of the sender is perceived and the receiver acts up on as intended to. The restricted window of time applied in aviation demands not only perception but also action and confirmation for the interaction to continue. So, as AIP1 points out pilot-controller interaction is symmetrical when all relevant information is in place for a specific situation, in standardized manner, so an ambiguity check should become possible.

When explanatory question are posed they lead to a possible communication breakdown, in a tit-for-tat interaction between controller and pilot about which of the two possess the intended meaning. Standardized phraseology demonstrates affiliation with one another in the pilots-controllers group, a phenomenon of linguistic convergence, similar to the adaptations described by Giles et al. (1991). AIP1 does not recognize and issue of authority in the pilot-controller relation, as expressed below:

It isn’t a matter of authority between a pilot and an ATC controller. It is a matter of responsibility. The pilot can request something and the ATC will work on it, to check if he can grant the request. In my 30 years career as a pilot, the ATC controllers were always willing to help. I can only think an
informal discussion with a controller in a small airport, in clear weather conditions with no traffic, in low level. In other words, when all conditions are very nice and under control and there are no safety risks.

AIP1 does not accept a power game, as he emphasizes responsibility. The pilot submits requests for service and the controller is there to help implement those requests, in terms of availability of resources (air and ground space included or even the frequency capacity permitting, if there is a need of an additional communication channel). A career experience a fighter pilot in one-seat fighters or in multi-crew reconnaissance aircrafts confirms that controllers are not in other side, but in the same side willing to help. Informal discussions are tolerable, in AIP1’s mind, when in ideal flying conditions and in small airports, where the window of time is wider and traffic are limited.

As the controller has a significant control on the situation on the ground and the scheduling of time slots for incoming and outgoing traffic, a position of power is in place but as a role of service, to do the work. Controllers as a professional group and pilots as their own come from different sub-cultures but collaborate to avoid a linguistic intergroup bias, with positive favorable terms for in-group members and negative undesirable behavior of the out-group members (Maas et al, 1989).

This accommodating feeling of affiliation is more apparent in smaller aviation communities like the Greek case, in which the density of flight and aerodrome flights, the affinity of aviation with the average layperson and the
international recognition of their professional competence have accomplished professional solidarity atmosphere coupled with a trusting environment (especially when military pilots are in missions or retired military pilots are employed in civil aviation). AIP1 ends his comments about the last part of AIP25’s scenario (from 5.5.1), regarding the social relationships in shifts and the balance between professional dependability and personal familiarity. AIP1 is prone on the separation of professional affiliation with personal relationships, as he states below:

As a pilot, in multiple Air bases and command centers I neither pursue social relationships with controllers to increase the feeling of mutual trust nor did I conceive an effort from their side to do so. I tend to believe in the personal-professional separation of roles; a key concept was the spirit of cooperation and the friendly atmosphere.

AIP1 says that being in the intense HAF and NATO operating environment he did not aim to form personal relationships and he did not have such inquires from controllers. His mission training and mindset is not directed to create relationships for his everyday life work, as the Air Force has a required level of expertise and dependability for all its members who participate actively in operations. The reciprocal behavior from the controllers to prioritize the professional tasks over personal acquaintance shows a work ethic culture that supersedes organizational patterns, even in the business world where social capital is a key determinant of career in market terms (Krebs, 2008). Air Force, especially with the defense-oriented doctrine of HAF, has a mission obligation and a sense of pride which
cover all other professional goals. In any case, the trusting environment of collaboration is build on complementarity of roles and constant self-improvement, as shown in the last part below, where AIP1 describes a certain type of guidance which was accommodating to the controllers:

In my experience as a Tower supervisor in Air Force missions, there have been times when I notice that the controller could not internalize the 3-dimensional projection of air traffic in Tower without radar for approach. Without interfering to the radio communication, as I was not authorized to do, I have explained that the controller’s instruction was not appropriate for the octave of fighter planes which was approaching. The controller did not take into account the diverse speeds of different aircrafts that could generate a cross over if separation margins are not keep proportional. That act has an impact to the projection of routes according to time. After this explanation the controller understood how to adjust the given instructions, as mid air collision was a possibility (especially in those speeds).

In HAF missions, especially when more than a pair of fighters is engaged military air traffic controllers are accompanied by a high rank officer, a HAF pilot, who

93 Duty-is-my-career mentality was apparent in a collective but anonymous letter (from thirty five fighter pilots) which was broadcasted on May 6, 2010, on the occasion of the economic challenges of Greek society (due the economic crisis) and austerity measures and fighter pilot salaries. Their bottom line was “When we are up there flying everything down there is small and we ignore it” (in the top rated RealFM 97.8 radio, Giorgos Tragkas, “In Athens” radio show). In another occasion, in the national Greek resistance day on October 28, 2014 the real time message “lift the head up” from Captain Stralis the pilot of the HAF Demo Team, during the parade while on flight, stimulated the morale of the people in the Greek society and diasporas (see http://www.protothema.gr/greece/article/421894/sminagos-stralis-eipa-sikoste-to-kefali-psila-ek-merous-tis-polemikis-aeroporias).
oversees the implementation of the flight or (most often drill). When different types of fighter or attack aircrafts operate together there may be significant differences in navigation and speed as afforded by each type. Thus, uniform instructions might provoke a risk of separation distance loss when the controller is not able (usually inexperienced) to fully understand how the screen indicators show in Tower screens. Flying missions may collide in real situations, if there are no adjusted instructions for the final approach. AIP1 perceived the mistake while in the Tower, but respected the authority of the controller, explained the situation and then the controller was able to retract the guiding instructions (in the same mode that AIP15 was suggesting in section in section 4.4.2 for correcting mistakes with responsibility).

The making of the mistake from the controller and the catch from AIP1 who explained the possibility of erroneous projection of the flight routes was a constructive confidence building process that AIP1 includes in the accommodating atmosphere of cooperation in the environment of the Tower. AIP1’s explanation using his tacit knowledge in Polanyi’s terms (1966) offered the controller a form of information acquisition from a trusted, responsible and capable pilot-supervisor who became the controller’s colleague, in the collegial sense of experts (Koskinen et al, 2003).

### 5.5.4 Home Base, Surrounding Traffic, Intimacy Limit and Mindfulness

The last response on the same scenario of “social relationships” comes from AIP6, the helicopter pilot of Hellenic Army aviation we have met on chapter 4.5.3.
He is more of a team player, despite his leadership position in his battalion, and always tries inculcate collaboration beyond mere authority as a Colonel of the Army. The last chapter of his career involves the active design of war simulation games for tactical training in NATO missions. In this stage, he has to be quite realistic about the actual environment, even beyond the ideal case sometimes presented in used and training manuals.

AIP6 comments on the scenario of AIP25’s bypassing of standard phraseology and professionalism, as well as the tendency to seek for personal relationships. His insights are below:

The non-standard phraseology communication usually happens at home base and on secondary radio frequencies or low traffic airports, where the environment “seems familiar”. The non-standard communication is true that sometimes facilitate understanding and accelerate a procedure (e.g.”-Hey, Michael, leave the external load north of the tower to get through the ground personnel moving this time on your right.

-OK, Ipporkatis, got it ”).

AIP6, without any latent thoughts, is clear to distinguish two categories of cases: (i) home base or secondary frequency communication or low traffic airport and (ii) compulsory standardization in the other case and in favor of the surrounding traffic. In the first category mentioned above, AIP6 is accepting the use of non-standard phraseology as a fact (and likely prompted) in familiar environments like the home base of a squadron or battalion where the sense of “I know where to go” prevails.
Also, in some occasions the aircraft (it is more common for the helicopters he is commanding, due to flexibility and volatility in their missions) asks for the secondary frequency, in order to avoid a primary frequency congestion and communicate with the controllers (or a mission supervisor) in a more comfortable way (to deal with an emergency or to clarify option and flight choices). The low traffic airport is not a typical case but rather an exception, where air traffic is under control and rather limited interaction is needed. The main reason for the use of non-standard phraseology is not random but is functional, since it might facilitate the better understanding of a situation and expedite peripheral supporting activities for specific mission.

In his example, AIP6, a certain ground traffic arrangement is agreed with only one interaction with not so explicit use of units of information (“north of the tower”, not numbered coordinates) and rather abstract reference (north of the tower) with an inferential extension (“this time, on your right”). The confirmation “OK, Ippokratis, got it” is in rather plain language but economical and applies to three communicative transaction units (“leave, get through, moving”, “got it” for all) with respective parameter values that would require step-by-step confirmations (Howard, 2008). This instance involves more gut feeling and experience (rather than explicit knowledge from SOPs) learned during observation, practice and past common experiences and interpersonal contact between “Ippokratis and Michael”, as Epstein (1999) explains for tacit knowledge. It is quite unlikely that the same arrangement would be performed if the two main actors change.
AIP6 continues in order to avoid any misinterpretation of his position; there is a level after which the use of non-standard practice is not sustained and cannot be applied. See below:

However, the relaxation and the expanded use of it, is dangerous, especially if done between people who do not know each other personally, or under high traffic conditions, as there is a risk of misunderstanding, incomplete messages and no confirmations, so that eventually, benefits of compulsory use of standard phraseology are more significant. Additionally, a communication between ATC and a pilot, should be also understood by the surrounding traffic (this is why around Greek airports of heavy traffic, communication is consistently by-the-book and in English language).

AIP6 stresses that a successful outcome accomplished with a non standard language cannot be generalized. The use of non standard phraseology cannot be expanded because the actor (pilot or other) feels relaxed about the initial outcome. Tacit knowledge transfer is possible with extensive interpersonal contact, after knowing “Ippokratis and Michael” know each other (Collins & Hitt, 2006). His strong disclaimer is mentioned to show rather the generic case and underline the exception of non-standardization is in first category of cases. The risk of misunderstanding, incomplete messages, and omissions of confirmations is a threatening burden of high stake.

Besides that, standardization in language is compulsory because the pilot and the controller are not in a vacuum (or bubble), but in an open airspace
environment where the surrounding traffic is approaching and if they understand
the dialogue they increase their situation awareness. That is why, he mentions, that
in Greek international airports which have dense flights communication is strictly
standardized, in ICAO standards.

AIP6 wants to expand on the case of standard phraseology and restricted
register by combining with the last part of AIP25’s scenario, regarding the
tendency to build social relationships and balance professional dependability with
familiarity. His comments below are mentioned as gap assessment of the first part
of his answer with the informal interaction of “Ippokratis and Michael” (italics and
explanatory parenthesis added):

The social relationships between pilots and ATC personnel are something
common in the home base environment. The tone of voice, rhythm, and
speech pattern between persons that know each other well, leave to pin
more things than those described by words. This definitely enhances an
already good communication as more data transmitted in less time. But,
exceeding an intimacy limit in communication, leading to large deviations
from standard procedures, should be a red line. For example, it is
unacceptable the following communication:

“- ES912, after takeoff fly direct to KINETA climbing to 2000’. Incoming
traffic, 3 miles east, at 300’.
- OK, guys, thank you . ”

(Note: No confirmation of instructions and possible risks)
Sociality, for AIP6, is inevitable and accepted in the home base environment. The patterns of interaction as well as the paralanguage elements enrich the communication content and information value and materiality of interaction between actors that know each other well (and it happens in the home base). In the same direction, in all international missions pilots take their aircrafts and maintenance personnel to ensure appropriate operational communication, as if they are in their home base (among other reasons).

This type of language convergence because of intimacy must not lead to broader deviation from standard operating procedures when decisions have to be made (usually in concurrent comparing and contrasting options). Having in mind the informal structure of the interaction between “Ippokratis and Michael”, AIP6 is presenting another view (a projected route after takeoff). The helicopter with call sign “ES912” is instructed to fly direct to a known airport (KINETA), in a certain altitude (2,000) after takeoff, while there is incoming traffic (3 miles east, at 300).

The over abstract response “OK, guys, thank you” is simplistic and out of the standard phraseology, as it has an broad inferential level (where the “OK” goes) and needs confirmation about the instructions and its values per “climbing” step. If one of the instructions is not perceived or misunderstood the risk increases. The readback confirmation is crucial in such type of instructions with more than one

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94 An indicative case for that risk is the fatal accident in Eastern Air Lines 1011, N310EA, Miami, Florida, December 29, 1972. The Autopilot was turned off and the crew did not notice as they had a landing gear issue. The ATC concerned from the loss of altitude asked “ATC: Eastern 401—how are things coming along out there? Captain: Okay—we’d like to turn around now and come back in.” as the Captain was thinking that the ATC was referring to the landing gear issue they had, just before the plane crashed. more at NTSB/AAR-73-14 report at http://libraryonline.erau.edu/online-full-text/ntsb/aircraft-accident-reports/AAR73-14.pdf
value to apply. The harmonization explained in section 5.5.3 is not happening with this interaction.

When noting the contrast that AIP6 is using to highlight the importance of standardized communication, then the Epstein’s (1999) attributes of mindfulness apply. AIP6 combines explicit knowledge (readily taught and accessible to awareness) with tacit knowledge; learned during observation and deliberate practice (intimacy and repetition of missions); with prior experiences; theories-in-action (familiarity with the home base environment); and values (social relationship in the home base); and is usually applied more inductively (being able to position equipment and personnel towards the Tower and the passage). Apart from that, mindfulness includes a “moment-to-moment self-monitoring” and AIP6 is conscious of what he saying as a common rule and what as an exception. Self-monitoring is a control alert and a feedback mechanism to tacit knowledge: values, peripheral vision and subsidiary awareness allow for new information and perspectives and trigger curiosity which sustains vigilance.

