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# IMPLICATURE UNDER PRESSURE: WHEN PILOTS AND CONTROLLERS READ BETWEEN THE LINES

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**Abstract:** Aviation English is designed to remove ambiguity, but pilots and air traffic controllers still rely on implied meaning, particularly when they are short of time or fuel. This study examines how conversational implicature, the meaning a speaker communicates beyond what is literally said, operates in pilot–controller and intra-cockpit communication under stress, and how its failure contributes to accidents. Using Grice's Cooperative Principle and Sperber and Wilson's Relevance Theory as the analytic framework, with Brown and Levinson's politeness theory as a supporting lens, the study conducts a qualitative pragmatic document analysis of cockpit voice recorder and air traffic control transcripts published in four official accident investigation reports: Tenerife (1977), Air Florida Flight 90 (1982), Avianca Flight 052 (1990) and American Airlines Flight 965 (1995). Forty-one safety-relevant exchanges were coded for the maxim at issue, the type of non-observance, the direction of inference and contextual stressors. Four recurrent patterns emerged: (1) *implicated urgency*, where speakers expected hearers to infer an emergency that was never stated in standard terms; (2) *mitigated warnings*, where junior crew members hinted at danger and seniors chose the face-saving literal reading; (3) *expectation-driven inference*, where hearers under goal pressure read ambiguous utterances as the outcome they wanted; and (4) *unvoiced doubt*, where a listener inferred that something was wrong but did not seek repair. One finding stands out. In a restricted code such as ICAO phraseology, leaving out a standard term is itself meaningful, so a crew that does not say "Mayday" implicates that there is no emergency. The study argues that Aviation English training and ICAO proficiency testing should explicitly address pragmatic competence, including when to abandon implication and state meaning directly.

**Keywords:** Aviation English; conversational implicature; pragmatics; communication under stress; pilot–controller communication; mitigated speech; ICAO phraseology

## 1. Introduction

Few kinds of spoken language are regulated as tightly as the talk between pilots and air traffic controllers. Since the International Civil Aviation Organization (ICAO) established English as the

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language of international radiotelephony, aviation communication has been governed by standard phraseology: a restricted code of fixed words, fixed word order and readback procedures, intended to keep each transmission short and free of ambiguity and to let the other party confirm it (ICAO, 2007, 2010). Where phraseology does not cover a situation, speakers must switch to "plain language", which ICAO expects to be equally clear, concise and unambiguous (ICAO, 2010).

In principle, this leaves little room for the indirect meaning that fills ordinary conversation, where speakers routinely mean more than they say. "It's getting late" can function as a request to leave, and "Do you know what time it is?" is rarely a question about knowledge. Grice (1975) called this extra layer of meaning *conversational implicature*, and argued that hearers work it out by assuming that the speaker is being cooperative. Aviation phraseology attempts to remove the need for such inference by making the literal message carry the full communicative load.

The accident record shows that this aim is not always met. Miscommunication has been identified as a contributing factor in many of the most serious accidents in aviation history (Cushing, 1994; Tajima, 2004; Estival et al., 2016). Studies of routine radio traffic also find that problems increase when speakers depart from protocol or pack too much information into a single turn (Howard, 2008; Morrow et al., 1993). Much of this research, however, has focused on lexical ambiguity, non-standard phraseology, accent and limited language proficiency, particularly among non-native speakers (Kim & Elder, 2009; Molesworth & Estival, 2015). Less attention has been paid to the *pragmatic* layer: what speakers intend to imply, what hearers infer, and how this process changes when crews are under stress.

Stress matters here because it affects how people both produce and understand language. When workload is high or time is short, attention narrows, working memory holds less, and people lean more heavily on what they expect to hear (Staal, 2004). Under those conditions, hearers are likely to fill gaps with assumed meaning, and speakers may fall back on habitual, indirect ways of speaking from Standard English instead of the explicit forms required by Aviation English.

This study therefore asks how implicature operates when pilots and controllers "read between the lines" under pressure. It addresses three research questions:

RQ1. What types of conversational implicature occur in safety-critical pilot–controller and intra-cockpit exchanges recorded in accident transcripts?

