2005

Investing in Safer Communications: Phraseology and Intelligibility in Air Traffic Control

Ana Margarida Casaca

Teresa C. D'Oliveira

INVESTING IN SAFER COMMUNICATIONS: PHRASEOLOGY AND INTELLIGIBILITY IN AIR TRAFFIC CONTROL

Ana Margarida Casaca
Instituto Superior de Psicologia Aplicada
Lisbon, Portugal

Teresa C. D'Oliveira
Instituto Superior de Psicologia Aplicada
Lisbon, Portugal
António Guerra
NAV, EPE
Lisbon, Portugal

Communications are central to air traffic control and any potential intervention that might contribute to its increased efficacy is considered relevant. This paper explores two main characteristics associated with communications: aeronautical phraseology and intelligibility. Although phraseology may contribute to an increased precision of the message, several factors may hinder it through speech intelligibility. In this study, air traffic controllers were asked to reproduce several messages that vary in phraseology correctness and speech intelligibility. Results suggest that considerable attention should be given to factors affecting speech intelligibility as increased numbers of errors and omissions were reported in messages with this characteristic.

Introduction

Communications critical role in Air Traffic Control is emphasized by its intervention in a variety of accidents and incidents (Davidson, Fischer & Orasanu, 2003). Although communications between controllers and pilots are standardized, errors may occur, and quite often with fatal consequences.

Communications between aircrews and air traffic controllers (ATCs) may be defined as the complete and effective transfer of information between these actors. This process of information transfer embraces many tasks and procedures that should be timely applied. In this process there are endless opportunities for human error to occur (Mackintosh, Lozito, McGann e Logsdon, 1999).

Hopkin (1995) argues that few studies on Air Traffic Control have actually considered the human factors associated with communications. Despite the lack of empirical support, phraseology and intelligibility are variables traditionally associated with communications' efficacy. The typical study considers the ATC as the sender of the information and the pilot as the receiver of such data. In this study, a different approach was used and ATCs were invited to analyze their colleagues' work. In particular, ATCs were asked to reproduce messages with varying degrees of correctness of aeronautical phraseology and speech intelligibility. This approach provided a unique opportunity to assess the controllers' awareness of the importance of communications to air safety in general and the potential implications of using non standard phraseology and unintelligible speech to the efficacy of aviation communications. As stated by Hopkin (1995), conveying information correctly actually represents a process that includes the listener's correct hearing and understanding. In Air Traffic Control, much of the richness of English and the flexibility and utility of speech must be curbed in the interests of standardization, intelligibility, completeness and the prevention of misunderstanding and error.

In this work the influence of professional experience on the ATCs ability to correctly reproduce a message was also analyzed.

Method

Participants

A total of 65 air traffic controllers, male and female, operating in the FIR (Flight Information Region) of Lisbon participated in this study. Volunteers were divided in three groups with distinct levels of professional experience: 12 ab-initio trainees, 11 less experienced controllers (up to 10 years of experience) and 42 very experienced controllers (more than 10 years of experience).

Instrument

A total of 30 real Air Traffic Control communications were recorded varying in phraseology (correct versus incorrect) and in

intelligibility (intelligible versus non intelligible). Messages also varied in extension, the simpler ones with only two elements and the more complex ones with more than tem elements. Communications were assessed by an independent expert bearing in mind each of the aforementioned characteristics. In a within design, ATCs were asked to listen to the messages and to reproduce them in writing. Only one chance for listening was provided, a feature particularly relevant in air traffic control communications as the readback procedure is associated with greater efficacy.

Results

Results were analyzed considering the following issues: full reproduction of the message content; sequence of elements in transmission; partial reproduction of the message contents (i.e., only the general idea is recorded), omissions and their content; mistakes and their content.

Kruskal Wallis analyses suggested that significant differences were obtained for the four types of messages in what concerns textual reproduction [$\chi 2$= 14.90, df= 3, p< .002], sequence of elements [$\chi 2$= 10.47, df= 3, p< .015], general content [$\chi 2$= 13.41, df= 3, p< .004] and omissions [$\chi 2$= 11.71, df= 3, p< .008]. Best results were obtained for intelligible messages (regardless of phraseology) followed but messages with the correct use of phraseology and finally messages with incorrect use of phraseology and non intelligible. A two-way ANOVA revealed that only intelligibility is a significant factor for the number of errors [$F(3,1)$= 5.531, p< .027], with non intelligible messages being reproduced with more errors. A first implication of these results is the suggestion that intelligibility is the most important variable for communications' efficacy. The use of correct phraseology on its own is not a guarantee of greater efficacy in terms of communications.

Professional Experience

A clear distinction between ab-initio ATCs and ATCs with professional experience may be made with ab-initio ATCs presenting worst results in terms of textual reproduction, sequence of elements and general content. Best results were obtained for ATCs with up to 10 years of experience

Discussion

Results suggest that intelligibility plays a more central role in the reproduction of a message. If a message is intelligible, ATCs tend to reproduce it

textually without errors or omissions regardless of the correct use of phraseology in the message. It is also important to emphasize that the lack of intelligibility in a message significantly increases the number of errors and omissions. One source of lower intelligibility is the presence of a specific accent of the sender speech which may cause ambiguities and doubts on the receptor regarding the message content. Such speech characteristics may disturb the efficacy of a given communication and therefore represent an avenue to improve the safety of the air traffic system. Familiarity with message content also represents an important issue. Difficulties in reproduction were evident in messages that included non-standard procedures or unusual aircraft call-signs even if the use of phraseology is correct and speech intelligibility is perfect.

In what concerns professional experience, the most important implication of this study regards the fact that ATCs with up to 10 years of professional experience present the best results in terms of message reproduction. Results regarding the effects of professional experience can be described as an inverted "U"relation. Ab-initio ATCs find it difficult to reproduce messages correctly. With experience, performance improves gradually. When a certain age limit is reached some breakdowns in the performance start to show, thus revealing professional experience does not always contribute in a positive way.

References

Davidson, J., Fisher, U. & Orasanu, J. (2003). *When language becomes a barrier instead of a bridge: Communications failures between pilots and air traffic controllers.* Paper presented at the 12th International Symposium on Aviation Psychology (April 14 - 17 2003). Dayton, Ohio.

Hopkin, V. D. (1995). *Human Factors in Air Traffic Control.* London: Taylor and Francis.

Mackintosh, M., Lozito, S., McGann, A., & Logsdon, E. (1999, October). *Designing Procedures for Controller – Pilot Data Link Communication: Effects of Textual Data Link on Information Transfer.* Paper presented at the World Aviation Conference, San Francisco.