5.6 Touching the Mother Tongue in Aviation Communication

The discussion about the voice and language in this study concludes with a short review of issues of language and mother tongue, as reflected but some of the discussants and will be the kick starters for further research. This section organizes the background of language and mother tongue in aviation communication, as collected by side informal discussions with the responders who were involved with
the IATA phraseology study (2011), prior to their replies to the specific scenarios of the current study.

Crystal (2003) analyzed how English has become the global language in 1951, primarily because English speaking countries dominated the flight operations, design, development and manufacturing of that era. ICAO recommended, as it was not an obligation\textsuperscript{95}, English language to be the de facto civil aviation language. Global English became a communication platform for business, science, and technology. On 2008 ICAO standards and recommended procedures (SARPs) required that aviation personnel only in international flights should master a set of word and phrases from the “ICAO Radio Telephony Phraseology”\textsuperscript{96}. Still there is no prohibition for the use of local (national) languages in domestic airspace.

Furthermore, Crystal recognized conversation registers such as “Seaspeak” for maritime use and “Airspeak” for Air Traffic Control and aviation. On the other hand, the need for bilingual ATC communications was underlined in empirical cases with aviation professionals. Ragan (1994) characterized “Airspeak” English as a controlled language in aviation that is broadly regarded as acultural; in contrast cultural factors and conversation interaction do have an effect on specialized communication.

\textsuperscript{95}ICAO Recommendation 5.2.1.1.2 stated that “pending the development and adoption of a more suitable form of speech for universal use in aeronautical radiotelephony communications, the English language should be used as such and should be available on request.” This recommendation remains in effect. It is notable that it is not compulsory, as a Standard would be.

\textsuperscript{96} A quick reference version of that document for Commercial Air Transport Pilots can be found at Eurocontrol’s skybrary at \url{http://www.skybrary.aero/bookshelf/books/115.pdf}. 
Airspeak wording is a controlled language with a singular context focusing on human-machine interaction and air transport safety conduct. But most aviation accidents are attributed to human error, with the large majority of it being communication problems (Billings, 1981). Problems of communication have been found to be a contributing or (sometimes) causal factor for many critical incidents as well as near and actual accidents in aviation (Cushing, 1994; Helmreich et al., 1999; Jones, 2003; Krifka, et al., 2003; Silberstein & Dietrich, 2003; Tajima, 2004). In terms of language use, Cushing (1994; 1995) analyzed problems of reference, repetition, inference, ambiguity and homophony in the English language. Jones (2003) spoke about “symptoms of miscommunication” (as violations of procedures and instructions) and communication-specific problems for language interpretation and phrasing.

On the other side of language use, Jones puts phraseology defects and implausible word choices. As a result, several categories of problematic communication were identified by Howard (2008): incorrect information, failure to provide information, request for repetition, and correction to repair a previous communication error. These categories are manifested in the use of English language in aviation communication and are accompanied by linguistic elements in the use of language: the context and expectations (what to hear instead of what is actually said); speech intelligibility (based on the phonological features of a mother tongue); paralinguistic factors (analyzed in the start of the chapter); aviation jargon (leading to ambiguity); words resemblance (homophones, homographs, homonyms
and synonyms), and code switching (changing languages in the course of communication).

5.6.1 Mother Tongue Scenario and Code Switching in Language

Code switching is the element discussed in this section, as the alternation between languages or dialects of the same language. Code switching occurs even in English between plain English and technical jargons (which creates subsets of English for special purposes). One of the aims of this study is to investigate the role of code switching from English to Greek, its causes and impact as perceived by the real users of the languages (pilots and controllers). The relevant scenario was developed in a briefing discussion in HCAA Flight School, from a pilot namely AIP24, and is the following:

ICAO English may be the spontaneous choice when I follow habitual in-flight processes (without too much processing in my mind). I know there is a difference in FAA when I fly in the US as recommended phraseology is not the same. Sometimes, I feel as I am a “recorded voice” in action when I apply the routine SOPs. In contrast when I have to do some more that the standard checklists, I find myself using Greek language and mostly Greek words inside English structures.

AIP24 is describing, here, a code switching process in multiple directions; ICAO English have several differences with FAA English (as shown in Appendix D of this study), English come as a default language, routine processes are close to automated passive functions, and checklist marking is like a dialogue mix of Greek
and English. Taking this scenario as a reference the question posed concerns the role of the Greek mother tongue “when communicating” and the comparison of its use in emergencies in compare to routine flights.

5.6.2 Responding to the Mother Tongue Scenario

Let’s see several responses collected from the discussants who participated in this study. I encouraged each responder to recall flights when mother tongue was used. The probing questions were about what is accomplished when communicating with the mother tongue or with standards phraseology. Also, is it different in emergencies in compare to routine flights, with the experience of the world around the flight (a GA type of awareness), as well as of the micro-environment of the cockpit, and the need to report and act?

AIP14, the most experienced controller in the discussion prompts the following response:

Yes, definitely, during emergencies, mother language can proven very helpful as you do not have to think about structure, right words, it is spontaneous. Communication in English is not always easy, especially when you have to speak in open language, you might not know all you want to say in the best way. I am trying to speak always in English during my work but it happened to me to choose mother language to overcome an emergency, when pilots are Greeks. I might need more training in English for such cases, but I wonder if I would ever be able to speak a foreign
language as I speak my mother tongue, during emergency cases, when stress prevails.

She emphasizes that although her motto is to speak English to all, when there is an emergency and more information are needed, she prefers the Greek mother tongue with Greek pilots.

AIP15, the enthusiastic and language-sensitive controller, recalls an example where code switching, more than once was helpful. See below:

On the other hand, when situations out of the ordinary occur, there is standard phraseology that should be applied but does not cover many aspects of the problem. As a result, it is inevitable to deviate from SOPs and use open language showing flexibility and not trouble the pilot who is not able to remember phraseology but feels more comfortable to speak in an open language giving more details and information about the condition either of the plane or the flight.

When I was working in Thira, a VFR flight was approaching the airport and the pilot was French. His English was poor and while he was approaching he declared that he had lost his way. In that case, I started talking to him in an open language in order to make him feel more safe and comfortable, using simple English words. He sounded from his voice that he was confused and even scared so when I saw him approximately 8 miles from the airport I used one or two phrases in French in order to show him that I was able to speak to his language with which he was the most familiar
with. It seemed to be helpful because afterwards he sounded more
comfortable and confident. Finally, he landed safely.

AIP15 notes that SOPs seem not to cover all eventualities (and that is why) they are
always in a dynamic upgrade when incidents happen. She recalls a flight
approaching with a French pilot who sounded confused; she changed to open
English to facilitate him and then to French in the final approach so that he would
feel more comfortable, safe and not confused and it worked.

AIP1 the fighter pilot with multinational experience adds on this scenario:
Bypassing the standard phraseology and code switching in Greek happens
when I have to request for a combinations of things, and it would be easier
for both parties to explain it in Greek (with several English jargon in and
out). In HAF it is likely to happen to save time from repetitions, and
clarifications. A typical example in HAF is that weather permitting, fighter
pilots need to save time and fuel for more drills instead of more speaking.
Of course in emergencies it is more efficient to address in the mother
tongue. In dog fights there is a mixture of several verbs in imperative and
English jargon in between.

AIP1 states that code switching maybe time consuming when a complex message is
transmitted, and the way to avoid repeated questions and clarifications. For HAF
pilots in drills save time is crucial and the mother tongue applies better (especially
in national air space where threat exists). Mother tongue is also the choice when in
emergency and code switching in a hybrid mode happens in dogfights.
Lastly, AIP6 the helicopter pilots of Hellenic Army brings several important points although he is using the mother tongue more. See below:

The above text describes perfectly what I feel about use of English and Greek mother tongue. On flights within Greece, routine communications permit the "luxury" of formality using English language. However, in stressful situations (like emergency procedures), when what is urgent is the immediate transmission of a clear message, and the full understanding of it by the receiver, all employ the native language. On flights abroad, or when there is a strong traffic around, the use of English is one way, usually burdening the pilot’s workload, depending on his ability to use the English phraseology.

He feels that AIP24’s scenario is exactly what his experience is. Routine flights have the “luxury” to use English (as for him it shows ideal conditions) but when a stressful situation happens and understanding is crucial for both sides, the mother tongue prevails. In international flights, standard English is used but always as a cumulative factor in pilot’s work load and situation awareness.

The common denominator of these replies (and others collected) is that mother tongue affects the way pilots and controllers perceive messages and situations, so their situation awareness (as shown in section 2.3.2 and the example of multi-nation force of NATO). In emergencies, their mother tongue, the Greek oral language, prevails and more research is needed to connect emotions with language use and comprehension in extraordinary situations (Valeontis, 1999; p.7-
Lastly, language and mother tongue seems to hold an important part of the programming of the mind (Katerinakis, 2003, p. 68-69) and code switching needs more exploration, in different conditions.

5.7 Summarizing the Chapter of Voice

Chapter 5 was the transition from the phenomenon of silence in Chapter 4 to the use of non-verbal communication, hesitation and verbal communication in aviation. The chapter continues from silence to paralanguage and verbal communication. Analysis starts with the landmark case of the Helios ghost plane, in which the scrambled F-16 pilot explains the Renegade response in an effort to communicate with a silent aircraft. The fighter aircraft was used as a communication tool.

Then the hesitation scenario (as introduced in 2.5.2) is used with an incomplete Tower call that was in a hesitant voice, after a takeoff clearance was received. This scenario is the main inquiry under the question “what would you have done and why” for pilots and air traffic controllers who offer their own reading and evaluation.

Fighter pilots argue for the primacy of safety in compare to any other criteria that may apply. Controllers’ messages should be immediate and clear to avoid uncertainty and misinterpretation. Controllers should operate like the “eyes and the ears” in the ground when the pilot is in the air. Hesitation might be a result of fear and incomplete situation awareness. Pilot’s interpretation depends on a multitude of factors which assemble to “triage”, to the so-called aviation instinct
and to the Langewiesche’s “buoyancy”. Human error may happen in a bad moment and should be accepted in order to get it corrected.

Then the chapter introduces the scenario directness in language, informality and social relationship building when exercising communication between pilots and air traffic controllers (section 5.5.1). This scenario continues with the addition of the importance of understanding the “others” (pilots the controllers and controllers the pilots) and their personality traits.

Professional ethics and self-monitoring as defined by Epstein (1999) cultivate the expertise set of tacit knowledge (Doak & Asimakopoulos, 2010). The importance of standardized communication is part of a social and collaborative operating environment with the air traffic controllers.

In the last part of the chapter, after an overview of language and English use in aviation communication, an additional scenario is introduced to lay the foundation for future research in pilot-controller communication; the mother tongue as a primary code switching element (section 5.6.1). The modern aviation system requires the maximum amount of information expressed with the minimum of effort and consuming the minimum of time; so, it has been McDonaldized in terms of Ritzer, (2000).

The distinction between routine and emergency situations is foundational for the mother tongue selection in all cases. The persistence in the use of mother tongue has traces of the linguistic relativism notion (Whorf, 1956). Mother tongue seems to provide the evidentiality about the reported facts. Airspeak Greek,
analogically to Airspeak English, could construct a concept of language security
and trustworthiness for national public policy in the Greek airspace.
CHAPTER 6: CONCLUSIONS

6.1 Overview of Contributions

The purpose of this dissertation has been to show how important human communication is in order to accomplish a (safe) flight mission. The value-added contribution of this dissertation has been to infuse communicative components to, both, human factors and systems theoretic approaches to aviation, in a way that has not been done before by communication scholars.

There are at least four of those components that document the accomplished theoretical contribution: (i) the deconstruction of silence phenomenon in multiple dimensions, as part of an interaction and accountability process; (ii) the synthetic proposition of a voice-categorical label which consolidates paralanguage and hesitation, non-verbal and verbal attributes, in a communication channel applicable in aviation; (iii) the incorporation of situation awareness, with its views of local, transitory and global, as a component in communication models; and (iv) the revisit of mother tongue as a non-conflictual but complementary communication tool which may facilitate linguistic security, instead of competing with the lingua franca in aviation, the topical standardized English.

It is important to have in mind that aviation industry pays attention to each sole flight instance, since an incident, event, recommendation or warning observed in a single flight could modify substantial practices and technologies in the sector. Flight operating manuals describe an ideal flight situation, with information in the presented as sequential, where as the real flight operating environment is quite
more interactive and pushes communication in the foreground. Overlapping of tasks, interrupting of tasks and communication and taking the turn to complete each activity are happening in any random flight. Cockpit crew has to interact with a range of human actors on the ground and in the air. These actors send critical information (and hearbacks) to the crew, expect information (and readbacks) from the crew, and affect the timing, sequence and performance of crew’s tasks with their demands.

A flight has been represented in various ways but not as an act of composite conversation that combines culture with communication of co-present, mediated and cooperative actors. Cockpit communication, in this study, extends the physical context of the flight deck with the control rooms of air traffic controllers and operators in a whole physical space of interaction. The current study focused on two major communication categories, coined as silence and voice.

Silence, here, is extended as a concept to cover multiple dimensions, beyond the studies of intra-flight communication where cabin crew members fear to speak-up and silence as a regulatory requirement of a sterile cockpit. This dimensionalization of silence is a clear theoretical contribution, as it specifies aspects of a concept that advance our understanding of flight realities (Babbie, 2009, p. 130). Silence in the cockpit has the form of no-talk; not-confirming/reading in checklist marking between pilot and co-pilot, or using a silent checklist to mark. Silence includes non-replying to calls from air traffic control for extended periods; no-talking between cockpit and the cabin; standing-by
silent in an expected interval till the next phase of flight. At an organizational level, silence has the form of not reporting flight incidents in the flight log or in the briefing/debriefing process.