RQ2. How do contextual stressors, such as time pressure, fuel state, weather and workload, shape the production and interpretation of these implicatures?

RQ3. What do these patterns imply for Aviation English teaching, Crew Resource Management (CRM) training and language proficiency assessment?

The study contributes to research on English for Specific Purposes (ESP) by applying classical and post-Gricean pragmatic theory to a high-stakes professional setting. It also offers practical recommendations for Aviation English education, including in Indonesia, where growing air traffic [citation needed] puts more pressure on the communicative competence of pilots and controllers.

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## 2. Literature Review and Theoretical Framework

### *2.1 Gricean implicature*

Grice (1975) proposed that conversation is guided by a Cooperative Principle: participants make their contribution such as is required, at the stage at which it occurs, by the accepted purpose of the exchange. He divided this principle into four maxims:

1. **Quantity:** give as much information as is required, and no more.
2. **Quality:** say only what you believe to be true and have evidence for.
3. **Relation:** be relevant.
4. **Manner:** be clear, brief, orderly and avoid ambiguity.

Implicatures arise when a hearer assumes that the speaker is cooperative and searches for a meaning that would make the utterance fit the maxims. Grice distinguished several ways in which a speaker may fail to observe a maxim: *flouting* it openly so that the hearer will infer something more, *violating* it quietly, which can mislead, *opting out* of cooperation, or facing a *clash* between two maxims (Grice, 1975; Levinson, 1983). Grice also distinguished generalized implicatures, which arise by default in most contexts, from particularized implicatures, which depend on a specific context. Levinson (1983) notes that generalized quantity implicatures are especially powerful: saying less than the strongest available term implicates that the stronger term does not apply.

The maxims read almost like a description of ICAO phraseology. Standard phraseology is designed to enforce Quantity (fixed information elements), Manner (fixed word order and pronunciation) and Relation (only operationally relevant content). The close fit has a consequence that this study develops. Because the code is so predictable, any departure from it, or gap in it, carries meaning of its own.

### *2.2 Relevance Theory*

Sperber and Wilson (1995) replaced Grice's maxims with a single cognitive principle: hearers seek the interpretation that yields the greatest cognitive effect for the least processing effort, and they stop at the first interpretation that meets their expectation of relevance. The account suits the study of communication under stress, since it ties interpretation to the hearer's cognitive resources and expectations. When a hearer is busy, tired or strongly expecting a particular message, the most accessible interpretation, often the expected one, will be accepted first, even if the speaker meant something else.

### *2.3 Politeness, mitigation and hierarchy*

Brown and Levinson (1987) explain indirectness as a strategy for protecting the hearer's and speaker's "face". Requests, corrections and warnings threaten face, so speakers soften them with hedges, questions and hints. In the cockpit, this produces *mitigated speech*. Linde (1988) analysed cockpit voice recordings and found that subordinates used more mitigated forms than captains, and that mitigated utterances were less likely to be acted upon. Fischer and Orasanu (1999) found that

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captains and first officers differed in how they phrased corrective requests, and that the most effective strategies stated the problem and a proposed action directly. Nevile (2004) showed, through conversation analysis of airline cockpits, that crew talk is carefully organised turn by turn and that the timing and form of contributions carry social as well as operational meaning.

Mitigation is therefore an important source of implicature in aviation: a hint such as "That doesn't look right, does it?" leaves the hearer to infer that action is needed, and gives the hearer room to decline that inference.

### *2.4 Aviation English, phraseology and plain language*

Aviation English is usually described as having two components: standard phraseology and plain language used in non-routine situations (ICAO, 2010; Estival et al., 2016). ICAO's Language Proficiency Requirements, adopted in 2003 and applicable from March 2008, with a transition period that ended in 2011, require pilots and controllers to reach at least Operational Level 4 on a six-level scale covering pronunciation, structure, vocabulary, fluency, comprehension and interactions (ICAO, 2010; Alderson, 2009).

