When communication breaks down
The case of flight AF 447

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Aviation is a domain where communication breakdowns is regarded as a serious threat to safety.
Outline

• Introduction
• Theoretical framework
• AF 447 the last minutes
• What went wrong?
• Other domains?
Introduction

• Who’s in Control?
  – Complex systems often have multiple agents and several interdependencies.
  – Information is distributed between system agents and artifacts
  – Control and/or information is often transferred between system agents
  – Collaboration necessary for optimal system performance
Theoretical framework

• Sufficient communication must be ensured for collaboration to succeed

• Human Agent Interaction ≠ Human Agent Cooperation
  – Common Ground
  – The Cooperative Principle
Theoretical framework

• Common Ground

• Is defined as:

“the sum of two or more peoples (or agents) mutual beliefs, knowledge and suppositions”

Theoretical framework

• The Cooperative Principle

• Gricean Maxims
  – The Maxim of Quantity
    • Make your contribution as informative as required...
  – The Maxim of Quality
    • Don’t say what you believe to be false or lack evidence of
  – The Maxim of Relation
    • Say what is relevant
  – The Maxim of Manner
    • Avoid obscurity and ambiguity, be brief and orderly

Theoretical framework

• The Maxim of Manner
  • Avoid obscurity and ambiguity, be brief and orderly
    – Airbus A320 crash at Strasbourg-Entzheim on 20\textsuperscript{th} of January 1992
    – Pilot thought he set the Flight Path Angle to \(-3.3^\circ\) when he in fact set the Vertical Speed to \(-3300\text{ ft/min}\)
    – Mode error?

http://lessonslearned.faa.gov/ll_main.cfm?T ablID=2&LLID=57&LLTypeID=2
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AF 447

• Airbus A330-203 flying from Rio de Janeiro to Paris on 31\textsuperscript{st} of May 2009

• Pilot flying expressed desire to climb to FL370 to fly above the clouds in the inter-tropical convergence zone
  – This was not doable as outside temperature and aircraft weight was too high
AF447

- 2 hrs 10 min in to the flight the Auto pilot disconnected
  - Stall warning was issued
- Aircraft went from normal to alternate law protection

Source: Bureau d'Enquêtes et d'Analyses (BEA, France, www.bea.aero)
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What went wrong

• Two key events will be described from a Gricean perspective

• Data from the Flight Data Recorder and the Voice transcriptions
What went wrong
Automation and computer feedback
What went wrong?

• 2 hrs 10 min:
  – 05; Autopilot disconnect, pitch angle from 0° to 11° in 12 seconds, change to alternate law
  – 08; Co pilot sidestick between neutral and ¾ of stop position
What went wrong

Source: Bureau d'Enquêtes et d'Analyses (BEA, France, www.bea.aero)
What went wrong

• 2 hrs 10 min:
  – 05; Autopilot disconnect, pitch angle from 0° to 11° in 12 seconds, change to alternate law
  – 08; Calculated Airspeed drops from 274-156 kt
  – 09; CAS drops to 56kt
  – 10; AOA is <4° Stall warning is triggered
  – 13; speed reading temporarily lowered, stall warning stops
What went wrong

- 2 hrs 10 min:
  - Co pilot in left seat realizes that they are in alternate law
What went wrong

• 2 hrs 12 min:
  – 33; Nose down command (100%)
  – 34; AOA valid, Stall warning issued
  – 35; decreased Nose Down command (25%)
  – - stall continues as AOA shifts between valid and invalid
  – 43; shift between nose up and nose down
  – 52; Nose up
What went wrong

• Gricean maxims;
  – Ambiguous stall message in cruise conditions
  – Excessive nose up inputs
    • Unclear whether the pilot flying understood the decrease in automation support
    • Nose down inputs were discouraged by stall alarm
What went wrong

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What went wrong

Crew interaction
What went wrong

“Existing commercial side sticks offer no visual or tactile cues to the pilot and must have restrictive performance limits.”
What went wrong

2:13:40; “But I’ve been at maxi nose-up for a while.”
What went wrong

Source: Bureau d'Enquêtes et d'Analyses (BEA, France, www.bea.aero)
What went wrong

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Other domains

• Driving Automation
• Air traffic control
• Military
• Medicine
  – Eg. Therac 25
• Process industry
Summary

- Sufficient communication must be ensured for collaboration to succeed
- Human Agent Interaction ≠ Human Agent Cooperation
- The Gricean maxims can provide guidance in assessing collaboration and communication
- The Gricean maxims may be applied to a multitude of domains
Thank you!

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