Since silence intervals are part of the interaction and vocal messages are needed to complete each interaction cycle. At this point, this dissertation synthesizes a vocal communication channel by consolidating non-verbal communication with paralanguage with verbal messages (as descriptions, calls, readbacks and hearbacks), in the category of voice.

Non-verbal is the communication without words, from vocalizations to gestures, and the use of objects and artifacts (Devito, 2011, p. 117). Paralanguage is the vocal but non-verbal dimension of speech exchanges and has to do with how something is said and not what is said. Paralanguage is an important vocal aspect of messages describing non-verbal cues of the voice like stress, pitch, rate, volume, or mainly hesitation talk (that is rather truncated or not) and the variations of all these.

Hesitation is a key aspect of paralanguage and may convey emotion or nuance meaning with forms like prosody, pitch, volume, intonation (Vasilescou & Adda-Decker, 2007). Hesitation, here, is commonly accompanied by silence as a result of uncertainty for the receiver or a reluctance to correct from the sender. Hesitation is closely related with meta-communication, as it communicates about other already transmitted messages. The complementary character (for the verbal or non-verbal message) of hesitations connects with different vocalic realizations: filling pauses, word lengthening, repetitions and speech repairs.
Apart from that, voice (here) includes the non-verbal communication of human actors across different airplanes and cockpits, as a transition stage from silence to verbal messages. It could take the form of waiving hands across cockpits; waiving wings during flight towards another aircraft; approaching the other in proxemic distance; using territorial markers in a cockpit to signal operating status; activating silent and audible but visually mediated messages in banners and symbols from the cockpit to the passengers or the form of radar locking in a fighter jet dogfight. All these attributes are different ways to signal a message in non-verbal channels.

Verbal messages refer to the use of words, oral and written, not to oral vocalizations. In aviation, the use of language is crucial for verbal interaction, as well as the effort to make the meaning of the interlocutors as equivalent with the meaning in words used. Along these lines, mother tongue, here, provides cultivation towards thorough understanding of the original aviation terminology in English. The use of familiar terms in a mother tongue, in specific cases, seems to facilitate the users to better understand the original aviation terms in English. It also highlights a direction for further research by investigating its role in familiarity between pilots and controllers.

Lastly, situation awareness, here, has proved to be a useful addition to communication model for proper reception and feedback, as well as meaningful feed-forward for continuing interaction. SA assembles the perception of the elements in the environment, within certain time and space, with the
comprehension of their meaning, and the projection of their status in the near future (Endsley, 1988). The discursive space of the extended cockpit, here, consists of actors that take roles and apply rules in order to complete tasks with their social actions. Conversation takes place in a time-critical situation and all interlocutors have to keep track of responding demands. They must understand the system in its entirety, position their role in it, and remain vigilant for consequentiality. The pilot’s SA means integrated understanding of factors that will contribute to the safe flying of the aircraft under normal or abnormal conditions (LA and TA, from section 2.3.2). As SA increases the pilot is increasingly able to “think ahead of the aircraft,” for a wider variety of situations (a type of GA, of section 2.3.2).

On the other hand, the air traffic controller needs to sustain GA, for the big picture ahead (in the immediate future time and for the available airspace status), while addressing/replying with LA to each different flight in the scope of approach control or air traffic control. TA is necessary for the controller to accomplish the required separation in the limited airways. SA is considered a process (to develop) and a product (of the conditions and interaction), in a particular context, at a particular point in time.

6.2 Silence-Related Theoretical Contributions

This dissertation explores how the concept of silence is used and understood from several aviation professionals who have discussed their perception and experiences on the base of real scenarios or in the context of their work. When pilots talk to each other or to air traffic controllers there are periods of silence or
no-talk, sometimes substantially longer than in ordinary everyday life conversations. There are particular stages like the cruising phase with the autopilot when silence is measured for many seconds or many minutes. Non-talk activities from pilots are the use of cockpit controls, displays, and written materials in charts and checklists, as well diagnostic activities to identify unusual situations. Talk and non-talk activities begin and end and they are relative to repeated non-talk periods which are coordinated during the flight. That means that silence flows in the conversation patterns used during flight communication and has an interactional effect for the work of both pilots and air traffic controllers (who have to follow these periods for multiple flights in each of their shifts).

The responders laid their framework on silence using their own recollections of typical examples or examples marked in their mind and are determinants of their decision-making. Even in case of accidents the crews and the controllers conducted their flights as routine, until the moment when things start to go wrong. Let us go over the results from analyzing the responders insights.

Organizational reporting and scapegoating process were pointed out in the Falcon VIP flight, as a view of human error. Silence was a latent phenomenon before take-off, during the critical twenty four seconds of descent, and a crucial factor in the accident analysis of cockpit recordings in the Falcon VIP flight, as described in Chapter 1. AIP9 introduced a landmark case of the “shaking VIP flight”, in which silence had a deeper content in organizational reporting; to speak up regardless how many times you are not heard and address the appropriate levels
responsible for accountability. Also, in this case, the concept of scapegoating for human error emerged, with its consequences in aviation safety, as well as in the complexity of civil aviation with economic, market and political concerns.

Silence was a dominant phenomenon in the Helios 522 ghost plane, which AIP13 described as an outsider, in Chapter 1. It may be one of the handpicked examples in which the hindsight mechanism (there are no survivors and very limited data from the recordings exist) is necessary to communicate the silence of a haunted story. Helios 522 flight redefines what it means to communicate in a timely manner, without waiting silent for feedback. Besides that, it started the discussion for the open channels of communication between the cockpit and the cabin crew members. The Falcon VIP flight and the Helios 522 flight constructed a system of reference regarding silence for all professionals who were on duty when the accidents occurred.

Air traffic controller AIP14 brought up a categorization which prioritizes in-flight activities and no-talk periods with distress or emergency situations, while the controller is waiting for feedback from the pilot who may need assistance. There are instances when silence is the magic word to keep, she emphasized. Also, she pointed out the importance of corporate brand, the position of organizational culture in the brand and the lack of motivation for crew members to frankly speak up.

AIP15, another air traffic controller, emphasized that miscommunication with a pilot which may be a result of loss of SA, if not repaired by the co-pilot who
had situation awareness and copied the received clearance but remained with silence. She pointed the informal grapevine micro-culture of humiliation which interferes with safety culture of the airliner, as well as not well-developed just culture.

Mutual silence with the implicit personality emerges when moving on to fighter pilots culture and expertise. AIP1 discussed the relation between trainee pilot and instructor officer. It is a relation of closeness and mentoring which may have a downside. Trust is reset when the instructor admits his mistaken to the trainee. AIP2 another fighter pilot emphasized the institutional response. He connected silence with SA and the leadership style necessary to lead by example. The person, who speaks in a flight, is the one who is aware of the situation. Rank does not work in the long run and operational respect is gained when you fly with the others, he emphasized.

Lastly, AIP6, a helicopter pilot connects with operating barriers. Marking a checklist or observing the checklist automation is decisive for flight cooperation between pilot-in-command and co-pilot. Also, silence could be a result of perceived conflict between efficiency/passenger comfort and safety. Silence could block reporting of all flight parameters. He also felt the impact of silence from his flight engineer in order to reinforce an open communication policy for operational issues in his briefings, before the final word of his mission command. So, silence is strongly related to the culture of authority or collaboration and affects flight and mission operating parameters.
Several cases of accident flights showed that failure to speak up or report appropriately can have devastating consequences. Silence is taking turns with interaction in emergency situations to protect the peace of mind necessary to deal with the mission critical environment, human lives and integrity of equipment. Interaction is effective when information elaboration occurs. The compulsion to communicate is an urge which harmonizes the actions of individual actors in the interests of the other members of the aviation community, at large. Thus, aviators and controllers agree to proceed or take the next speaking turn from a period of silence: to receive something that pilots say, something that pilots say or do, or something about how or why they say or do it. Long silences could indicate an escalated problematic situation, where as no silence could flood communication channels. Voice is a complementary channel that succeeds silence, and onetakes turns from the other, in normal flight conditions.

6.3 Voice and Language- Related Theoretical Contributions

Chapter 5 was the transition from the phenomenon of silence in Chapter 4 to the use of non-verbal communication, hesitation and verbal in aviation communication. Voice-categorical label connects silence with paralanguage and mediates the transition from non-verbal to verbal communication.

Reconnaissance, interception, non-verbal gestures and verbal messages communicated the Renegade process of the Helios 522 flight, with AIP23 as the
leading pilot. The two scrambled fighter planes took off in a mission that started from reconnaissance and continued to interception, without the final phase as Helios plane crashed by itself. The Renegade response protocol is described in terms of its communication significance. Furthermore, the agonizing effort of using the fighter plane as a communication tool (by waving the wings), the cockpit-to-cockpit face-to-face communication, the hand gestures, the affordances of time, the verbal communication of the emergency in two levels (inside Helios flight to the cockpit voice recorder and the flight data recorder, and outside from the F-16 to the receiving control centers), as well as the moment of breath and the moral inquiries of the pilot establish a unique case in aviation communication.

This flight description is communicated by out-flight real-time observation, of the interception pair since no direct communication was received from the silent aircraft. Verbal messages from the scrambled fighter pair meta-communicated the situation when original communication was continuous silence. The commentary of AIP13, the accident investigator, provided unknown insights regarding the Renegade protocol communication and the moral basis of the shooting down dilemmas from the authorized actors.

In the scenario of hesitation, an aircraft with a takeoff clearance received a truncated Tower call in a hesitant voice. Prudence was the strategy to cope with. The pilot decided to abort the take off, as they were in the rolling phase and uncertainty captured their mind of what the controller’s concern was. The pilot and co-pilot confirmed the prudential action to bypass the clearance, and cancel the take
off at the moment of which the controller prompted them to disregard his truncated message with no other explanation. This scenario is described as if they were doing debriefing, by evaluating the action of pilot after it happened.

AIP1, the fighter pilot, argued that hesitation leads to uncertainty and misinterpretations. Safety is the primary concern when violating a clearance, in comparison to any other criteria that may apply (corporate, organizational, scheduling etc). Controllers’ messages should be immediate and clear to avoid uncertainty and misinterpretation risk.

Then, AIP10, a civil aviation pilot, argued on the pragmatic basis of a bad moment (a random factor) and the Captain’s profile. Pilot’s interpretation depends on a multitude of factors which assemble to “triage”, the skill of prioritizing by abstracting information which originates from the medical field. Along these lines, to cope with hesitation the flying instinct (the Langewiesche’s “buoyancy” of section 5.4.2) could be a differentiating factor. Then, AIP14, the most experienced controller, argued on the connection of hesitation with fear and situation awareness. The pilot has taken a prudential decision, given the circumstances, and AIP14 added the fear of the air traffic controller with the recording device in the background and the recent trend of litigations of aviation professional in incident or accident cases. The content and style of verbal communication may depend on the availability of a recording device. Another explanation, for hesitation, is the loss of situation awareness from the controller at the time.
The next discussant, AIP15 a air traffic controller, argued for the collaborative environment that is necessary for pilots and controllers to feel in the same group. The controller should work as the alter ego of the pilot, providing the “eyes and the ears” for the ground when the pilot is in the air (or for the surroundings, when the airplane is on the ground). Moreover, she offered a well versed suggestion on the human error. Human error should be accepted as a reality. An erroneous instruction with a stable voice is preferred from hesitation and uncertainty should be explicit. In the next turn of the communicative transaction a clear correction could clarify the situation and restore the pre-established trust in a fiduciary relationship. It is a constructive view of human error with the required transparent audit trail.

Then Chapter 5 introduces the scenario of language directness, informality and familiarity by AIP25, a civil aviation pilot, who speaks about the ways of approaching the relationship with air traffic controllers. This scenario continues with the addition of the importance of understanding the “others” (pilots the controllers and controllers the pilots) and their personality traits. AIP25 is adding that it took him more than 1,000 hours of flights in order to start feeling comfortable with a level of knowledge that would allow him to interpret rules and situations with his tacit knowledge, after applying the explicit one from his training.

AIP15 is the controller to reply in this scenario, citing the importance of professional ethics as a controller and the effort she makes to understand the profile
of pilots better, when they do their work (even observe them in the cockpit when they aviate). AIP1 is the fighter pilot who replies arguing on the importance of standardized communication but also the need of constructing a social and collaborative operating environment with the air traffic controllers. And he has been experiencing that for thirty years in his career; so it’s not an ideal, it is real.

AIP6, the helicopter pilot from the Army, is the last responder. He identifies the category of interaction in the home base familiar environment with an accepted deviation from standardization, which is sometimes instrumental for routine functions. He also, acknowledges the generic category of keeping the standardized phraseology, in other missions and non-familiar environments to avoid miscommunication that may be fatal. AIP6 underlines a case of mindfulness during flights, when an expert performer pilot develops the necessary self-monitoring.

In the last part of Chapter 5, after an overview of language and English use in aviation communication, an additional scenario is introduced to lay the foundation for future research in pilot-controller communication; the mother tongue as a primary code switching element. The modern aviation system requires the maximum amount of information expressed with the minimum of effort and consuming the minimum of time. This is often addressed as macdonaldization of language.

AIP24 is a pilot in HCAA Flight School, who shares his problematic on the lack of standardization of the spoken English language, the Air Speak English and the lack of conformity between FAA English expressions and ICAO English.
expressions. These discrepancies make it difficult to localize aviation English to a standard terminology of Greek (as mother tongue for domestic flights). AIP24 shares his practice of going to mother tongue out of routine flights and to mix Greek and English when going over checklists to avoid automated marking. The responses in this scenario show one direction of further research which has started with members of the Special Committee of Air Traffic Management Terminology (OMEODEK) which was established after I have submitted an ad hoc institutional proposal to HCAA and the Hellenic Society for Terminology (ELETO).