Researchers have questioned whether this framework fully captures professional communicative competence. Kim and Elder (2009) found that Korean aviation personnel saw communication problems as shared between native and non-native speakers, not only a matter of non-native proficiency. Kim (2018) argued that successful aviation communication also depends on operational knowledge, strategic competence and the ability to manage interaction, which general language proficiency does not guarantee. The UK Civil Aviation Authority's analysis of occurrence data likewise highlighted non-standard phraseology and native speakers' use of idiomatic plain language as recurrent risks (Clark, 2017).

### *2.5 Miscommunication and stress*

Several studies have examined when pilot–controller miscommunication becomes more likely. Morrow et al. (1993) found that problems in routine communication were associated with non-standard phrasing, long messages and difficulties with readback. Howard (2008), analysing more than 15 hours of tower communications at 15 U.S. airports, found that problematic communication appeared more often in pilot turns and increased after turns containing more information or protocol violations. Molesworth and Estival (2015) showed experimentally that external factors such as workload affected communication errors in general aviation. Cushing (1994) and Tajima (2004) catalogued accident cases in which ambiguity, homophony and non-standard phrasing contributed to loss of life.

Research on stress and performance shows that acute stress narrows attention, reduces working memory capacity and increases reliance on heuristics and prior expectations (Staal, 2004). Sexton and Helmreich (2000) found links between cockpit language, workload and error. Taken together, this work suggests that stress is likely to affect implicature from both sides of the exchange: speakers may revert to habitual indirectness, while hearers may resolve indirectness in the direction of their expectations.

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### *2.6 Research gap*

Existing work has documented *that* miscommunication occurs and identified many lexical and procedural causes. Fewer studies have analysed accident communication systematically through implicature theory, and fewer still have connected implicature to stress. This study addresses that gap by combining Gricean and relevance-theoretic analysis with attention to contextual stressors in authentic accident transcripts.

## 3. Method

### *3.1 Research design*

This study uses a qualitative pragmatic document analysis. Accident transcripts are suitable data for this purpose because they record authentic, unscripted talk produced under real operational pressure, and because official investigations supply detailed information about the context, including time, fuel state, weather, workload and crew roles, that pragmatic analysis requires. The approach is interpretive: it does not attempt to assign causes to accidents, which is the task of the investigating authorities, but to explain how meaning was implied and inferred in the recorded exchanges.

### *3.2 Data sources and case selection*

Four accidents were selected through purposive sampling. Each case met three criteria: (a) an official investigation report is publicly available and includes cockpit voice recorder (CVR) and/or air traffic control (ATC) transcripts; (b) the investigating authority identified communication as a contributing factor; and (c) the recorded exchanges took place under identifiable operational stress. The cases also vary in setting (ground, take-off, approach, en route), participants (cockpit-internal and pilot–controller) and language background (native and non-native speakers of English).

**Table 1. Cases analysed**

| Case | Date | Phase and setting | Main stressors | Primary source |
|---|---|---|---|---|
| KLM 4805 / Pan Am 1736, Tenerife | 27 Mar 1977 | Take-off, fog, congested diverted airport | Crew duty-time limits, low visibility, diversion | Subsecretaría de Aviación Civil (1978) |
| Air Florida Flight 90, Washington | 13 Jan 1982 | Take-off in snow | Delays, icing, schedule pressure | NTSB (1982) |
| Avianca Flight 052, New York | 25 Jan 1990 | Holding and approach | Prolonged holding, low fuel, poor weather, missed approach | NTSB (1991) |
| American | 20 Dec 1995 | Night descent | Late runway | Aeronáutica |

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| Case | Date | Phase and setting | Main stressors | Primary source |
|---|---|---|---|---|
| Airlines Flight 965, Cali | | and approach | change, time pressure, unfamiliar terrain | Civil of the Republic of Colombia (1996) |

### *3.3 Unit of analysis and data preparation*

The unit of analysis was the *exchange*: an initiating utterance and the responses that followed it, up to the point where the topic changed. From the transcripts in each report, all exchanges in which an utterance carried, or could reasonably be taken to carry, safety-relevant meaning beyond its literal content were extracted. This produced 41 exchanges (Tenerife, 9; Air Florida, 8; Avianca, 14; Cali, 10). Where the original talk was in Dutch or Spanish, the English translation published in the official report was used, and this is treated as a limitation.

