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Air Traffic Communications in Routine and Emergency Contexts:

A Case Study of Flight 1549 'Miracle on the Hudson'

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Abstract:

This paper is a conversation analytic investigation of Air Traffic Control (ATC) communications with U.S. Air Flight 1549 and other flights before, during, and after a critical emergency in which the plane (safely) landed in the Hudson River. While foundational conversation analytic research on air traffic communications has already been done, this method has not yet been systematically applied to air traffic communications during actual emergencies. This project will therefore fill a gap in previous research by analyzing ATC/plane interactions during an actual emergency and investigating whether routinized procedures alone are the most effective when emergency situations occur. I will show how routine interactional conventions in this work setting (e.g., the use of scripted talk and 'positional' grammar) help participants to maintain the safe flow of air traffic and to accommodate emergencies when they occur. I will show that during the critical emergency the ATCO and the pilot of Flight 1549 switched from a routinized (scripted) form of interaction to a conversational form of interaction, and at times to a 'hybrid' format

which combined elements of routine ATC talk with elements of the speech exchange system of ordinary conversation.

1. Introduction

Previous studies of air traffic communications and human factors in aviation have investigated a wide range of issues. Falzon (2009) analyzed how participants manage the coordination of multiple tasks in Air Traffic Control/Aircraft Crew interactions. Other studies investigate how safety analysts should study incidents in order to more effectively reduce mid-air collisions (Brooker, 2005), how the work of air traffic controllers can be studied in simulators (Ham, Park, and Jung, 2008), and how new technology can affect air traffic control communication (Cox et al., 2007; Fulton, Westcott, and Emery 2011; Malakis and Kontogiannis, 2014; Mosier et al., 2013; Olson and Sarter, 2001; Sharples, et al., 2007; Stedmon et al., 2007). Other research investigates how communication problems within crews or between the

plane and Air Traffic Control can lead to accidents (e.g., Cushing, 1994; 1995; Jones, 2003; Howard, 2008).

When aviation emergencies are successfully resolved it is useful to explore the factors that lead to that success. The “miracle on the Hudson” occurred on January 15, 2009, when U.S. Airways Flight 1549 lost both engines due to bird strike shortly after taking off from LaGuardia Airport in New York City (McFadden, 2009). The pilot was rightfully congratulated on his skill in landing the plane safely in the Hudson River without losing a single life. Part of the miracle was due to the skill of the pilot, and part was due to the "miracle" of the routine interactional procedures used by air traffic personnel in the cockpit and in the air traffic control tower.

Planes are assisted through take off from airports by the airport’s Air Traffic Control. The Radar Approach Control (“TRACON”) officer views the planes on his or her radar screen and gives them directions such as which way to turn or how high to climb after takeoff (the “initial climb”). The RAC officer is continually available for radio communications from all the planes in his or her range, and knows their location from watching the radar screen (see Harper and Hughes, 1993).

RAC officers' interactions with the planes differ from ordinary conversation (e.g., Sacks, Schegloff and Jefferson, 1974), and from many other types of institutional or workplace talk (e.g., Drew and Heritage, 1992), in several ways. In this paper I will outline some of these differences and show how these routine interactional procedures help the RAC officer facilitate the safe flow of air traffic and manage emergencies when they occur. This will be done through an analysis of the audio recording and transcript of the communications immediately prior to and during Flight 1549's emergency landing.

One of the important elements of air traffic communications is the frequent use of scripted language (e.g., Howard, 2008; Nevile, 2004a). Howard (2008) conducts a quantitative analysis of pilot/ATC communication and concludes that deviations from scripted speech increase the likelihood of communication problems; Prinzo and Hendrix (2009) found that the complexity of messages and increased message length increased likelihood of problems. Tajima (2004) discussed accidents resulting from insufficient knowledge of English. Insufficient fluency becomes increasingly problematic in non-scripted exchanges or in emergency

situations. However, the use of a conversation analytic approach to analysis may reveal a different perspective on the role of “non-scripted” speech in pilot/ATC communication.

I will show that during the critical emergency the RAC officer and the pilot of Flight 1549 switched from a routinized (largely scripted) form of interaction to a conversational form of interaction, and at times to a ‘hybrid’ format which combined elements of routine RAC talk with elements of the speech exchange system of ordinary conversation. I will first describe the methods and data and then analyze the routine RAC/plane interactions and those that occurred during the emergency faced by U.S. Air Flight 1549.