Controllers AIP14 and AIP15 and fighter pilots AIP1 and AIP6 emphasize the distinction between routine and emergency situations. In the latter case, the mother tongue is the selection in all cases when an emergency occurs or an extraordinary situation (e.g. a dogfight is developing, a mechanical damage occurs, or severe weather presents a threat). The persistence in the use of mother tongue, even in a blended with a few English aviation jargons, has traces of the linguistic relativism notion. It seems that mother tongue, and Greek language in particular which exists in a continuum since antiquity, is a language shaping several aspects of the professional and institutional subcultures in aviation (and for the most part in the Air Force). The connection of emotional reactions under pressure and language speaking falls in the same dimension, as well as an introduction of a concept of affordances for the mother tongue (i.e. does the mother tongue allows more or better communication with its tools?).
Lastly, the importance of language localization for ICAO standards as a major training tool and a mental exercise of translatology is already another inquiry during the earlier stages of the current dissertation (Katerinakis et al., 2013). An airplane flight is a communication session in the high complexity environment of the flight deck during the interaction of air traffic controllers and pilots following the model: “spoken- heard-understood- applied.” The criticality of language use in aviation safety is based on linguistic phenomena like vocalization, homophony, punctuation, ambiguity, inference and repetition. Airspeak Greek analogically to Airspeak English could construct a concept of language security and trustworthiness for national public policy in the Greek airspace.

### 6.4 Situation Awareness Communication-Related Contributions

Both conceptual categories of silence and voice have a significant impact on situation awareness (SA) of all the actors in this GT approach. Situation awareness is a causal category with a crucial effect on aviation safety. In review of section 2.3.2 and several empirical data from the responders, SA emerges as a useful addition to the communication model of interaction with perception, comprehension, and projection, as its primary functions.

SA was formally introduced in human factors, critical systems design and cognitive engineering literature by the empirical domain of war tactics (with monitoring the opponent with slow processes) and sports management (with an implicit immediacy, as situational awareness). During World War I, the identification of SA came with the realization of the importance of being aware of the
enemy before the enemy does so, in order to communicate the appropriate commands. SA distinguishes the understanding of system status by human operators and the actual system status itself. Thus, it differentiates the users who interact from the channel and the context they use.

SA covers the individual’s perception of the “here-and-now” while this state adjusts in time. SA includes perceiving the elements of the environment (who is where, in the interaction), comprehending their meaning (what is the exchange content and what is the initiation), and projecting their status in the future (what they will do for feedback or completion of the interaction). The three types of SA reflect communicative interactions better, as they include the state of the individual actor, the cooperating actors, and the time dimension (as showed in Figure 2.1). By dividing SA in parts in information processing tasks are added prior to the performed tasks. The result would be a better prepared message to continue interaction.

The complete picture of SA is synthetic combination of different viewpoints. The functions of perception, comprehension, and projection are sequential and parallel and “awareness” starts at a local level (as current knowledge of task-related events), continues at a transitory level (as mere awareness moving from one situation to the other with turn taking in communication) and becomes global (as assessment of the full scope picture of flying, controlling or maintaining an aircraft). The reply to “who is where”, for example, includes actors, objects and features of the environment of the situation. Awareness is a variable state, an attainment from the answers in the three questions: who is where, what is said, and
how the state is projected in the near future. In this model, the three questions are considered to be components in the intersection. Each component is a stage that requires some data from different forms of information processing. Data input, processing, and reasoning all overlap (as discrete items and as a continuous flow) to lead to SA.

In dynamic interactions the situation is in fluctuation, and all data, evaluations and assessments are of a transitory nature. Air traffic control and airfield ground movement of aircrafts, as well as most forms of football, basketball, or disaster management deployment are activities to apply this model. The combined answers to the three questions, above, formulate the Transitory Awareness (TA).

Two other types of awareness complement the viewpoints of the concept; the local awareness (LA) and the global awareness (GA). The decisive factors for the separation for these viewpoints are the constrained time of limited availability, the span of command (the number of people who report/communicate to a commander rather than the commander’s rank), and the geographical area of interest (or the medium, like air navigation or sea cruising). The message follows a path of a slower process for storage (as memory) and information processing, so that “awareness” would embrace locally-situated and then global events.

A typical example for that communication flow with SA would be a flight with commercial pilots in a two-person crew. Each pilot has a different LA. The (flying) pilot-in-command who is the pilot will have inputs from the controls (and the actions performed) which may not be available to the co-pilot. The rate of change for cues in the environment and the key items of information determine measures of awareness. A
military pilot in a ground attack mission experiences a far greater change to the TA than a commercial pilot in the final approach to land, although the LA situation may be quite similar. Thus, indicators that are of immediate importance in TA may decline in importance to contribute to LA. Variations in data importance are associated with the changes in operating and flying environment, as an ecological perspective.

When SA is conclusive for more actors involved then the typology of TA, LA, and GA is closer to reality, from multi-lateral points of view. In this sense, the air traffic approach controller and the pilot of an aircraft on final approach have a common goal and they are both concerned with the same high-level task, but they attend different data inputs and acquire different degrees of TA, LA and GA. Furthermore, when the aircraft is moving on the ground (like in section 5.4.3 or 5.4.4) TA, LA, and GA measures change again.

In the example of Helios 522 flight the two fighter pilots intercepting the silent passenger aircraft possess TA (after their briefing) and LA but low GA, where as the Chief of HAF (in command post) had a high TA. The Prime Minister had high GA but limited TA and lack of LA. The pilot flying in the interception communicates his LA to increase the TA of the Chief of HAF, who in turn conveys the messages to the Prime Minister who has to rely on the communication flow of lower-ranked actors and defend the necessity with his decision.

In the typology of awareness the transitory type is closer to the group communication and teamwork. The local type fits typical perception in communication models. Also, the local and global types are linked with situations of multiple levels of hierarchy and intra-organizational communication. The separation of SA in types
denotes that an individual could commit in awareness of any type (or of all types at once). Real-life topical factors and message flow (in flight, combat, or other activity) indicate which type is relevant. As it happens in communication patterns, “the participants' confidence” in their situation awareness might be different than their “actual situation awareness”. Receivers perception of a message may be different than the intended content of the message.

SA, especially in the expansion of the three types, implies clear communicative dimensions as human actors should act upon, respond to, and confirm/correct important informational cues. Apart from that, human communication forwards the information flow functioning in LA type, and facilitates the move to TA type. The GA type needs also reporting and critical evaluation and access to privileged operational and mission information. Awareness (of all types) is internal to the individual and the meaning making process, and does not reside on any (technological) information display. The individual actor develops awareness when considering the interpersonal interactions and relationships with relevant communication. Interpersonal communication, here, includes the form of the “individual-group-team”, or the form of “own vs opposing force/group” in command and control contexts.

**Other Examples of SA Realities in Flight Communication**

The high level of standardization in aviation is expected to streamline SA, but the operating environment still has humans with multiple languages and
mindsets working together and interacting in international flights (in diverse conditions).

The deadly Tenerife disaster at Los Rodeos airport on 1977 (described in section 2.3.2) is a clear example of the effect of language, meaning and its context to LA and TA types of awareness. The Dutch copilot being in the take off process was not understood by the Spanish controller who replied with a vague “OK.” The Dutch captain mistook the meaning of "clearance" at that specific point in time and powered up, replying with a hanging "Let's go". Then the controller called for “standby” and increased complexity in the interaction. A dynamic flux in TA and LA types from one utterance to the other occurred in the eight minutes before the collision, as the controller had a change to the GA type due to the ground movement of the US flight. The controller spoke simultaneously with the US flight crew and the crew members in the Dutch flight find it hard to hear. Neither the copilot nor the flight engineer, in the Dutch flight, questioned their pilot-in-command who had a senior position (as it happens in several responses in Chapter 4 and 5), and the impact occurred about thirteen seconds later.

In Tenerife disaster, derangement of all types of awareness for the different actors was combined with additional factors (fog, small and unfamiliar aerodrome, news distractions, and the expedition and rush to cover the schedule delays from previous days). Information storage and processing for all these factors were very import for appropriate message transmission in the communication among the
Control Tower and the two aircrafts. The information parameters of SA are valuable inputs for communication processes.

In rescue, disaster relief and military coalition operations the cooperation of multi-national and multi-force teams increased the potential for misunderstanding due to incomplete SA and the relative use of different languages. The relay of commands and the confirmation of information flow is a demanding communication accomplishment which has an effect to awareness of LA, TA and GA type. A similar situation of interpretive messages, fragmented information flow and gradual development of awareness happens in NATO reconnaissance flights with multi-nation crews of the NATO AWACS (like the pilot who responds in section 4.5.1). These are instances of major communication challenges, in terms of language and culture, which clearly affect SA (and consequently effectiveness and safety) especially in the immediacy of a flight situation.

In the emerging causal category of SA in this study, four key elements cooperate: humans (as users and interactants), informational cues (as stimuli processed), behavioral cues (paralanguage and role expectation attributes), and appropriateness (as regularity) of the responses. This regularity implies the comparison of the actual response with an anticipated response (a choice from a number of possible expected responses). These expected responses formulate an instrument for a performance measure of SA, from both pilots and controller’s sides, as it is apparent in the responses analyzed in Chapter 4 and 5.
For example, for a HAF pilot SA (TA type) means to understand the threats and intentions of the “non-friendly” aircraft or enemy forces, as well as the status of his own aircraft (LA type) and communicate that way. In order to project the situation on his near future it is necessary to communicate from the start (communication builds a foundation for a GA type also). For an air traffic controller, SA requires estimation about current aircraft positions and use of flight plans to arrange the necessary separation between aircraft positions and entities in the airspace (GA type), in order to predict future states of potential conflict (LA type). Of course, the controller is not an observer and needs to communicate in all stages and has a considerable effect to the SA of the cockpit crew (TA type for the controller).

Even in the AIP10’s suggestion who thinks that triage priority and allocation of resources, we found an occupational skill that should be part of situation awareness response for the pilot. The context determines, to a large extent, the meaning of verbal and non-verbal behaviors. The way that pilots perceive incoming signals demands the abstract thinking, immediacy, and priority handling of triage to select and prioritize the next actions, in AIP10’s view.

Thus, as an emerging communicative parameter, situation awareness includes acquisition of information from the immediate (and the co-present controller) surroundings, integration with relevant knowledge of the situation, exploration of a mental picture for the situation, and anticipation of reactions for
the immediate future. Hence, situation awareness has a clear effect on aviation safety and should become an added component in communication models.

6.5 Partnerships and Further Research

I have conceived the current dissertation as a research project in the basis of human communication in highly mediated environments, safety, language security (standardization and propagation of mother tongue terminology with aviation English), pilot knowledge and expert performance, and a constructive approach to human error in organizational behavior. Analysis for data collected during the course of this ongoing project resulted to the current dissertation which focused on the concept of “silence and voice” (as labels of categories) and situation awareness, as a contributor to aviation communication for safety. But several other topics emerge en route and could develop further beyond the current dissertation.

In the early stages of this research I became engaged to the work of HAAISB, Hellenic Aviation Incident Reporting Committee (EAPA), the HCAA Flight School (SPOA), the daily routine of Hellenic Air Force Squadrons, and the challenges of work in Control Towers. During these interactions, I have proposed to upgrade language and terminology training, on the basis of mother tongue, in order to position Greek aviation English in the appropriate terminological level, as a field of study in the Hellenic Society for Terminology (ELETO). In a cooperative effort with the SPOA School for air traffic control, a new permanent committee on Air Traffic Management Terminology (OMEODEK) was institutionalized inside
the HCAA\textsuperscript{97}. The scientific foundation and support for this committee derives from ELETO\textsuperscript{98}, a terminological society with strong tradition in working on neologism and translatology, with my participation as well (this is an institutional and scientific partnership). The initial contacts for the current dissertation, as well as the discussion with several of the responders started en route of this project. The first outcome of this collaboration was the paper on aviation terminology, which presented the topic, for the first time in the map of scientific inquiry beyond what practitioners do, in the Greek scientific community and its specialized society on Greek terminology\textsuperscript{99} (this is a research partnership). These activities generated a substantial motivation for the community of air traffic controllers and aviators in Greece, who have now creates an informal discussion network to follow through the linguistic and standardization evolutions and relevant consultations\textsuperscript{100}.

The work with OMEODEK and the resultant inquiry had already an impact to curriculum adjustments in SPOA and in language proficiency evaluations. The

\begin{footnotesize}


\textsuperscript{100} A Facebook group (at https://www.facebook.com/groups/OMEODEK/) administered by ATCs Kostas Patouras and Nikos Papadopoulos is running to accommodate the discussion about aviation terminology. This platform integrates the contributions of members of the aviation community, translators, practitioners, scientists and regulators.
\end{footnotesize}
mother tongue (widely used in domestic flights, in the dense network of more than forty airports in Greece) could be a useful tool to better understand the standardized ICAO phraseology.

EAPA committee of anonymous reporting was introvert. My application was the first one, in their records, with an inquiry for data (2012). Now, it works regularly in using standardized incident monitoring at a national level and, for EASA, at a European level. Similarly, the HAAISB received the first two inquiries for research in communication issues with my application (2012-13). Those inquiries contributed in generating an atmosphere of accountability to the public, as both committees have a significant role in the development of safety culture in the sector.