### *3.4 Analytical framework and procedure*

Analysis followed two coding cycles. In the first cycle, each exchange was coded deductively using the categories in Table 2. In the second cycle, codes were compared across exchanges and cases to identify recurrent patterns, which were grouped into themes.

**Table 2. Coding framework**

| Dimension | Categories |
|---|---|
| Maxim at issue | Quantity, Quality, Relation, Manner |
| Type of non-observance (Grice, 1975) | Flouting, violation, opting out, clash |
| Direction of inference | Speaker-intended implicature not recovered; hearer inference not intended by speaker; inference recovered but not acted upon |
| Politeness strategy (Brown & Levinson, 1987) | Bald on record, positive politeness, negative politeness, off record (hint) |
| Contextual stressors | Time pressure, workload, fuel, weather or visibility, fatigue or duty time, hierarchy |
| Relation to phraseology | Standard; non-standard; plain language; standard term omitted |

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### *3.5 Trustworthiness*

Both authors coded the exchanges independently and resolved disagreements through discussion until agreement was reached. Interpretations were checked against the factual findings, conclusions and probable-cause statements of each investigation report, so that the pragmatic reading remained consistent with the established record. An audit trail of coding decisions was kept.

### *3.6 Ethical considerations*

The study uses only publicly released official documents. Crew members are referred to by role (captain, first officer, flight engineer, controller), not by name, out of respect for those who died and their families.

## 4. Results

The 41 exchanges grouped into four recurrent patterns of implicature failure. Table 3 shows how often each pattern occurred in each case; some exchanges showed more than one feature, and each was assigned to its dominant pattern.

**Table 3. Distribution of implicature patterns by case**

| Pattern | Tenerife | Air Florida 90 | Avianca 052 | American 965 | Total |
|---|---|---|---|---|---|
| A. Implicated urgency | 0 | 0 | 9 | 1 | 10 |
| B. Mitigated warning | 2 | 6 | 3 | 0 | 11 |
| C. Expectation-driven inference | 5 | 2 | 2 | 5 | 14 |
| D. Unvoiced doubt | 2 | 0 | 0 | 4 | 6 |
| **Total** | **9** | **8** | **14** | **10** | **41** |

The sections below illustrate each pattern with excerpts from the transcripts published in the official reports. Excerpts are given in the reports' English wording, including translations where the original talk was not in English.

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### *4.1 Pattern A: Implicated urgency (Avianca 052)*

Avianca Flight 052 held for more than an hour in poor weather near New York before attempting an approach to John F. Kennedy International Airport, then executed a missed approach and ran out of fuel (NTSB, 1991). Throughout, the crew communicated their fuel state in plain language but never used the standard terms "Mayday", "Pan-Pan" or "emergency" when speaking to ATC.

After the missed approach, the first officer told the approach controller that the aircraft was "running out of fuel". The controller then offered a routing that would bring the aircraft round for another approach and asked whether this was acceptable "with you and your fuel", to which the first officer replied, "I guess so."

The report records that, inside the cockpit, the captain had instructed the first officer in Spanish to tell ATC they were in an emergency (NTSB, 1991). The first officer's transmission conveyed the fuel problem descriptively instead.

From a Gricean perspective, the crew relied on a particularized implicature: "running out of fuel", said after a long hold and a missed approach, was meant to communicate *we are in an emergency and need immediate priority*. For the controller, however, the utterance was interpreted against the norms of the restricted code. Within ICAO procedures, an emergency is declared with specific terms, so the absence of those terms produced a stronger, generalized quantity implicature: *the crew has not declared an emergency, therefore the situation is not an emergency*. The hedged reply "I guess so" further weakened any urgency, since it accepted the controller's plan instead of rejecting it.

This is the study's central finding. In a restricted code, omission carries meaning. A Standard English speaker may consider "we're running out of fuel" an unmistakable alarm. In Aviation English, the same phrase without the standard keyword can implicate the opposite.

The one Pattern A exchange in the Cali case had a similar structure: the crew's request for a different routing implied time pressure, but this was not stated, and the controller had no reason to treat the request as urgent.