2. Data and Methods

2.1 The Conversation-Analytic Method

The theoretical and analytical perspective used in this project is conversation analysis, a qualitative approach to analyzing talk in interaction which grew out of the

ethnomethodological perspective developed by Harold Garfinkel (1967). The ethnomethodological approach to sociological investigations focuses on understanding human action, both in its social context and in terms of how it creates social structure and social organization (Atkinson and Heritage, 1984; Boden and Zimmerman, 1991; Button, 1991; Heritage, 1984; Turner, 1974; Watson and Seiler, 1992). Conversation analysts study talk in its sequential context in order to discover the common-sense understandings and procedures people use to shape their conduct in particular interactional settings (Garcia, 2013; Heritage, 1984; Heritage and Clayman 2010; Hutchby and Wooffitt, 2008; Liddicoat, 2007; Sacks, 1984; Schegloff, 2007; ten Have, 2007). Members' shared interactional competencies not only enable them to produce their own actions but also to interpret the actions of others. Because participants display their orientation to the procedures they use in the utterances they produce (see also Heritage and Atkinson 1984; Schegloff and Sacks, 1973), analysts are able to discover conversational procedures by analyzing the talk itself. The conversation is assumed to be a context within which participants shape their own utterances and interpret the utterances of

others (Goodwin and Duranti, 1992; Heritage, 1987). Thus the sequential context-- the immediately prior utterances, the interactional context, and physical and temporal contexts are all assumed to be potentially relevant to the participants as they structure their talk (Heritage and Atkinson, 1984). Roles do not just affect behavior by providing a set of rights, obligations and expectations; people instantiate their roles by their actions (Halkowski, 1990).

While the speech exchange system of ordinary conversation (whether conducted in a work place or in an informal context) provides for maximum flexibility in terms of the organization of turns at talk, types of turns produced by participants, and topics of talk, among others things (Sacks et al., 1974), talk in work place settings is often more highly structured or constrained on these types of dimensions (e.g., Antaki, 2011; Boden and Zimmerman, 1991; Clayman and Heritage, 2002; Drew and Heritage, 1992; Heritage and Clayman, 2010; Heritage and Maynard, 2006; Sacks, 1992; Sacks et al., 1974). Heritage and Clayman (2010: 32) describe how participants “talk... institutions into being”:

“We do not mean by this to suggest that every time persons talk they invent institutions from scratch. Far from it: the institutions of education, news, courts, and medicine plainly antedate the lives and actions of the persons who participate in them. But these institutions do draw life from, and are reproduced in, those actions. The word we have used for this in this chapter is ‘instantiate’. By this we mean that the sequences of talk we have examined are aligned with, and embody, some of the basic imperatives of the institutions within which they are found. Talking in these ways is, in part, how these institutions are realized: that is, are rendered observable and consequential in everyday life as the real entities that persons take them to be. Talking in these ways is part of being a teacher or a student, an interviewer, a lawyer or a doctor. These roles are enacted by talking in these ways. Failing to talk in these ways, by contrast, can lead to difficulties in realizing, or being recognized in, these institutional roles and activities.” (Heritage and Clayman, 2010: 32)

There are a range of institutional settings in which the differences between ordinary conversational interaction and workplace talk is consequential.

Researchers studying telephone surveys note that there is a tension between the desire to provide a uniform survey experience (in order to increase the scientific validity of the study), and the need to deal with interactional contingencies or unexpected situations that may arise (Maynard, Freese and Schaeffer, 2010; Maynard and Schaeffer, 2002; Schaeffer and Maynard, 1996). Maynard, Schaeffer, and Freese (2011) find that while scripted phone call openings for soliciting survey participation may be effective much of the time, specific actions in the very beginning of the call can warrant alteration of the script in order to increase rates of participation. Lavin and Maynard (2001) find that there is a tension between an interviewer's need to create a standardized telephone survey experience and to align with a respondent's invitation to treat something as humorous (e.g., when respondent laughter invites an interviewer to respond with laughter). Previous research on emergency service telephone calls has identified routine procedures for

answering the call, identifying the call taker, formulating the statement of the problem and the request for help, asking questions of the caller to obtain information necessary to the provision of help, and granting the request for help (Whalen and Zimmerman, 1987; 1990; Zimmerman, 1984; 1992a; 1992b). These procedures enable callers to effectively manage what for them is an unusual event, but for the call taker is a routine part of their every day work experience. Previous research has shown how call takers use aspects of the organization of ordinary interaction (such as repair procedures; Jefferson, 1974; Schegloff, Jefferson, and Sacks, 1977) to handle problematic moments in the call caused by the caller's actions (Whalen and Zimmerman, 1998; Zimmerman, 1984).