I am not approaching aviation realities as a tabula rasa, as there are several preconceptions about the field of aviation, its position in social life of individual actors and its role in collective society (at least in the case of Greece). The work on aviation terminology and safety, as well as the study of the military defensive culture and rule-based knowledge and expertise covers a scope broader than the current dissertation. In my case, my personal background in the Air Force, the bonding cultivated in the time of service in real crises, and the affiliation with several businesses active in military procurement due to my business involvement provide familiarity, access to people and sites, entrusted discussions, and valuation criteria. An additional challenge, due to the role of aviation in Greek society, is to investigate the roots of effectiveness and organizational performance that we meet
in the Air Force in order to apply them in other managerial and institutional structures.

The ground for further research is laid with the combination of further inquiry in scenarios and correlations that seem plausible in the operating culture of Air Force and the service culture of aviation. Also, the deeper investigation of the decision making conditions from pilots in crises is expected to be a fruitful path. In the case of air traffic controllers, their co-presence should be employed in any cockpit-related interaction to broaden the scope of analysis.

Further investigate of the issue of mother tongue in aviation communication, could cover in two dimensions: as a channel of cultivation to better understand the instances of the respective Aviation English terminology, and as the preferred tool in emergency situations. The desired clarity of “one-word one-meaning” is a certain direction in the latter dimension.

At an institutional level, the engagement in standardization localization processes at EU level should include communication. One of the keystones of European integration is the localization of institutional and regulatory content in the language of member states. What is the trade-off between a lingua franca and a mother tongue, along these lines?

“Triage” is a concise notion, a common practice in the medical field that seems to have analogies in the field of aviation. The abstract idea of mindfulness and the skill to prioritize activities and critically extract information from a pressing situation could find an inclusive combination using triage.
Fighter pilots seem to advance in expert performance and self-monitoring skills. When they operate in a defensive military doctrine, the reactions and communication patterns seem to be different in comparison to those of offensive missions. Also, their interpretation of tacit knowledge needs further inquiry regarding the balance between mission commands and their flying efficiency.

The briefing and de-briefing process is in the heart of managerial efficiency of the sector. That process of communication and meta-communication could provide valuable input in other organizational settings.

The use of checklist as communication tools is an under-investigated topic that could provide useful insights for quality assurance purposes. Also, the checklist format, as message design configuration is a clear communicative dimension that should be combined with human communication capacity. The tendency of checklist automation and over-reliance in automation sometimes equals to deskilling. It is a phenomenon that needs further investigation.

The current dissertation highlighted the importance of human communication, with the categories of silence (personal, operational, institutional and regulatory) and voice (hesitation, non-verbal and verbal communication) and the concept of situation awareness in order to accomplish a safe flight mission.

Little was known, before, about the human communication use of silence and voice in flights and their impact on effective flight communication, especially in unusual or emergency situations. Also, the flight pattern of “aviate, navigate, communicate” underlines the category of situation awareness. The inquiry on the
real-life scenarios used for this study will continue in search for the aviation instinct.
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APPENDICES

APPENDIX A: THE SHEET OF SCENARIOS ......................................................... 384

A.1 Short Instructions in English ......................................................... 384

A.2 Short Instructions in Greek .......................................................... 384

A.3 Contents of Scenarios and Themes of Open-ended Questions ..... 385

1. Silence: When aircrew members don’t speak up and why (a, b)? 386
2. Hesitation Exists or Needed? ......................................................... 387
3. Directness in Language ................................................................. 388
4. Professional Relationship Factor .................................................. 388
5. Standardization, Language Factor, and Mother Tongue (a, b) 389
6. Trust and Professionalism ............................................................. 390
7. Instructor with Trainee in Flight Mode (a, b) .................................. 390
8. Communication Equipment Use and Priorities (a, b) ..................... 391
9. Dual Instruction .............................................................................. 392
10. Redundancy as Mutual Verification .............................................. 393
11. Listening Mode (Pilot - ATC) .......................................................... 394
12. Forward interpretation or ‘GetThereItIs’ (Pilot - ATC, a, b) ............ 395
13. Superiority and Authoritative Mindset (Pilot specific) ................. 396
14. Witnessability as "Building up the Picture" (Controllers’ specific) .... 396
15. The Two-challenge Rule (an analogy from the medical profession/nuclear reactor operation): ................................................. 397
16. Affordances and Skills ................................................................. 398
17. Oral Information ........................................................................... 399
18. Heuristics and Experience ............................................................ 399
19. Relationship and Familiarity ......................................................... 399
20. Air Force/Military Aviation Doctrine (fighter pilot specific) .......... 400
21. To Remember ............................................................................. 401
22. Feeling Safe.................................................................................................................. 401
23. Safety and Just Culture ............................................................................................... 402
24. Briefing- debriefing................................................................................................... 402
25. A Why Question......................................................................................................... 402
Note: Write any comment .............................................................................................. 402
APPENDIX B: ISHIKAWA DIAGRAM AND QUESTIONING ROUTE................................. 404
    B.1 The Ishikawa Diagram .......................................................................................... 404
    B.2 Questioning Route of the Ishikawa Diagram .................................................... 406
APPENDIX C:”EGO- ALTER” INTERACTION WITH AN ADJUSTABLE QUESTIONNAIRE ................................................................................................................................. 408
APPENDIX D: ICAO- FAA BASIC ENGLISH PHRASEOLOGY DIFFERENCES.......................... 413
APPENDIX E: NAMING CONVENTIONS AND PROFILES............................ 414
APPENDIX A: THE SHEET OF SCENARIOS

This is the sheet containing the final scenarios used in the third stage of data collection, according to the GT approach used for this study (explained in section 2.4). The attempts for data collections started with the first stage interaction of Appendix C, the main theme shifted to the second stage using the questioning route of a fishbone diagram (from conditions to conclusion). In this third and final stage real-world scenarios were developed and used.

A.1 Short Instructions in English

All responses are preserved as completely anonymous and confidential and any information included in the study does not identify you as a respondent, in the final format. The “questionnaire” is used as a source for taking quotes and concepts and will not be used in a raw format. This interview sheet is part of a dissertation research using pilot, air-traffic controllers, accident investigators and aviation security experts from the USA and Greece detecting the role of mother tongue and micro-cultures in flight communication and coordination, and the type of knowledge they accumulate by actually “doing” the flight, making decisions and using their experience. Thus, we are approaching the questions as knowledge elicitation and not as Q/A; personal opinions and examples are appreciated and that is why anonymity is preserved. The reply space frame is adjusted for typing, as you like.

Thank you,
Theodore Katerinakis, MSc, ABD, Adjunct Faculty
Culture and Communication, Greek Studies, International Business
http://www.drexel.edu/culturecomm/academics/graduate/phdCultureComm/gradStudentDirectory/Katerinakis_Theodore/
e-mail: tk325@drexel.edu, skypename: tkaterinakis, tel: 607 351 0861

A.2 Short Instructions in Greek

In Greek (Ελληνικά): Ο στόχος της διατριβής είναι να τονίσει το επίπεδο πολυπλοκότητας και κρισιμότητας των επαγγελματιών της αεροπλοΐας, την αισθητοποίηση της πτήσης μέσα από την επικοινωνία, τη σημασία της γλώσσας στην επικοινωνία αυτή, καθώς και το επίπεδο γνώσης που συσσωρεύουν οι πιλότοι και οι ελεγκτές ώστε να μπορούν να λειτουργούν αποτελεσματικά και, πολλές φορές, με στοιχεία που δεν περιλαμβάνονται στα εγχειρίδια επεξεργάζονται πληροφορίες και δημιούργοντας τη γνώση τους. Η παρούσα έρευνα αποτελεί τμήμα της διατριβής του ερευνητή σε μια συνεργασία μεταξύ του Προγράμματος Ελληνικών Σπουδών του Drexel (Φιλαδέλφεια, ΗΠΑ) με τη ΣΠΟΑ και την ΟΜΕΟΔΕΚ (στο αρχικό στάδιο και με την ΕΑΠΑ

### Α.3 Contents of Scenarios and Themes of Open- ended Questions

1. Silence: When aircrew members don’t speak up and why?(a,b) .......................................................... 386
2. Hesitation Exists or Needed?.......................................................... 387
3. Directness in Language ........................................................................ 388
4. Professional Relationship Factor .......................................................... 388
5. Standardization, Language Factor, and Mother Tongue (a,b) .................. 389
6. Trust and Professionalism ...................................................................... 390
7. Instructor with Trainee in Flight Mode (a,b) ........................................... 390
8. Communication Equipment Use and Priorities (a, b) ................................ 391
9. Dual Instruction ...................................................................................... 392
10. Redundancy as Mutual Verification ....................................................... 393
11. Listening Mode (Pilot- ATC) ............................................................... 394

Σας ευχαριστούμε
Θ. Κατερινάκης, Πρόσεδρος Καθηγητής, Πρόγραμμα Ελληνίκων Σπουδών Drexel
http://www.drexel.edu/culturecomm/academics/graduate/phdCultureComm/gradStudentDirectory/Katerinakis_Theodore/
12. Forward interpretation or ‘GetThereIts’ (Pilot- ATC, a,b)..............................................................................395
13. Superiority and Authoritative Mindset (Pilot specific).........................................................................................396
14. Witnessability as “Building up the Picture” (Controllers’ specific) .................................................................396
15. The Two- challenge Rule (an analogy from the medical profession/nuclear reactor operation): ......................397
16. Affordances and Skills ..............................................................................................................................................398
17. Oral Information .......................................................................................................................................................399
18. Heuristics and Experience .......................................................................................................................................399
19. Relationship and Familiarity .....................................................................................................................................399
20. Air Force/MilitaryAviation Doctrine (fighter pilot specific) ..................................................................................400
21. To Remember… .........................................................................................................................................................401
22. Feeling Safe .............................................................................................................................................................401
23. Safety and Just Culture ..............................................................................................................................................402
24. Briefing- debriefing .....................................................................................................................................................402
25. A Why Question .........................................................................................................................................................402

Note: Write any comment ..................................................................................................................................................402

1. Silence: When aircrew members don’t speak up and why (a, b)?

“Several accidents have shown that crew members’ failure to speak up can have devastating consequences. Despite decades of crew resource management (CRM) training, this problem persists and still poses a risk to flight safety. To resolve this issue, we need to better understand why crew members choose silence over speaking up. We explored past speaking up behavior and the reasons for silence in 1,751 crew members, who reported to have remained silent in half of all speaking up episodes they had experienced. Silence was highest for first officers and pursers, followed by flight attendants, and lowest for captains. Reasons for silence mainly concerned fears of damaging relationships, of punishment, or operational pressures.”

a. What is your opinion about the crew members? Did you have such an experience, as a controller expecting a crew member to speak-up? What would you do in such a position?
b. Air traffic controllers and “Fighter Pilot mission supervisors in the Tower” are “co-present” in the cockpit. Do you have an experience of wanting to speak but preferred silence? Why? Is there any specific training on how to use/coordinate silence or it is just a matter of rank and authority?

2. **Hesitation Exists or Needed?**

*Situation* from B737 Captain's Report, 
[http://asrs.arc.nasa.gov/publications/callback/cb_396.html#4](http://asrs.arc.nasa.gov/publications/callback/cb_396.html#4)

- On takeoff roll approaching 80 knots, the Tower Controller called us and said in a very slow, unsure voice, “[Callsign 1…2…3…4…] (pause).” He sounded as if he had something to tell us, but did not know what to say. We both noted a tone of concern and hesitation in his voice as if he was still unsure of something at that moment. We were light weight and had 13,000 feet of runway ahead of us. We had to make an immediate decision.

*The Reporter's Action:* I elected to initiate rejected takeoff procedures. During deceleration the Tower Controller said, “Disregard.” The sound of one’s voice, the tone and force, all convey a message. I did not like the message I was receiving and could not gamble that he was trying, but unable, to warn us of something ahead. I would take the same action again.

*(From the First Officer’s report on the same incident)*

*I believe the rejected takeoff was the right thing to do. When you get a call from Tower at that point in the takeoff roll, the first thing that pops into your mind is*
“something’s wrong.” In the few seconds before he finished his thought, we were left to guess what the call was about. We were still relatively slow speed on the roll, so the Captain did what was prudent and safe by rejecting.

What is your opinion on the ATC hesitation? Did you have such an experience? What would you do if you were the pilot? Is there a way to repair hesitation? Do you think that the first officer should interfere in another way? What is your training on that?

3. Directness in Language
In a flight phraseology survey a pilot commented: “Of course, if I know the ATC person I may bypass the standard phraseology and say “Eh, John this is Tom; what happened, did you hear me? Do you mean it or I have to wait for descent?” If not I may just stay to wait, especially if I do not have a series of corresponding flights in a sequence. I know that safety is the primary concern but we are also professionals who communicate in discussion terms. I feel it as more natural...

What is your opinion on the pilot’s comment? How direct/informal you think you should be? What is more efficient in your experience? Is it a matter of authority between a pilot and an ATC member?

4. Professional Relationship Factor
A pilot comments: “When I started my career I had a concern, almost fear about the risks that are uncertain when I receive indefinite communication. It took me several hundred hours, I could say after 1,000 flying hours to start felling safe about myself and specific travel routes (when the weather is general terms “stable”). I try to include in my social relations people from ATC, as well as other aviation professionals in order to develop a level of familiarity for their
personalities. When I fly abroad, especially overseas I make an effort for an intense briefing about the local controllers, their behaviors and stereotypes in the use of air-speak English and phraseology.”

How do you feel about developing social relationships with pilots flying in your shifts? Is it a trust factor or an obstacle? Do you think that professional dependability is enough, or personal familiarity plays a role? What is your balance on that?

