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Comments on Confusing Conversation at Cali

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There are interesting linguistic aspects of the conversation between Air Traffic Control (ATC) and American Airlines 965 (AA965) shortly before the crash of AA965 near Buga, Columbia, on 20 December 1995. Our comments rely on the NTSB Press Release. The two relevant navigation plates are the Cali VOR/DME/NDB Rwy 19 Instrument Approach Procedure (*http://www.jeppesen.com/cali-1.html*) and the Cali Rozo One Arrival Procedure (*http://www.jeppesen.com/cali.html*).

We are not asserting here that the linguistic features we emphasise are causal to this accident. Whether they are will be determined by the official report of the accident investigation committee, and it would be inappropriate for us here to prejudge this determination. It is nevertheless clear that such features may be causally relevant.

First, there is *lexical ambiguity* in the ATC-procedural language: *ROZO* is the name of a *fix* (1) and also part of the name of an *arrival* (2). It's well-known that lexical ambiguities easily engender confusing conversations. It surprises us that, in a safety-critical situation such as an instrument approach procedure, names were not chosen to be unambiguous. Syntactically, `*ROZO*' is the fix and `*ROZO One*' is the arrival. Lexical ambiguity occurs because the word `*ROZO*' is used in two different lexical constructions. (This confusion was also noted by Wally Roberts.)

Second, naming an *arrival* after its *endpoint*, rather than its *start*, may be semantically dissonant for US pilots. Semantic dissonance can easily lead to confusion with respect to temporal as well as spatial location (see, for example, The Parable of Next Thursday). In the USA, arrivals are generally named after starting fixes rather than near-endpoints (um, we're inducing from the sample of *SFO* and *SJC*), in contrast with the *Rozo One Arrival*. However, we note that the opposite is true with road naming conventions in a variety of cultures (e.g., we expect the *Monterey Road* to lead in the direction of Monterey). The *Tulua* radio beacon is the entry point for the Rozo One arrival, some 22 miles before the

initial approach fix for the Rwy 19 approach, itself 9 miles before the *Rozo* beacon, which is actually the *final approach fix*, 2.6 miles before the runway threshold.

Consequences of both these features are starkly present in the partial transcript provided by the Columbian authorities. Here is the report verbatim from the original clearance to the end of reported conversation. Our comments follow.

> *Approach replied, "Roger 965 is cleared to the VOR DME approach runway one niner, ROZO Number One arrival, report Tulua VOR"*
>
> *The flightcrew readback was, "Cleared the VOR DME one niner ROZO one arrival, we'll report the VOR, thank you Sir"*
>
> *Cali approach immediately clarified with, "Report Tulua", and the flightcrew immediately acknowledged, "Report Tulua"*
>
> *The flightcrew referred to the cockpit chart package (approach publications) after ATC instructions to "Report Tulua"*
>
> *Flightcrew discussion took place about the navigational aids to be used in the ROZO 1 Arrival, specifically their position relative to Tulua*
>
> *About 30 seconds later the flightcrew requested, "Can American Airlines 965 go direct to ROZO and then do the ROZO arrival sir?"*
>
> *Several radio transmissions then took place: Approach replied, "affirmative direct ROZO one and then runway one niner, the winds calm". The flightcrew replied, "all right, ROZO, the ROZO 1 to 19, thank you, American 965". And the controller stated, "Affirmative, report Tulua and twenty one miles, 5000 feet". The flightcrew acknowledged, "OK report Tulua, twenty one miles at 5000 feet, American 965"*

AA965's requested clearance (after the phrase `*About 30 seconds later*') demonstrates a linguistic expectation. Going `*direct to ROZO and then do the ROZO arrival*' only makes sense if one expects that fix *ROZO* is the beginning of the *ROZO* arrival. Which it ain't. That's point two at work.

Then, the response from ATC:

> *[..] Approach replied, "affirmative direct ROZO one and then runway one niner, the winds calm"*

First, the ATC response `*affirmative*' is incorrect. AA965 cannot fly what they requested. A *clearance*(3) is both a commitment by ATC to keep the airspace clear for the space and time slots indicated and a mandatory (but revisible) routing instruction. Any clearance must be a possible routing. Which AA965's request is not.

Second, notice the following words spoken by ATC: `*direct ROZO one*'. (This is a complete phrase, as indicated by the following conjunction, `*and*'.) It is a syntactically incorrect phrase in any grammar of pilot-controller speech. The word `*direct*' must be followed by the name of a fix. If `*ROZO*' is interpreted as the fix, the word `*one*' is then superfluous. The entire phrase `*ROZO one*' denotes an arrival, and an arrival name cannot correctly follow the word `*direct*'. The lexical ambiguity enabled production of this syntactically incorrect and semantically confused phrase.

Then follows a precise repeat from AA965 of their unfulfillable request, and a further `*affirmative*' from

ATC.

Further, our colleague, the cognitive psycholinguist Hans Strohner, made two pertinent observations. He noted that, in order to make decision *D1: how to fly the arrival/approach*, AA965 had to make a decision *D2: which methods to use to make D1*. There are two main methods: *M1: conversation with ATC*, and *M2: looking at charts (including electronic charts)*.

Strohner pointed that by disavailing themselves of *M2* (consulting the charts), AA965 had only one method, *M1* (conversation with ATC) and no means of cross-check (under the assumption that these were the two main methods). This increases the chances of failure at *D1*. And, as we have seen, the *D1* decision failed because of the semantic failure of *M1*, the ATC-AA965 conversation.

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Notes

(1): *FIX- A geographical position determined by visual reference to the surface, by reference to one or more radio NAVAIDs, by celestial plotting, or by another navigational device.* Federal Aviation Administration, Airman's Information Manual, Pilot/Controller Glossary. Back

(2): *ARRIVAL ROUTES (ICAO): Route identified on an instrument approach procedure by which aircraft may proceed from the enroute phase of flight to the initial approach fix.* Jeppesen Chart Glossary, p5 (Aug 12-88). Back

(3): *AIR TRAFFIC CLEARANCE- An authorization by air traffic control, for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace. The pilot-in-command of an aircraft may not deviate from the provisions of a visual flight rules (VFR) or instrument flight rules (IFR) air traffic clearance unless an amended clearance has been obtained. Additionally, the pilot may request a different clearance from that which has been issued by air traffic control (ATC) if information available to the pilot makes another course of action more practicable or if aircraft equipment limitations or company procedures forbid compliance with the clearance issued. Pilots may also request clarification or amendment, as appropriate, any time a clearance is not fully understood, or considered unacceptable because of safety of flight. Controllers should, in such instances and to the extent of operational practicality and safety, honor the pilot's request. FAR 91.3(a) states: "The pilot-in-command of an aircraft is the final authority as to, [sic] the operation of that aircraft." THE PILOT IS RESPONSIBLE TO REQUEST [sic] AN AMENDED CLEARANCE if ATC issues a clearance that would cause a pilot to deviate from a rule or regulation, or in the pilot's opinion, would place the aircraft in jeopardy.* Federal Aviation Administration, Airman's Information Manual, Pilot/Controller Glossary. Back

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