### *4.2 Pattern B: Mitigated warnings (Air Florida 90)*

Air Florida Flight 90 crashed into a bridge over the Potomac River shortly after taking off from Washington National Airport in heavy snow (NTSB, 1982). The CVR shows that the first officer repeatedly noticed problems but expressed them indirectly.

While waiting in a long queue for take-off after de-icing, the first officer suggested checking the wings again because they had been waiting a while. The captain replied that he thought they would be departing in a minute, and the topic was dropped. During the take-off roll, the first officer commented on the engine instrument readings:

> **First officer:** God, look at that thing. That don't seem right, does it? ... Ah, that's not right.

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**Captain:** Yes it is, there's eighty.

**First officer:** Naw, I don't think that's right. ... Ah, maybe it is.

(NTSB, 1982, CVR transcript)

Each of the first officer's turns is an off-record or negatively polite warning in Brown and Levinson's (1987) terms. The tag question "does it?" invites agreement and leaves the captain free to decline. The intended implicature, *we should abort the take-off*, is never stated. The utterances also flout Quantity, because they do not give the information the situation requires: what is wrong and what should be done. The captain resolved the implicature at its literal level, as a question about an instrument reading, and answered it. Finally, "maybe it is" withdrew the challenge entirely. This pattern closely matches Linde's (1988) finding that mitigated utterances are less likely to be taken up.

In the Tenerife case, a parallel exchange occurred in the KLM cockpit seconds before the collision. The flight engineer asked whether the Pan Am aircraft was not clear of the runway. The captain answered emphatically that it was, and the take-off continued (Subsecretaría de Aviación Civil, 1978). The question form again carried an implied warning, *I am not sure the runway is clear*, which the most senior crew member resolved in the direction of his existing plan. In the Avianca cockpit, the first officer's softened reports to the captain about what he had told ATC showed the same feature in reverse: politeness towards the captain may have masked the fact that the emergency had not been declared in standard terms.

### *4.3 Pattern C: Expectation-driven inference (Tenerife)*

The collision at Tenerife between two Boeing 747s, operated by KLM and Pan Am, killed 583 people and remains the deadliest accident in aviation history (Subsecretaría de Aviación Civil, 1978). The airport was congested with diverted aircraft, visibility was poor in fog, and the KLM crew were under pressure to depart before reaching their duty-time limit.

After receiving its route clearance, which did not include a take-off clearance, the KLM first officer transmitted, "We are now at take-off." The tower replied, "OK," followed by an instruction to stand by for take-off. The second part of the tower's transmission was largely blocked by a simultaneous transmission from the Pan Am crew reporting that they were still on the runway.

Two inferential failures interacted. First, the KLM first officer's utterance was ambiguous in Manner: it could mean *we are at the take-off position* or *we are taking off*. Second, the tower's "OK" was not a standard clearance term, but in the context of the KLM crew's strong expectation of departure, it offered the most relevant interpretation with the least effort: *you may go*. This is the outcome that Sperber and Wilson's (1995) principle of relevance would predict. A hearer under time pressure accepts the first interpretation that fits expectations; for the KLM captain, that interpretation was permission to take off. Meanwhile, the tower controller appears to have taken "at take-off" to mean *at the take-off position, waiting*, which made "OK, stand by" a natural response.

The five Pattern C exchanges in the Cali case followed the same logic. As the investigation report describes, the crew accepted an offer of a straight-in approach to a different runway, which greatly increased their workload and reduced the time available to descend, and their subsequent

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requests and readbacks were interpreted by each party in ways that fitted their own understanding of the aircraft's position (Aeronáutica Civil of the Republic of Colombia, 1996). Short acknowledgements such as "affirmative" functioned as confirmation of whatever each party already believed.

### *4.4 Pattern D: Unvoiced doubt (Cali)*

American Airlines Flight 965 struck a mountain while descending at night towards Cali, Colombia, after the crew became uncertain of the aircraft's position (Aeronáutica Civil of the Republic of Colombia, 1996). The investigation found that the controller had noticed that some of the crew's requests and position reports were inconsistent with the clearance and the aircraft's likely location, but did not question them. The report also discusses the role of language: the controller, a non-native speaker of English, had limited means to probe the situation in non-routine English, and the investigation noted that he might have questioned the crew more had the exchange been in Spanish.