5. Standardization, Language Factor, and Mother Tongue (a,b)

a. Pilot’s comment: “For example, when I am in a Greek airport it is really efficient for me and for the safety of my flight to “transcend” SOPs and try to develop a conversational relationship with my controllers (departing and arriving). It is not to violate the handbook but to be laconic and clear when something goes out of the routine. On the other hand I have noticed that ATC people are likely to stay in the letter of ICAO phraseology, they do not seem to feel the liberty or need to deviate.”

Why do you think that he speaks about a” need” to transcend SOPs? Do you support that “not following the letter of the book” shows that flexibility or that it creates inconsistency? Do you have personal examples to share? What is your experience on ATC personnel? How do you accomplish the “1 word – 1 meaning” phraseology?

b. “ICAO English may be the spontaneous choice when I follow habitual in-light processes (without too much processing in my mind). I know there is a difference in FAA when I fly in the US as recommended phraseology is not the same. Sometimes, I feel as I am a “recorded voice” in action when I apply the routine SOPs. In contrast when I have to do some more that the standard checklists, I find myself using Greek language and mostly Greek words inside English structures.”

Do you feel that when you coming from a non-English mother tongue plays a role in what you are accomplishing “when communicating”? Is it different in emergencies in compare to routine flights?
6. Trust and Professionalism

In the aviation community, most people have faith to each other’s professionalism. Do you take professional behavior for granted? Do you play by your role, only? Do you need “interpersonal trust” to the individual (with your crew and the ATC)? How do you develop/communicate that?

7. Instructor with Trainee in Flight Mode (a, b)

Several reports have indicated a lack of assertiveness on the trainee’s part, and a failure to challenge the instructor even when the trainee believed the instruction was wrong. The following study report excerpt exemplifies how confusing and vague communication by both instructor and trainee can result in a safety incident:

a. Instructor said... 'Uh, you can have control if you, uh, want it.' I probably replied ‘OK’ rather than the usual ‘I have control.’ I began to pull the nose up slowly when I thought I felt my instructor push forward on the wheel [and] relaxed...Nosewheel touched down first and we bounced...Fortunately we walked away...with an undamaged aircraft. ‘Wishy washy’ coms played a major role in this. (ASRS Record #240165)

Have you been to such a position? What is your opinion (in the position of an instructor or trainee)?
b. It is a common technique of flight instructors to allow the trainee to make mistakes in an attempt to develop independent actions and observe the trainee’s level of awareness. However, especially during IFR operations, or when compliance with an ATC directive is doubtful, corrective verbal comments by the instructor have a significant impact on flight safety. What is your opinion (as instructor or trainee)? How do you develop your communication to repair such cases?

8. Communication Equipment Use and Priorities (a, b)
An instructor’s testimony:
a. “We had started flying using headsets, with the radios being monitored through the headsets. After the first landing the student stated he would prefer to continue without the headsets as he didn’t feel comfortable wearing them. I said OK. We got involved in doing touch and goes (5 of them) and I failed to notice
that we had not heard from Tower during this time. When I did notice that the speaker button was not in the proper position, I made contact with the Tower. They (Tower) terminated the flight and I was instructed to call the Tower. (ASRS Record #290210)

How confident are you to fly without listening to the Tower? What would you do in such a position?

b. An instructor’s perception of task priority may have been distorted by the desire to critique the student and resulted to wrong-runway takeoff:

“We took off on [runway] 24 instead of 30, as the Tower subsequently informed us. As I reviewed the event later, with my student and in my own mind, I realized how I may have added to the uncertainty. I was busy pointing out airport markings and critiquing the flight to this point. The priority should have been communications with the Tower and standard procedure (ASRS Record #137322).”

How do you stay focused on the instruction flight? Did you have such an experience? How do you keep up with priorities during flight?

9. Dual Instruction
Reports suggest that the operational context in which dual instruction often occurs, specifically, the simultaneous occurrence of internal verbal or external radio
Communications with aircraft maneuvers and demonstrations may be an incident-generating factor. But it is also helpful for instructors to remember that every word counts—as well as the timing of training-related critiques. For example, it is more effective for an instructor to say “turn left 90 degrees,” than to ask, “where are you going?” as the aircraft enters controlled airspace without a required clearance. Studies suggest the need to improve the clarity, economy, and judgment of priority of verbal communications in dual training, especially for flight instructors. Trainees need to be able to express doubt or uncertainty, and also to admit mistakes.

<table>
<thead>
<tr>
<th>How do you accomplish such tasks? Could you described briefing and debriefing techniques to do so, or you prefer to do it during the flight? Do you feel comfortable with multitasking?</th>
</tr>
</thead>
</table>

10. Redundancy as Mutual Verification

In several transcripts, a pilot misreads the numbers in a clearance message and repeats back the erroneous units for controller confirmation. A controller did not hear—or did not listen to—the incorrect readback. The airman accepted lack of response as silent confirmation that the readback was correct. Inadequate “Roger” or “okay” or “so long” types of pilot acknowledgments for clearances that precluded any controller double-check of the completed exchange.

<table>
<thead>
<tr>
<th>a. Do you think that readback-hearback interactions create more fatigue and are monotonous or you take them as necessary? Is it plausible to make such inferences in flight or it is just a matter of experience?</th>
</tr>
</thead>
</table>
b. An experienced flight instructor commented in a report: “misread, turned out, guessed, hearing one number and saying back another, hearing what I expected to hear, forgetting to change the altitude reminder to a new altitude, even ascertained by an informal consensus vote in the cockpit”, are common occurrences in flights. What are the “rules of thumb” to repair or prevent them? Is it part of the unexpected to deal with?

11. Listening Mode (Pilot- ATC)
A pilot complained in a collective report: “while it is possible that we may misunderstand the controller, nevertheless we were relying upon the controller to correct any mistakes in the readback. My impression is that controllers are not in the listening mode. As soon as they issue a clearance, they start talking to other aircraft and pay no attention to the readbacks!”

Did it happen to you? Are there any problems in prioritizing “listening” vs “speaking”, “readback and hearback” more between different flights? Are you
involved in any type of training for that?

12. Forward interpretation or ‘GetThereItIs’ (Pilot- ATC, a, b)

a. A controller in a collective report: “In my experience, flight crews are prone to interpret an advisory of traffic at some altitude as clearance to that altitude. If flight crews plan to request a specific altitude they tend to translate the next clearance to that altitude.”

Do you think that pilots tend to be furious and take the next step for granted? Is it a phenomenon of “get-there-itis”; i.e. I want to arrive rather sooner than later (for the next position and for the final destination)?

b. If we are aware of this “get-there-it is”, we can break the domino effect; an effect that takes place in every accident related to pilot error. One bad decision, leading to another bad decision, leading to an even worse decision, and inevitably ending with severe consequences.

What is the type of training/experience that helps you avoid such a domino-effect? How do you communicate a change of a decision/repair a bad decision? What is the instruction and the practice to repair such cases?
13. Superiority and Authoritative Mindset (Pilot specific)

Being a Captain: The flight officer had a background of military fighter aircraft and is used to being his own commander and taking the initiative. I was hesitant to give him hard orders so I let him make several moves before I was ready for them. Later, I had a long conversation with him as to who was the “Captain.”

Being the co-pilot...: The captain was so sure of himself that it would have been presumptuous for me to ask him to verify the information. The next time, I will find a way to do it regardless of the Captain’s attitude.

Did you have an experience of conflicting roles? Is there a mindset of authority or rank? Is it different between men and women in those positions? What is your perception and what would you do?

14. Witnessability as "Building up the Picture" (Controllers’ specific)

Air traffic control can be viewed as collaborative activity. Controlling air traffic is managing events in real time rather than following the kind of plan which determines in advance what it is the controller should do next. An important part of
this is "looking about 5 to 10 minutes ahead all the time....sometimes a little further than that", in order to get an idea of the actions needed to be taken 'now'. As one controller described the process at some length, the kinds of check you do is check your information which is your strips which will show you whether an aircraft is in there or not, and that means then that you don't have to look all over the radar... it would be an impossible job to sit down and look at the radar and look at all the different blips and try to avoid them by putting the aircraft into blank spaces on the radar, so you have got to have this information to tell you what traffic is coming into and out of the sector.

What is the communication used during this type of scheduling? Are there any time gaps during this communication? Do you use any visual or other practical aids like "paper strips"? How do you hold/remember that type of information?

15. The Two-challenge Rule (an analogy from the medical profession/nuclear reactor operation):

The two-challenge rule allows one crew member to automatically assume the duties of another crew member who fails to respond to two consecutive challenges. For example, the pilot-on-the-controls becomes fixated, confused, task overloaded or otherwise allows the aircraft to enter an unsafe position or attitude. The pilot-not-on-the-controls first asks the pilot-on-the-controls if she/he is aware of the aircraft position or attitude. If the pilot-on-the-controls does not acknowledge this
challenge, the pilot-not-on-the-controls issues a second challenge. If the pilot-on-the-controls fails to acknowledge the second challenge, the pilot-not-on-the-controls assumes control of the aircraft.

Do you think that you could apply that rule? Can you think of any examples?

For ATC: Is that happening between controllers disagreements (between area approach and airport tower or other sectors of air traffic control)?

16. Affordances and Skills
Flight operation and air-traffic control is considered a mission critical environment because of human safety involved, high-stakes in resources, time constraints, and the mission involved in military aviation.

What helps you operate better under pressure when time is critical? What is the level of training or experience that facilitates coping with overlapping communication and decision-making under pressure and limited time?
17. Oral Information

Experienced practitioners in their daily practice, rather than totally relying on Standard Operating procedures, make use of their own tacit experiences when faced with decisions to make.

Do you happen to obtain information/knowledge/expertise about your work orally or from manuals and the books? Are there any cases that you would like to share?

18. Heuristics and Experience

It is widely accepted that mastering most complex human endeavors (from chess playing to medical intensive care) requires a 10-year of experience. What is the experience that you would describe as necessary and adequate in your sector? Does it mean to be able to interpret SOPs and Rules of Engagement (RoE) to solve problems and make judgments quickly and efficiently, but they are also prone to errors.

How do you communicate your situated knowledge when changing shifts? Do you like to write short notes as reminders? What are the conditions of affecting performance to hold?

19. Relationship and Familiarity

A common theme in discussions with pilots and air-traffic controllers a typical conclusion is that “having gone to the flight school/air force academy together/being in the same crew many times, being in the same shift many times/being in the same dyad or quadruplet or octave of fighter planes together creates a type of closeness and proximity that facilitates communication and mission completion.”
How do you communicate with your “buddies” from those cases? Does it help you bypass standardized patterns? Can you think of any examples from verbal or non-verbal communication? What happens when crews and shifts change? Did you have any relevant experiences in international missions/missions?

20. Air Force/Military Aviation Doctrine (fighter pilot specific)

In the case of fighter pilots many accounts connect the political and tactical training culture with effectiveness in mission completion and operating under pressure. Furthermore, when training is focused on defensive missions and the broader political surroundings promote a defensive doctrine fighter pilots seem to have an esoteric motivation that goes beyond their operational mandate.

Is that happening in your experience when flying in NATO/international missions in compare to national missions? Does it affect the way you operate/communicate during flights? Is it the mission or what you feel about it? Do you connect “mother tongue” with “mother land” when you communicate? How do you manage the multiplicity of communication from Air Force command, traffic control, mission chief etc that accumulate?

In Greek:-------------------------------------------------------------Στην περίπτωση των πιλότων μαχητικών πολλές εξιστορήσεις συνδέουν την πολιτική και την τακτική (αμυντικό δόγμα) με την αποτελεσματικότητα στην ολοκλήρωση της αποστολής. Επιπλέον, όταν η κατάρτιση επικεντρώνεται σε αμυντικές αποστολές και οι ευρύτερες πολιτικές περιβάλλον προωθούν ένα αμυντικό δόγμα πιλότοι μαχητικών φαίνεται να έχουν μια εσωτερική κίνητρο που πηγάνει πέρα από την επιχειρησιακή εντολή τους (κανόνες εμπλοκής). Τι σημασία έχουν για εσάς οι κανόνες εμπλοκής και πώς επηρεάζουν την επικοινωνία σας στο σχηματισμό;

Είναι σχετική η εμπειρία σας, όταν πετούν διεθνείς αποστολές του NATO σε σύγκριση με τις εθνικές αποστολές; Έχει επηρεάσει τον τρόπο που λειτουργείτε/επικοινωνείτε κατά τη διάρκεια πτήσεων; Είναι η ίδια η αποστολή ή τι νιώθει ο πιλότος γι 'αυτήν; Μπορείτε να συνδέσετε "μητρική γλώσσα" με "μητέρα πατρίδα" όταν επικοινωνείτε; Πόσο διαφορετική για εσάς είναι η αμυντική από την επιθετική
πολλαπλότητα της επικοινωνίας από την εντολή απογείωσης από ετοιμότητα, τον έλεγχο της κυκλοφορίας, επικεφαλής της αποστολής κλπ που συσσωρεύονται (KENA, EKAE, Αρχηγός Αποστολής-COC, Επόπτης Πύργου):

21. To Remember…

Is there any flight/example/case that you always remember, so far? Why?

Do you fly with a “plan B” in mind or in your briefing?

ASRS #409: “I have flown many years and I am very comfortable flying VFR and IFR, even VFR when the ceiling is low as long as the visibility is as good as it was this day. However, I let my comfort level lull me into departing without a viable Plan A and no Plan B.”

22. Feeling Safe

In a more general idea, what makes you feel safe in communication (from one shift to the other in ATC and with incoming pilots)? What type of briefing do you think is efficient?
23. Safety and Just Culture

What is the meaning/your understanding/perception of safety and just culture for you?

