

ATTACHMENT 2

**Reprint from an Australian accident report concerning speech analysis
(2 pages)**



**Transport and
Communications**

ACCIDENT INVESTIGATION REPORT

**Mid-Air Collision Between
Cessna 172-N VH-HIZ and
Piper PA38-112 VH-MHQ
Near Tweed Heads, New South Wales**

20 May 1988

BASI REPORT 881/1042

BUREAU OF AIR SAFETY INVESTIGATION

VOICE STRESS ANALYSIS

Introduction

Both aircraft (VH-MHQ and VH-HIZ) were training flights operating under VFR. They collided in the circuit area with fatal injuries to all on board. Previously, VH-HIZ had made a touch-and-go and was requested to expedite a right turn. VH-MHQ was on a down-wind leg but was then instructed to make a left-hand orbit adjacent to the runway in use at about 1000 ft AGL, which ultimately placed the aircraft into conflict with VH-HIZ.

The AVR tape indicates that the ADC/APP's rate of issuing instructions increased considerably prior to the accident. One possible inference, therefore, is that the workload on the controller contributed to the accident by reducing his available information processing capacity, which consequently reduced his ability to appreciate fully the dynamics of the ATC situation and to anticipate the effects of his instructions on the aircraft in the circuit area.

In order to substantiate that inference, we require evidence that the controller's mental workload was sufficiently great at the time. Insofar as mental workload constitutes a stress on the individual, voice stress analysis is one potentially useful technique for estimating the level of that stress. The rationale for the technique is the empirical evidence that the nature of a person's voice may change during stressful events. A spectrogram of the voice then provides a formal (visual) means of assessing the extent of that change.

Voice stress analysis requires that the same phrase or word is inspected both before and during the assumed stressful event. Aircraft callsigns are good candidates for analysis because they are repeated often in an aviation environment. In order to test statistically whether subtle voice changes exist, at least 10 samples must be taken at each stress level. Alternatively, the analysis may simply be used to support what may already be heard, in which case a single sample at each stress level may confirm that a relatively gross change in voice exists. That has been the most common use of spectrographic analysis previously.

Analysis

Due to the limited number of callsign samples available from the AVR tape, comparisons between single samples only were made. The callsigns compared were 'Hotel India Zulu' (at 1554:51 hours and 1607:15 hours), 'Mike Hotel Quebec' (at 1554:42 hours and 1607:44 hours), and 'Foxtrot November Oscar' (at 1557:07 hours and 1607:06 hours).

In all cases, the later callsign was spoken at a faster rate, which is probably a reflection of the fact that the ADC/APP was issuing several instructions with limited available time at that point. With both VH-MHQ and VH-HIZ, some of the component syllables were not articulated as clearly and

were slurred together, which is also consistent with a rapid speaking rate.

There was no evidence of a change in the controller's pitch around 1607 hours.

The conventional index of voice stress is a raising of pitch. That feature has been observed, for example, in pilots who were in imminent danger, although not without exception. The individual's personal response to the situation probably exerts a large influence on the voice.

In retrospect, it is not particularly surprising that no voice pitch changes were observed in this analysis. The inference being tested was that the ADC/APP was subject to a high degree of mental workload, ie, information processing load. Voice changes, however, have typically been observed in persons subject to a high degree of anxiety, which is a different category of stress from mental workload. It is possible for the processing demands of a task to generate anxiety in an individual if he/she perceives that he/she is not coping, but there was no evidence of that response in this analysis.