The use of routine procedures is also effective in air traffic communications. Nevile (2004a) found that airline flight crews use scripted talk to facilitate the work of flying the plane (see also Arminen, Auvinen and Palukka, 2010; Falzon, 2009; Jones, 2003). Cockpit crews are trained to use scripted phrases (Falzon, 2009; Howard, 2008; Nevile, 2004a) or 'standard call outs' (Arminen et al., 2010) to efficiently convey important information during the flight (among other tasks). For

example, when the engines of U.S. Air Flight 1549 failed, the captain used a scripted phrase (“my aircraft”) to quickly and efficiently take over the controls from the co-pilot, and the co-pilot responded in turn with “your aircraft” (Wald and Baker, 2009).

In addition to the scripted talk described by Nevile (2004a), previous research has found the use of a call and response pattern in the cockpit to complete checklists (Nevile, 2001), the use of “and-prefaces” to indicate connections with prior actions when several things are being done at once (Nevile, 2006), and the coordination of talk with embodied action to efficiently communicate what actions are being done and need to be done next as the crew members work together to fly the plane (Nevile, 2004b).

Air Traffic Control personnel also use routine procedures to facilitate the flow of air traffic to prevent accidents (e.g., Sanne, 2003). As Harper and Hughes (1993) note, Air Traffic Control work is challenging because all of the planes in the air must be constantly kept track of and prevented from colliding with one another:

“At its simplest and most general, the controller’s problem is a scheduling one. For any controller the traffic has to be taken as and when it arrives in the segment of airspace for which he/she is responsible and threaded together into an orderly pattern before aircraft are handed over to the next sector. The scheduling has to be achieved in and through making the traffic flow. Aircraft cannot be parked for a couple of minutes nor can ‘jams’ be allowed. Even in holding patterns aircraft are still on the move, part of the flow of traffic, and must, therefore, be taken into account.” (Harper and Hughes, 1993: 130)

In this paper I conduct a single case analysis of the interactions between one RAC officer and the flight crew of U.S. Air Flight 1549. The purpose of a single-case analysis is to use findings from previous conversation analytic research to understand a particular event (e.g., Clayman and Whalen, 1988/9; Garcia and Parmer, 1999; Osvaldsson et al., 2012; Psathas, 1992; Schegloff, 1987; Whalen et al.,

1988). This approach enables us to compare the single case with published findings about routine air traffic communication and routine interactions in other settings, in order to gain new understandings of potential causes of communication failure or success during air traffic emergencies.

2.2 Data

The audio recording and official transcript of the accident involving U.S. Air Flight 1549 are available online from the Federal Aviation Administration website. The data used in this paper are from the New York Terminal Radar Approach Control, which is the position which communicated directly with the plane. The audio recording covers a period of twenty minutes. It begins about seven and a half minutes prior to the Flight 1549 emergency and includes several minutes after the incident. While the transcripts provided were adequate for the Federal Aviation Administration's investigation of the accident, I revised the transcript for accuracy and for consistency with Jefferson's (1984; 1985; 2004) conversation analytic transcribing conventions (transcribing conventions are in the Appendix).

While foundational conversation analytic research on air traffic communications has already been done (e.g., Arminen et al., 2010; Frankel, 2000; Harper and Hughes, 1993; and Nevile, 2004a) this method has not yet been systematically applied to air traffic communications during actual emergencies. This project will therefore fill a gap in previous research by analyzing RAC/plane interactions during an actual emergency and investigating whether routinized procedures alone are the most effective when emergency situations occur. In this paper I will first analyze how this RAC officer conducts routine exchanges with a number of planes, and then compare these routine interactions with his interactions with U.S. Air Flight 1549 during the emergency.