24. Briefing- debriefing

What is the importance of ‘briefing- debriefing’ in your functions? Does it happen to complement your briefing during a flight?

25. A Why Question

Why did you choose to come to the ATC profession? Why did you become a pilot? What is/was your vision/goal when you started?

Note: Write any comment you may have for the questions or the cases of this “interview”.

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Thank you for your cooperation. Ευχαριστούμε για τη συνεργασία.

Theodore Katerinakis - Θεόδωρος Κατερινάκης
**APPENDIX B: ISHIKAWA DIAGRAM AND QUESTIONING ROUTE**

This is the diagram containing the constituent questions in the second stage of data collection, according to the GT approach used for this study (explained in section 2.4). The second and final shift on the main topic occurred in the transition to the scenarios (in Appendix A). Fishbone diagrams (also called Ishikawa diagrams or cause-and-effect diagrams) are visual tools that show the path for contributing factors to a certain event (area of interest or problem). The main arrow or trunk represents the main goal, and primary factors are represented as sub-arrows or branches. Stems, leaves and so on are added as secondary factors and tertiary factors respectively (Tague, 2004; AOTS, 1985; Nelson, 1998; Newby et al, 1996; Smith & Ragan, 1993; USAF, n.d.; DoN, 1993).
B.1 The Ishikawa diagram
### B.2 Questioning Route of the Ishikawa Diagram

Theoretical Theme (in the “fish head”): Practitioners in their daily practice, rather than totally relying on Standard Operating procedures, make use of their own tacit experiences when faced with decisions to make.

**Is it valid for pilots?** In order to draw the frame for pilots as highly-skilled practitioners in an environment of mediated communication, and explain communicative activities that they commit.

<table>
<thead>
<tr>
<th>Do you agree? What is your experience?</th>
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<tbody>
<tr>
<td>It is important to interact with colleagues to acquire knowledge that they have in their heads?</td>
</tr>
<tr>
<td>Do you do that in formal meetings (like the briefing room or in informal occasions (hang-out in the squadron)?</td>
</tr>
<tr>
<td>When stationed in other bases, do you find it difficult to cooperate?</td>
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<tr>
<td>In what sense do you use rules and codified policies that are straightforward? Would you like periodical customization of rules?</td>
</tr>
</tbody>
</table>

**Is it valid for Air Traffic Controllers?** In order to show how pilots (senders) perceive or understand the position of ATC (receivers) in their communication interaction. This sequence could be used to validate questions.

<table>
<thead>
<tr>
<th>Is it important to interact with ATC colleagues?</th>
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<tbody>
<tr>
<td>It is important to develop personal contacts in your squadron?</td>
</tr>
<tr>
<td>ATC in your missions has an additional superior flight officer to conduct your coordinated missions. Do you feel that necessary for ATC?</td>
</tr>
<tr>
<td>Do you rely on what ATC suggests/decides or you prefer to follow your mission briefing</td>
</tr>
<tr>
<td>Do you think that ATC work is more repetitive-mechanistic than yours?</td>
</tr>
<tr>
<td>Does it happen to interpret ATC guidelines on your own? Do you need to adjust your flight plan/route with your own initiative?</td>
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</tbody>
</table>

**Standard Operating Procedures:** to point out what are the standards in their operation, how they acquire communication competence and data rules, as well as how they perceive their “liberty to interpret”.

<table>
<thead>
<tr>
<th>What is the protocol/s you use for training in your pilots Academy?</th>
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<tbody>
<tr>
<td>If you are trained in civil aviation, what is your involvement in military flight missions (air space restrictions, drills, VIP flights, emergencies)?</td>
</tr>
<tr>
<td>Please describe typical attributes/examples of phraseology used in flights.</td>
</tr>
<tr>
<td>Do you think of it as critical?</td>
</tr>
<tr>
<td>The word &quot;apply&quot; or &quot;interpret&quot; when speaking about RoE and SOP?</td>
</tr>
</tbody>
</table>

**Rules of Engagement:** to explain what makes it different in the rules of specific mission (military aviation) in compare to standard processes.

<table>
<thead>
<tr>
<th>How do you acquire tactical training for missions?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is it common to deal with disagreements when you design routine missions?</td>
</tr>
<tr>
<td>Please list some examples of RoE. What is your opinion about those rules? How different are they from SOPs? Is there room for your own decision or tolerance?</td>
</tr>
</tbody>
</table>
Do you give feedback on the application/feasibility of RoE (during debriefing)?

**Automation and technological tools/aids:** to investigate trust in automation, interactions with autopilot, reliance on critical thinking/expertise on input data.

Do you prefer simulation/emulation or live flights? How often do you use the auto pilot?
How would you feel to fly a drone? (perceptions, advantages and disadvantages)
Visual flight rules of Instruction flight rules? Is there any preference for you?
Decision with experience, instinct or instrument indicators? Do you remember such "judgment calls"?

**Environment: collaboration and criticality; to investigate the context of the flight communication model in different stages of an aviation career.**

Does it feel different to fly in national missions in compare to NATO or other missions?
What is that you understand with the concepts risk, "safety", "mission accomplished"?
Readiness: how do you cope with long readiness?
Does it cultivate strong relations in the team
Day-to-day training and maintenance of flight status
Is it there any transition from training in the academy and on-the-job training

**Flying Instinct: to investigate deeper characteristics that define the pilot’s personality and affect their communication and team spirit.**

Awareness and trusting colleagues
A flight that you always remember
Who do you think as your mentor?
What is your personal doctrine?
Why do you fly? Why did you become a pilot?
We-ness: my squadron, my family; my "colleagues", "my brothers"?

**Flying as Feeling or a Profession: emotional profile of a pilot in regards to implicit communication.**

Is it fearful to fly?
How does it feel to serve in defensive missions?
Do you have religious feelings for what you do?
Is there any morality call when you fly?
APPENDIX C: "EGO-ALTER” INTERACTION WITH AN ADJUSTABLE QUESTIONNAIRE

This is a transcript of an interaction used in the first stage of data collection, according to the GT approach used for this study (explained in section 2.4). The theme of the discussion was experience, explicit knowledge, and creative deviance from the rules. The first shift on the main topic occurred in the transition to the Ishikawa diagram and questioning route (in Appendix B).

Ego: Hello, Captain A and thank you for participating in this study. I want to thank you for taking the time to meet (e-meet)/deal with my questions, and I would like to talk about your flight experiences and specifically the use of Standard Operating procedures and the extent to which individual initiative is necessary in aviation decision-making skills.

All responses are confidential and any information included in the study does not identify you as a respondent.

Alter: I understand as I was briefed it with Colonel K, when you first visited the base. How do you know him?

Ego: I was serving my duty in 115 CW during the Imia crisis and I was a substandard during the week of COC missions.

Alter: nice, I was in the Academy at the time…

Ego: coming from that experience I wanted to accent the importance and role of HAF pilots as highly skilled, risk-taking practitioners and decision makers. Furthermore, I would like to explore the limitations, tolerance or creativity involved when following SOPs and RoEs. Lastly, to explore the role of communication in an efficient implementation of a flight mission.

Alter: these are kind of esoteric questions that we keep in the back of my head, since when I am about to fly I never know what my experience would be.

Ego: I know, I know …and I thought to use some real cases to have a base for this discussion.

Alter: (nonverbally knocking head to go on)

Ego: Here is a situation reported in NASA’s Aviation Safety Reporting System:

A real case of a B737 Captain’s Report: On takeoff roll approaching 80 knots, the Tower Controller called us and said in a very slow, unsure voice, “[Callsign 1…2…3](pause).” He sounded as if he had something to tell us, but did not know what to say. We both noted a tone of concern and hesitation in his voice as if he was still unsure of something at that moment. We were light weight and had 13,000 feet of runway ahead of us. We had to make an immediate decision.

Ego: What is going on here, in your opinion?

Alter: Oh... that is not so uncommon situation [laughing]. I am not sure why they report it.
Ego: What do you mean? This is the ASRS anonymous system of reporting. What are the rules for that?
Alter: So, when we are in the flight school we share training ours with ATC so that we understand their work. They have multiple stimuli in their screens and visual scope and each communication unit is a separate case.
Ego: [interrupting] is or should be? Do they have to multitask?
Alter: Of course, they do but they have resources to isolate frequencies, call signs, one flight-after another and also to categorize intra-flight communications (from pilot-to copilot etc).
Ego: I see, but let’s go back to the rules. What are the SOPs applied in this situation.
Alter: I have to say that in such a discussion I feel like a doctor who evaluates another doctor’s patient, without being there. But, this is straightforward to say that I should ask back to ATC, before reporting back on the command, “what happened? Repeat Tower”?
Ego: Do you just repeat, as we would do in routine conversation? What about the tone of the voice and hesitation?
Alter: If it is not incidental (as it could be), it could be a warning sign for an uncomfortable situation, a problematic pendency or something that has to do with the actual flight, or the status of the runway, or the taxiway.
Ego: So how do you evaluate that on site? Do you just follow the book or try to relate more with the ATC person?
Alter: It is quite different is you are airborne or you are preparing for clearance. It seems that this pilot is still on the ground, isn’t he?
Ego: Correct, he was in the ground. But, how do you decide?
Alter: At first, when on the ground, if I have a co-pilot I consult him for his opinion as it is common for us to challenge the ATC when in small airports. If you are airborne that is a different story.
Ego: Is it so objective to tell, about a busy or a small airport or how you relate with ATC?
Alter: Of course, if I know the ATC person I may bypass the standard phraseology to say “Eh, John what happened? Why do you hesitate?” If not I may just stay to wait, especially if I do not have a series of corresponding flights in a sequence. I know that safety is the primary concern but we are also employees...
Ego: So, do you think that this is judgment call? What are your criteria? Are they different from the book?
Alter: when I started my career I had a concern, almost fear about the risks that are uncertain when I receive indefinite communication. It took me several hundred hours, I could say after 1,000 flying hours to start felling safe about myself and specific travel routes (when the weather is general terms “stable”). I try to include in my social relations people from ATC, as well as other aviation professionals in order to develop a level of familiarity for their personalities. When I fly abroad, especially overseas I make an effort for an intense briefing about the local
controllers, their behaviors and stereotypes in the use of air-speak English and phraseology.
Ego: Do you really need to go so deep when you prepare your self for a flight? [with naiveness] I thought ICAO phraseology and standardized training guarantee uniformity...
Alter: we are not in an ideal world, and we are still humans. Pilots and air-traffic controllers are social animals with training and experience but with preferences and prejudices, also. For example, when I am in Greek airport it is really efficient for me and for the safety of my flight to “transcend” SOPs and try to develop a conversational relationship with my controllers (departing and arriving). It is not to violate the book but to be laconic and clear when something goes out of the routine. On the other hand I have noticed that ATC people are likely to stay in the letter of ICAO phraseology, they do not seem to feel the liberty or need to deviate.
Ego: Why do you speak about a need? Do you support that “not following the letter of the book” you are more flexible?
Alter: No, it is not exactly that. I say that rules may come to an end in a situation of escalating crisis or even when you have multiple warning signals that have to be communicated. It is ironic, sometimes, that after all this complexity that we experience and operate in a flight cockpit and plane “piloting” is implemented only when we communicate our acts and we communicate to act.
Ego: So, do you feel that coming from an non-English mother tongue plays a role in what you are accomplishing “when communicating”? 
Alter: I would say yes and no; my point is that language (and mainly phraseology) may affect my understanding and the messages I convey but my Greek experience seems quite embedded in my language skills. Of course I have gone over various ICAO certifications but still a lot of times it is spontaneous to think in terms of “Greek reality and mentality” since I need to fly to diverse small airspaces for domestic flights and accomplish some type of rapport with different controllers. ICAO English may be the spontaneous choice when I follow habitual in-light processes (without too much processing). Sometimes, I feel as I am a “recording” in action when I apply the routine SOPs. In contrast when I have to do some more that the standard I find myself using Greek language and mostly Greek words inside English structures.
Ego: that means that in this case of hesitation, would go to a direct Greek comment/inquiry to use?
Alter: it is quite likely, especially if I was flying when time is critical and decision-making space is constraint.
Ego: But in this case, it is how you hear the other talk and not so what does he say?
Alter: We are instructed and trained to be more rigorous and economical when we communicate; every message has to have a clear start and end. But, since I receive human voice in my headphones, it is implicit communication with an element with a bit of trust.
Ego: In the aviation community I have seen that most people have faith to each other professionalism. Why do you need trust?
Alter: I agree that you have faith to your partners –that how I feel about all participants in a flight mission- because that it what we do. I use technology, I use tools, I use communication in systems that are dependable and I have faith... but with ATC I need something more, I need to establish trustworthiness in what the other person does and trust in what he/she communicates (sometimes I have experienced differences when speaking in a female ATC in compare to man but it is another story). When I need guidance, when I need confirmation, when I need a solution I cannot have second thoughts. I need to feel that there is no question in what ATC is saying. Flying is not an individual accomplishment; it needs collective work on board the plane but also a relationship continuum with the controllers. That is why when I know their first name, I use it, although it is not recommended. This concept is more important to be accomplished in routine iterations of flights, as you may only need to make use of it when an incident is unfolding, an event may be progressing, or an emergency is diagnosed. It is part of the idea of being proactive, to know your resources and especially the human resources you can rely on.

Ego: that’s really useful captain. Let’s see what that pilot and copilot reported in action:

**The Reporter's Action:** I elected to initiate rejected takeoff procedures. During deceleration the Tower Controller said, “Disregard.” The sound of one’s voice, the tone and force, all convey a message. I did not like the message I was receiving and could not gamble that he was trying, but unable, to warn us of something ahead. I would take the same action again.

