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Errors of perception in air traffic control

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Abstract

Accurate and timely perception of visual and auditory information by air traffic controllers is critical to aviation safety. The aim of this research was to investigate the types of errors of perception that occur in air traffic control (ATC). The data were gathered from interviews with 28 UK area controllers and a review of 48 area and terminal control incidents involving loss of separation in the UK spanning three years. The data gave rise to a set of classifications, which form part of the technique for the retrospective analysis of human error (TRACEr). The results are discussed in terms of theory and empirical research. Key main implications for future automation are outlined, in terms of display design, automation reliability and the operation of multiple tools designed and developed separately.

Keywords: Perception; Air traffic control; Human error; Incident analysis; Interviews; Controller tools

1. Introduction

The tasks of the air traffic controller are unusual in the intensity of the demands on both visual and auditory perception. Controllers have a substantial amount of information to process, a limited period to process the information, and must maintain their performance continuously and consistently for periods of up to 2 h at a time over a shift. It is not surprising, then, that 'errors'of perception occur – information is not detected, not identified, misidentified, or otherwise misperceived. Since each controller may have several aircraft

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under his or her control, thousands of lives may be dependent upon the eyes and ears of a controller.

That perceptual failures can contribute to fatal disasters was illustrated tragically in the crash on 1 July 2002 over Überlingen, Germany. According to the investigating authority, one of the two immediate causes was that: "The imminent separation infringement was not noticed by ATC in time. The instruction for the TU154M to descend was given at a time when the prescribed separation to the B757-200 could not be ensured anymore" (BFU, 2004, p. 5) (three systemic causes were also found). The controller was, in fact, monitoring two frequencies and two radar displays, which was not unusual in the Zurich Area Control Centre at night.

In a review of ATC-related accidents and incidents occurring between 1985 and 1997, Pape et al. (2001) found that attention (and memory) failures were the most common types of errors by ATC personnel. Jones and Endsley (1996) analysed 143 aviation incidents involving flight crew and air traffic controller errors implicating situation awareness. Of the 262 errors identified, 72% of controller errors (and 77% of flight crew errors) concerned perception. The remaining errors concerned comprehension and prediction. Recent risk modelling work has shown that the biggest controller-related contributor to mid-air collisions is a failure to detect a conflict in time (Spouge and Perrin, 2006). Few other studies break down the 'perception error' category further, and well-known error classification systems such as GEMS (Generic Error Modelling System, Reason, 1990) make little mention of errors of perception *per se* (more in the form of action slips or subsequent decisions).

The aim of this research, therefore, was to investigate errors that occur in UK area and approach control in light of cognitive psychology research, and probe the possible implications for future air traffic management (ATM). This paper focuses on errors of perception (including detection). Another part of the study focusing on controller memory errors is reported in Shorrock (2005). The term 'error' is perhaps a misnomer since the underlying processes, such as expectation, are required for normal performance. Also considering the context of many errors, both external and internal, the error would be the 'normal' or most likely behaviour. However, the term is widely used, and is used here as a starting point for understanding the processes and context, and implications.

Visually, area and approach controllers need to monitor or search one of a number of static and dynamic displays. The primary visual display for most controllers is the radar display, used to monitor the progress of flights. Radar is used to generate symbolic aircraft displays with a 'blip' for each aircraft, and a four-figure code (in a label or track data block), which is then converted to a callsign. Also in the label are other static and dynamic information such as actual flight level (FL), a climb/descent arrow, cleared FL, destination code, co-ordination status and ground speed. This is overlaid onto an electronic map of the airspace, which includes graphical information such as airway boundaries, radio beacons, airfields, danger areas and military training areas. Additionally, a short-term conflict alert (STCA) is often available, and sometimes other electronic tools.

Another key information source is the paper flight progress strip (FPS) or electronic strip. The FPS is a thin cardboard strip representing an aircraft, mounted on a plastic holder, usually coloured according the direction of the flight in a radar environment. The controller marks the FPS to indicate the various instructions and authorisations passed to the pilot. Any changes of information that affect other sectors are fed into a computer and relayed to the appropriate sectors. The FPS display (or board) contains one or more FPSs for each aircraft in the sector, placed in geographical and time order (though controllers