3. Routine RAC/Plane Interactions

In this type of work environment all of the RAC/plane radio transmissions are audible to all planes in the sector (see Sanne, 2003). Because of this, excessive talk could distract cockpit crews from the performance of their tasks and from in-plane interactions with each other (Cushing, 1994). Sanne (2003) notes that regulators

strive to minimize the amount of extraneous conversation (such as greetings, farewells, and other courtesies) in these types of exchanges. The cockpit crew responds to RAC communications when they are addressed to their plane, and works around them when they are addressed to other planes (Nevile, 2001).

The RAC/plane radio transmissions in these data are typically short. The advantage of short transmissions is that they interfere as little as possible with the work of the RAC and cockpit crews by keeping the radio channel as uncluttered as possible; some research shows shorter messages resulting in fewer comprehension errors (Morrow and Prinzo, 1999). The timing of exchanges in RAC radio communications is determined by the flow of air traffic, so long gaps without any talk do occur and are not treated as problematic. There are often long pauses (up to a minute or more) between sequences of messages (Falzon, 2009).

3.1 The Organization of Routine Sequences

There are two types of routine sequences of exchanges between RAC and airplanes in these data which I call 'initial climb' and 'routing' sequences. The initial

climb sequence is initiated by the plane’s flight crew after the plane has taken off from the airport. The pilot announces his presence, conveys his location and trajectory, and (implicitly—see below) requests instructions for where to go next. The routing sequence is initiated by the RAC officer. He or she contacts a plane visible on his or her radar screen in order to give them further directions.

3.1.1 The Initial Climb Sequence. This three-turn sequence occurs when an exchange is initiated by a plane’s flight crew after taking off from the airport. In Excerpt 1, Northwest Airlines Flight 337 (“NWA337”) has just taken off from LaGuardia Airport and contacts the RAC officer (“L116”) in order to request instructions for their initial climb:

Excerpt 1: (New York Tracon RAC, January 15, 2009)

8 NWA337: (north)west three thirty seven (uh thousand) for
 five
 9 thousand

10 (0.8)

11 L116: northwest three thirty seven new york departure
radar

12 contact climb and maintain one five thousand

13 (0.1)

14 NWA337: one five thou:sand northwest three: thirty seven

Turn 1. In the first transmission in the sequence the pilot identifies his plane and announces his takeoff from the airport with his plane's call sign: "(north)west three thirty seven" (line 8). After the call sign he produces the substantive portion of his message: "(uh thousand) for five thousand" (lines 8-9). This locational information functions as an implicit request for instructions from the RAC officer.

Turn 2. In the second turn in the sequence the RAC officer responds to the plane's initial transmission by first repeating the plane's call sign. Next, they produce a self-identifier (an institutional identification rather than an individual

identification—see below). Finally, they provide instructions as to which path the plane should take.

In Excerpt 1 above, L116 begins his response with the call sign of the plane he is addressing (line 11). By putting the plane's call sign at the beginning of this utterance, L116 is able to simultaneously signal to the pilot of that plane that he is being addressed and to the pilots of other planes in range that they are not being addressed.

Note that if this exchange had occurred in the context of an ordinary conversation, it would be assumed that L116's response was directed at the prior speaker unless indicated otherwise. In these routine radio transmissions it is not taken for granted that the prior speaker is the one addressed, because other planes may or may not be attending to the exchange or may also need instructions. Every time there is a transmission all planes within "ear shot" need to be able to tell who is addressing who so that they do not accidentally miss a transmission directed at them or mistakenly assume that a transmission meant for another plane was directed at them (see Cushing, 1994). The turn allocation procedures (Sacks, et al.,

1974) are thus different from turn allocation in ordinary conversation or talk in other institutional settings because call signs and institutional identifiers are used to select next speaker rather than relying on indexical expressions such as pronouns or on sequential position in the interaction.

The next part of L116's utterance is his self-identification: "new york departure radar contact" (lines 11-12). This is an institutional or categorical identification rather than an individual self-identification. While in ordinary conversational exchanges, whether on the phone or face to face, the identification and recognition of the individuals interacting is typically necessary (Schegloff, 1968), in workplace interactions, institutional or categorical identifications may be used instead (as in emergency phone calls to the police—Zimmerman, 1984). In RAC radio communications the identity of the specific individuals involved is not relevant for the completion of the work at hand. Therefore, institutional or categorical identifications (specifically, the call signs for the airplanes and variations on "New York Departure Radar Contact" for the RAC) are used instead of individual identifiers such as names or job titles.