*(From the First Officer’s report on the same incident ;)* I believe the rejected takeoff was the right thing to do. When you get a call from Tower at that point in the takeoff roll, the first thing that pops into your mind is “something’s wrong.” In the few seconds before he finished his thought, we were left to guess what the call was about. We were still relatively slow speed on the roll, so the Captain did what was prudent and safe by rejecting.

Ego (continues): What is your opinion?

 Alter: better safe than sorry is a canon. The pilot perceived a level of uncertainty. Since they were on the ground there is no safety issue at stake, so a delay is a prudent choice and action, as the first officer suggests. I am not sure whether I would do the same thing or not. If I was in a Greek airport I would try to resolve this “uncertainty hesitation” with a more informal inquiry; i.e. to ask back and clarify the sources of this hesitation. Still, in EU Airspace as governed by Eurocontrol delays may have domino-effects in consequent routes (mainly in busy airports). That means that if you lose your time stamp to depart you may need to wait for the next cycle of allocated expected departure times that may be quite disturbing if you have consequent flights.
Ego: That a really thoughtful comment from my theoretical point of view also. Would you like to share any example of yours in a similar case?

Alter: I have not experienced that so far, as I try to be persistent with ATC when there is an uncertainty. But, I always have in mind the tragic collision in Tenerife Airport on 1977 when the crash took place on the ground!!!

Ego: Is there any flight that you always remember?

Alter: that is the flight that stays in my mind to remain proactive. I also keep aside to complement, my spiritual beliefs although I cannot articulate it with facts but I reserve it as a contributing factor for a peace of mind.

Ego: In a more generic idea, what makes you feel safe in communication?

Alter: Feeling safe in communication means to feel during the flight. Flight briefing in carrier’s headquarters is very important, meeting my crew members is really useful, and being able to start conversation with informal tips with ATC. Also, I need to follow the inflight take-off checklist and study the flight log for potential entries and problem resolution. Thus, I need to go by the book with SOPs in order to be able to have choices in my decision making. Sometimes, eliminating alternatives may be more important than having more, especially when time is counting down. Lastly, when I have the option (or tolerance), to speak briefly in my mother tongue, that is another assurance in my mind.

Ego: let’s recap some key points; safety is a doctrine for you. Communication is a key tool to accomplish a flight. I daily practice, rather than totally relying on Standard Operating procedures, you make use of your own experiences when faced with decisions to make. To communicate in Greek, maybe also necessary in a limited form, especially when your experience allows you to go beyond self-reliance in automation.

Alter: I wouldn’t recap it that way but this is a fair statement to conclude.

Ego: Is there anything, you would like to add?

Alter: I would like to point out that is a very important topic for the aviation sector and your collection would be a very good start to initiate an ASRS system to be constructive in everyday life of aviators.

Ego: Thank you very much, for your time and I will keep you posted. ■
APPENDIX D: ICAO- FAA BASIC ENGLISH PHRASEOLOGY DIFFERENCES

The use of aviation English challenges cockpit communication in international flights. Differences in phraseology generate a division by a common language.
APPENDIX E: NAMING CONVENTIONS AND PROFILES

Discussions were recorded with the naming convention of airport names to preserve anonymity (forty six airports are documented and supervised by the Hellenic Civil Aviation Authority and twelve combat wings, without using all of them). That was the first level of coding the names. In a second level, all names were codified with a conventional acronym: Aviation Informant Professional <number>.

1. AIP1 HAF Fighter Pilot with more than 20 years of flight mission experience, a second University degree, and NATO AWACKS Crew Supervisor. He graduated from the Air Force Academy with a less adventurous ambition in comparison with his pilot-colleagues; instead of being obsessed with the latest technological breakthrough in aircraft hardware he was inspired by the communal living and close ties formulated in the flight school and wanted to dedicate his learning on how dyads of pilots, or group of pilot classmates would become competent and reliable professionals. After spending 10 years in A-7 squadrons, he graduated with a second university degree in decision sciences. He spent several years in HAF General Staff and other eight years in NATO Reconnaissance Squadrons representing Greece. His missions were designed to aviate, as Chief of the Strategic Design Unit onboard, with a team of international crew members in AWACS aircrafts, before returning to serve in the HAF General Staff again, in a new branch. He had to undertake diverse missions, work in multicultural and multilingual military environments and developed a strong sense of collaborative work in several thousand flying hours. He has active experience in national fighter missions in HAF, in international reconnaissance missions for NATO where he needed to take-off and land in most of the seventeen countries which consists the operational branch of NATO.He believes that Air Force works because of the groups of people that are calibrated in sophisticated team work after intense training.

2. AIP2 HAF Fighter Pilot with more than 25 years of experience in elite units, two post graduate degrees, head of HAF Academy curriculum development. Strong Background in aviation safety and international fighter missions. A HAF fighter pilot at the rank of Brigadier General with twenty years of operational experience in 4,000 flying hours on board of T-2s, A-7s, and Mirage 2000-5, which are considered the elite unit of HAF. He holds postgraduate degrees from the US military Schools, and has served in the Hellenic Air Force Academy where he redesigned several parts of the curriculum. His involvement on tactical and operational training for different generation of pilots oriented his focus on mentoring, tactical design and international allied missions. His bonding with the younger officers is exceptional; he has spent three years on consecutive shifts every second day in his base and formulated a tight bond with the younger pilots who were in the tactical training phase.

3. AIP3 Brigadier General HAF, in commanding positions of a NATO major installation, with 30 years of flight experience. Served in commanding positions of fighter squadrons and pilot training squadrons with A-7s. He has substantial experience in international culture and mission coordination.

4. AIP4 Brigadier General (HAF) just retired due to health reasons, with commanding experience in fighter squadrons and pilot training squadrons (A-7s). Strong interest in pilot safety, with research work on the “supervisor’s error” in advanced mission design and training.

5. AIP5 Brigadier General (HAF), with very extensive commanding and managerial experience (in NATO's Allied Joint Force Command Naples) and HAF combat wings (in A-7s). With a second degree in political science and a strong awareness on public policy and personnel management.

6. AIP6 Colonel of Hellenic Army Aviation, with commanding experience at a battalion level and specialization in tactical design. A helicopter pilot known for effective crew coordination. He is a key partner in NATO simulation games design. He is specialized in Chinook helicopters and serves with close cooperation with Apache attack helicopters. After spending fifteen years in conventional Army operations out of the Hellenic Army Military Academy, he has experienced a chain of command established without flexibility and a tradition of hierarchical organization and ethos that goes back to ancient historical warfare, in the epic works of Homer, Thucydides, Xenophon.

7. AIP7 Major General (HAF), with commanding position in three combat wings, the Hellenic Tactical
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Background and Experience</th>
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<tbody>
<tr>
<td>8.</td>
<td>AIP8</td>
<td>Civil Aviation pilot with 25 years of experience in passenger planes in one of the two largest airliners in Greece. His flight experience includes routes all over Europe, the Middle East and the Arab States. Most of his flying hours are in B-737 aircrafts.</td>
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<tr>
<td>9.</td>
<td>AIP9</td>
<td>Civil Aviation pilot with 20 years of experience in passenger planes and more than 10 years in VIP planes. In the past 10 years he is flying in European countries and Russia. He has a personal experience from major aviation accidents, accident investigation and the respective litigation.</td>
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<tr>
<td>10.</td>
<td>AIP10</td>
<td>Civil aviation pilot with a strong experience in various aviation topics (radio communication, search and rescue communications equipment in military and commercial environment, and air traffic control). His expertise and passion is aviation history and has experimented with civilian unmanned vehicles. He has an authentic drive for aerial inquiries and considers aviation an ultimate goal in life. He started from after high school in the vocational training school for technicians in aviation engineering and continued with degree in radiotelephony and radio-communications (commercial, in HAF and Hellenic Coast Guard). In a period of fifteen years he obtained flight degrees from schools in the USA, France and Greece, as well as flight simulator instructor degree, while working as a commercial pilot in Greece. He coordinated the single-day transition from one airport to the other Athens Airport to the new “Eleftherios Venizelos” Airport and supervised the Air Traffic Control in ten peripheral airports of the Aegean islands for quality assurance.</td>
</tr>
<tr>
<td>11.</td>
<td>AIP11</td>
<td>A top executive in HCAA, with a specialization in environmental engineering in aerodrome installations and a strong managerial and supervisory experience.</td>
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<tr>
<td>12.</td>
<td>AIP12</td>
<td>A top executive in the Supervisory Council for Air Navigation, with an expertise in aviation economics and public infrastructure design. He has spent 5 years as an administrative member of the HAAISB and as a national delegate to ICAO.</td>
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<td>13.</td>
<td>AIP13</td>
<td>An experienced accident investigator with more than 140 accidents investigated; after serving in HAF and employed in civil aviation, with thousands of flying hours in three generations of aircrafts. He graduates from Air Force Academies in two countries and specialized in accident investigation in three different countries. He has a strong experience in international aviation coordination in Europe, US and Asia, and has provided important safety recommendations in the industry. Served in ICAO delegations and task forces for 15 years.</td>
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<tr>
<td>14.</td>
<td>AIP14</td>
<td>The most experienced Air Traffic Controller in this study, with active participation in SPOA and EASA task forces. One of the first women in air traffic control in Greece, who is also married to an air traffic controller. She has an expertise in aviation regulatory framework in Europe and relevant public policies. After having a thirty-year experience in the sector, she is one of the first few women in the profession in Greece, coming from a background in law. She served as delegation member in the European negotiations for the Single European Sky initiative and is still an instructor in the Civil Aviation School. She is quite sensitive in the use of airspeak English and airspeak Greek.</td>
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<tr>
<td>15.</td>
<td>AIP15</td>
<td>A female young air traffic controller, with a degree in international relations and fluent in three languages. She has an active participation in aviation terminological research. A young controller with a different profile, both in the admission point as well as in her current work. She is a woman again but entering a professional world with a rapid growing percentage of 30% and with the first woman Head of the HCAA to assume position in the current decade. She is the first ten years of her career, graduated as top in her class from Civil Aviation School, and comes from a linguistic background coupled with international relations; flights for her is a realization of European policies for open borders. Her career aim is to continue to accident investigation and to fill as many positions as possible in peripheral airports before assuming responsibility in one of the three major airports in Greece. She considers the sector as a research vocation and is enthusiastic for aviation and more spontaneous in her reactions.</td>
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<tr>
<td>16.</td>
<td>AIP16</td>
<td>Male air traffic controller in his third airport position, working for 6 years in Athens Airport tower.</td>
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<tr>
<td>17.</td>
<td>AIP17</td>
<td>Female air traffic controller (and married to an air traffic controller), in one of the top 4 airports in the Greek island periphery.</td>
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<td></td>
<td>AIP18</td>
<td>Male air traffic controller with responsibility on collecting the anonymous incident/accident reports from Greek airspace and inserting them in the European Incident Database. This is the process started on 2005 to consolidate reporting at a national level (Permanent Committee for Safety Reporting). Anonymous reports update the database at a European level and encourage the flow of reports similar to the NASA/ASRS system.</td>
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<td>AIP19</td>
<td>A very experienced female air traffic controller who is heading the service in a major island airport. She has experienced the pressing operation of controlling air space during the occurrence of major physical phenomena like earthquakes. She has also a certified instructor on safety courses for air traffic controllers in SPOA.</td>
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<td>AIP20</td>
<td>A Lieutenant General in HAF flight engineering, involved with aerospace navigation system and an expertise in satellite monitoring.</td>
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<td>AIP21</td>
<td>An experienced male air traffic controller responsible for the localization of ICAO manuals in the Greek Flight School (SPOA). He is a member of the social media administration for a community of practice of aviators involved in language localization standards.</td>
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<tr>
<td></td>
<td>AIP22</td>
<td>A male air traffic controller with the strongest theoretical background for those who respond in this study. He holds a PhD in aviation safety. He is an active controller in a major island airport and participates in EASA task forces.</td>
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<td>AIP23</td>
<td>Fighter pilot in F 16 with experience in Renegade interceptions.</td>
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<td></td>
<td>AIP24</td>
<td>A commercial pilot who introduced the language standardization scenario after a debriefing discussion in SPOA School.</td>
</tr>
<tr>
<td></td>
<td>AIP25</td>
<td>A civil aviation pilot introducing the directness in language scenario, after discussing the IATA phraseology survey.</td>
</tr>
</tbody>
</table>
Vita

Education
- PhD in Communication, Culture and Media, Drexel University, 2014
- MSc, Communication Science, Drexel University, 2009.
  MS Portfolio in Social Networks, Ethics, and International Negotiations
  Thesis: Multiple Criteria Decision Aid & Multiple Criteria Decision Making

Research and Teaching Interests
- Aviation Communication, Language and Discourse Analysis in ATM
- Social Network Analysis and Community Transactional Ethics
- Information Theory and Systems Analysis, Document Value and Workflow
- Social Economy, Cooperative Banking, Regional & Island Economics
- Human Resources Training, Recruiting & Evaluation

Courses Taught
- Regional Studies in Economic Policy & International Business (INTB338/IAS390)
- Research Methods I (SOC250), Principles of Communication (COM111)
- Elem. Modern Greek I, II, III (GREC101, GREC102, GREC103)
- Internm. Modern Greek (GREC201), Communicate in Greek: Philoxenia (GREC 280)
- Greek and Cretan History, Economy and Society (GREC 380, GREC313)
- Crete Through the Looking Glass (ANTH340), Cretan Civilization: Unraveling Ariadne's Thread (IAS360)
- Drexel Study Abroad in Crete, Co-Instructor at

Selected Publications