In Gricean terms, the controller drew the correct inference, *something is wrong with this crew's picture of their position*, but opted out of making it explicit. In relevance-theoretic terms, the cost of formulating a non-routine question in a second language under time pressure exceeded the perceived benefit, so the doubt remained private. Pattern D therefore represents a different type of failure from Patterns A to C: the implicature is recovered but not acted upon.

At Tenerife, the two Pattern D exchanges came from the Pan Am cockpit and the tower. The Pan Am crew had difficulty identifying the correct taxiway exit and expressed their concern among themselves, but their uncertainty was not fully conveyed to the controller. The controller, for his part, did not explicitly confirm the KLM aircraft's status after its ambiguous transmission.

### *4.5 Role of stressors*

All 41 exchanges took place under at least one identified stressor, and 33 involved two or more. Time pressure was the most common stressor, present in all four cases. Its effect was consistent across patterns: it reduced the number of words speakers used, increased the use of short acknowledgements ("OK", "affirmative", "I guess so"), and pushed hearers towards the interpretation that would allow the operation to continue. Hierarchy acted mainly in Pattern B, and second-language demands mainly in Patterns A and D.

## 5. Discussion

### *5.1 Implicature does not disappear in a restricted code; it changes form*

The first research question asked what types of implicature occur in safety-critical exchanges. The findings show that standard phraseology does not eliminate implicature. Instead, it shifts implicature into two places. The first is the *gap* between the code and the situation: when a situation is not covered by phraseology, speakers fall back on plain language, and plain language brings everyday indirectness with it. The second is the *code itself*: because phraseology is so predictable, any deviation from it, or any omission of an expected term, generates a strong generalized implicature.

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Previous research has paid little attention to this second point. Studies of non-standard phraseology (Howard, 2008; Clark, 2017) have treated deviation as a source of ambiguity or confusion. The Avianca case suggests a sharper interpretation: a missing standard term sends a signal of its own, and that signal can contradict what the speaker intended. This extends Levinson's (1983) analysis of scalar quantity implicature to an institutional setting. In the aviation scale, "Mayday" and "Pan-Pan" are the strongest terms; choosing a weaker description implicates that the stronger terms do not apply.

### *5.2 Stress pushes speakers towards Standard English and hearers towards expectation*

The second research question asked how stressors shape implicature. The findings are consistent with the model suggested by the literature on stress and cognition (Staal, 2004). Under pressure, speakers in this study tended to revert to the indirect strategies of Standard English and of their first-language pragmatics: hints, tag questions, hedges and descriptive statements in place of explicit directives. This is the reverse of the transition the research topic describes, from Standard English to Aviation English. Training aims to move speakers towards the explicit norms of the professional code, but stress appears to pull them back towards habitual conversational norms.

Hearers, meanwhile, showed the pattern predicted by Relevance Theory (Sperber & Wilson, 1995). Under high workload and time pressure, they accepted the most accessible interpretation, which was usually the interpretation that allowed the current plan to continue. This would explain why the KLM captain heard permission to take off, why the Air Florida captain heard a question about an instrument, and why the Avianca controller heard a routine fuel report. In each case, the costly interpretation, *stop, this is dangerous*, required more processing effort and conflicted with the hearer's goals.

These results are consistent with earlier research on mitigation (Linde, 1988; Fischer & Orasanu, 1999) and on problematic communication (Howard, 2008; Morrow et al., 1993), but they add an explanatory link. Mitigation is dangerous because it hands the hearer a choice between a literal and an implied reading, and stress tilts that choice towards the literal reading, which costs less effort and fits the hearer's goals.

### *5.3 Native speakers, non-native speakers and shared responsibility*

The cases do not support a view that implicature failures are mainly a non-native speaker problem. The Air Florida crew were native speakers of English, and their exchange showed the most extensive mitigation in the dataset. In the Avianca and Cali cases, second-language demands did play a role, especially in the decision not to formulate an explicit message or question. These findings agree with Kim and Elder (2009) and Estival et al. (2016), who argue that successful aviation communication is a shared responsibility. They also support Kim's (2018) argument that general language proficiency is not enough: what failed in these cases was largely pragmatic and strategic competence, not grammar or vocabulary.