It is through this institutional identification that the officer constructs his utterance not just for the pilot he is addressing (who now knows that he is communicating with the correct person to guide them on their way), but also for the overhearing audience of other planes in the sector. Previous research has shown that problems can occur when a plane mistakenly takes direction from the wrong air traffic controller (see Cushing, 1994), or when there are problems distinguishing addressed recipients from non-addressed overhearing audience members (see Nevile, 2009). The third part of L116's transmission consists of instructions to the plane ("climb and maintain one five thousand"; line 12).

Turn 3. The third turn in the sequence is the pilot's acknowledgement of their receipt of the instructions; this turn also serves to verify that the instructions have been correctly received. Note that in the pilot's response (line 14) the first thing he does is repeat the instructions, thus reversing the order of his initial turn in the sequence. Following the preference for contiguity (Sacks, 1987; 1992), since agreement is preferred, a positive response will be the first thing in the responder's utterance, while a dispreferred response will typically occur after something else.

By positioning the repeat of the instructions at the beginning of this utterance the pilot places it contiguously with L116's instructions from the end of his prior turn. Since getting the instructions right is of the utmost importance, repeating them immediately facilitates their speedy repair, if necessary. The pilot's line 14 ends with his plane's call sign ("northwest three: thirty seven").

By means of this "initial climb" sequence the participants display that the correct plane has heard and acknowledged the instructions given. This routine format enables repairs to be made if either L116 or the pilot of the plane notice an error or an inconsistency (see below). When L116 does not initiate a repair, the pilot can assume that he has the correct instructions (Falzon, 2009).

3.1.2 "Routing" Sequences. After the plane has taken off and the initial climb sequence has been completed, there is typically at least one more sequence of messages exchanged between RAC and the plane before it leaves the vicinity of the airport and heads on its way. These two-part "routing" sequences are initiated by the RAC. Via this routing sequence, the RAC officer manages the plane's location

and trajectory relative to their intended destination and the location of other planes in the sector.

Turn 1. In the first turn in the routing sequence the RAC officer begins by providing the call sign of the plane being addressed and then provides instructions for the plane.

Turn 2. In the second turn in the sequence the plane's flight crew responds with a two-part transmission: first they repeat the instructions given by the RAC officer, then repeat their call sign.

Excerpt 2 shows a typical routing sequence in which L116 initiates an exchange with NWA Flight 337:

Excerpt 2: (New York Tracon, January 15, 2009)

34 L116: northwest three thirty seven turn left heading three

35 two zero

36 (0.2)

37 NWA337: three two zero northwe:s:t three: thirty seven

L116's transmission in lines 34-5 begins with the plane's call sign ("northwest three thirty seven") followed by instructions for the pilot ("turn left heading three two zero"). This transmission is quickly followed by a response from NWA Flight 337.

The response begins with a partial repeat of the instructions ("three two zero") and ends with the plane's call sign ("northwe:s:t three: thirty seven"; line 37).

The RAC officer does not respond to the second message in a routing sequence unless there is a problem with the sequence that needs to be repaired. For example, Excerpt 3 shows L116 initiating repair of a pilot's message. Apparently he had difficulty hearing the message and therefore asked for a repeat (in lines 178-9).

Excerpt 3: (New York Tracon, January 15, 2009)

172 L116: >eagle flight forty seven eighteen climb maintain

one

173 two thousand<

174 (about 1.5 seconds)

175 EGF4718: okay one two thousand and ah () five and

176 (two eighty heading)

177 (about 5 seconds pause)

178 L116: (and) eagle flight forty seven eighteen i'm sorry i

179 missed that >say it again<

180 (about 2 second pause)

181 EGF4718: and uh we're up to twelve thousand uh two eighty

(on

182 tuh heading)

183 (0.5 seconds)