### *5.4 Implications for training and assessment*

The third research question concerned practical implications. Five recommendations follow from the findings.

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RQ1. Teach that omission is meaningful. Aviation English courses should explicitly teach that, within the code, not using a standard term communicates something. Learners should practise declaring emergencies and urgency with "Mayday" and "Pan-Pan" until the terms are automatic under pressure, and should be shown cases such as Avianca 052 to understand the consequence of descriptive alternatives.

RQ2. Train explicitness as a stress skill. Because stress pulls speakers back towards indirectness, explicit communication needs to be trained under realistic workload, for example in simulator scenarios that combine time pressure with non-routine events. Assertive statement formats used in CRM, which state the concern, the problem and a proposed action, give speakers a ready-made explicit structure.

RQ3. Teach hearers to check, not infer. Controllers and pilots should be trained to treat ambiguous or hedged utterances as a signal to confirm. Short clarification phrases, such as "Confirm you are declaring an emergency" or "Say intentions", replace a risky inference with an explicit answer.

RQ4. Include pragmatic competence in assessment. ICAO's rating scale already includes an "interactions" criterion, but test tasks rarely require candidates to detect implied urgency, resolve ambiguity or challenge a hint. Test designers could add tasks of this type, building on the arguments of Kim (2018) and Alderson (2009).

RQ5. Address native-speaker practice. Native speakers should be trained to avoid idiomatic, hedged and indirect plain language on the radio, because it is harder for international listeners to interpret and because, as Air Florida shows, it is dangerous even between native speakers (Clark, 2017).

For Indonesia, where Aviation English is taught in flight schools, air traffic services training and university ESP programmes, these recommendations suggest a shift in curriculum emphasis. Alongside phraseology and listening practice, courses can include analysis of authentic accident transcripts and role-play of non-routine situations in which learners must choose between implication and explicit statement. Since indirectness is also a valued feature of politeness in Indonesian interaction [citation needed], learners may benefit from explicit discussion of how professional radio norms differ from everyday norms.

### *5.5 Limitations and future research*

This study has several limitations. First, it analyses only four cases, chosen because they are well documented; the patterns should therefore be treated as an analytic framework to be tested, not as statistical generalizations. Second, accident data are subject to hindsight bias: knowing the outcome makes some implicatures appear more obvious than they were at the time. Third, parts of the Tenerife and Avianca data are translations, which may not preserve the pragmatic features of the original Dutch and Spanish talk. Fourth, written transcripts do not capture prosody, such as intonation and stress, which speakers use to signal urgency.

Future research could apply the same coding framework to a larger corpus of incident reports, such as voluntary safety reports, or to recordings of routine radio traffic, to see how often these

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patterns occur when no accident follows. Experimental and simulator studies could test whether training in explicit communication reduces Pattern A and Pattern B failures under workload. Research in Indonesian and other Southeast Asian contexts would also help clarify how first-language politeness norms interact with Aviation English under stress.

## 6. Conclusion

This study examined how pilots and controllers "read between the lines" under stress, using Gricean and relevance-theoretic analysis of transcripts from four major accidents. It identified four recurrent patterns of implicature failure: implicated urgency, mitigated warnings, expectation-driven inference and unvoiced doubt. Across these patterns, stress had a consistent effect. It pushed speakers back towards the indirect habits of Standard English, and it pushed hearers towards the least effortful, goal-consistent interpretation.

The study's main theoretical contribution is to show where implicature goes in a restricted code such as ICAO phraseology. It moves into the situations the code does not cover and into the code's own omissions. Because the code is predictable, the absence of an expected term becomes a powerful signal in its own right, and this signal can contradict what a speaker means. Moving from Standard English to Aviation English therefore means learning a pragmatic rule as well as new vocabulary and phraseology. In safety-critical situations, meaning has to be stated outright, and anything doubtful has to be checked.

For Aviation English teachers, curriculum designers and examiners, including those in Indonesia, the findings point to the need to train and assess pragmatic competence explicitly, under conditions that resemble the pressure of real operations.

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