184 L116: okay thank you eagle flight forty seven eighteen

turn

185 left two two zero

186 EGF4718: two two zero forty seven eighteen

Note that L116 uses an and-preface in line 178 (Nevile, 2006) to introduce his repair initiation, thus explicitly presenting it as a continuation of prior talk. He then repeats the call sign of the plane he is addressing so that all planes in the sector will know which plane is being addressed. Finally, he apologizes, explains what the problem is, and asks for a repeat (“>say it again<”; line 179). The pilot then repeats the information (lines 181-2). Note that he also uses an and-preface to mark this utterance as connected to prior talk. In line 184, L116 first acknowledges receipt of the information (“okay”); then thanks the pilot for the information, and finally uses a routine format for his response (the plane’s call sign followed by instructions). The pilot then uses the routine format discussed above to verify receipt of this information (line 186—repeat of the information followed by the aircraft’s call sign). Note that in this repair sequence ordinary interactional conventions (e.g., and-prefaces, thanks, and apologies) are used when necessary, but the routinized format of the transmissions is returned to as soon as possible. It is to this contrast between routinized, largely scripted talk and talk that follows the conventions of ordinary interaction that we now turn.

3.2 Grammatical Truncation and Positional Grammar

As in the cockpit interactions described by Nevile (2004a), much of the radio communications between L116 and the planes in the air is scripted. Participants in these data rely on what I call “positional grammar.” This means that the meaning of a sequence of numbers or words and numbers is typically displayed through its position in the transmission rather than through the use of sentence structure or grammatical structure. The Federal Aviation Administration guidelines instruct pilots to use a specific format for their transmissions which includes information on the proper order of information in radio transmissions (Federal Aviation Administration, 2006). The sentential structure of utterances which is apparent even in time-sensitive emergency phone calls to the police is bypassed in these RAC/plane interactions in favor of scripted speech in which sentential grammar is starkly truncated.

The participants in the routine initial climb and routing exchanges in these data only occasionally use conjunctions or prepositions (such as “and” for “for”) to

connect parts of their messages. When a sequence is routine, all the participants know how the transmission should be structured or formatted.

For example, in lines 8-9 of Excerpt 1 (above), NWA337 says "(north)west three thirty seven (uh thousand) for five thousand". This utterance includes several numbers and one or two words. It is the convention that the first thing that is said is the plane's call sign, and the second thing that is said is the locational and directional information. This routine ordering lets L116 hear and understand the information provided correctly, rather than as a random stream of words and numbers. When different types of information are presented in one transmission, or when the type of instruction could be ambiguous, words are used to preface the numbers to indicate the type of information they provide. For example, in Excerpt 1 above L116 says "climb and maintain" (line 12).

3.3 Opening and Closing Sequences

The series of dyadic exchanges between L116 and individual planes in these data are accomplished without discrete opening or closing sequences. In practice,

the "opening" of each sequence of exchanges is made relevant by the plane moving into the radar range of L116 (e.g., by taking off from the airport). The call sign of the plane serves as the opening of the sequence and the opening of the first transmission, with the pilot initiating the first transmissions to L116 with the call sign of their plane, and L116 initiating transmissions to particular planes with their call sign.

When greetings and farewells occur they are typically appended to an existing message rather than being conveyed in a separate transmission. Farewells such as "good day" or "so long" only occur at the end of the last exchange between L116 and the pilot--when the plane is leaving the RAC officer's airspace. The "so longs", when they occur, therefore signal the end of a series of two or more sequences, rather than the end of a turn. Excerpt 4 shows a routine exchange in which farewells are exchanged:

Excerpt 4: (New York Tracon RAC, January 15, 2009)

28 L116: november seven six golf? >(flight=heading)< of
two

29 six zero?, contact departure one two zero eight five

30 so=long

31 (0.5)

33 N376G: two zero eight fi:ve and two sixty on thuh heading.

34 seven six golf >good=day<

The exchange with N376G includes a "so=long" from L116 in line 29, followed by a ">good=day<" from N376G in line 32. In both of these turns, the farewell is placed at the end of the transmission. A discrete closing sequence is not needed, because these exchanges are monotopical. Once the relevant information has been communicated and its receipt verified, there is nothing more to discuss. The listeners can also tell that the utterance is over because the speaker cuts the radio connection, thus terminating the live "buzz" and restoring the radio frequency to silence.

Occasionally, a farewell will be produced as a separate message in these data. Excerpt 5 below shows L116 producing a free-standing farewell (“>good=day<” in line 6) as the plane “BSK699” leaves his airspace. Since the RAC officer’s view of what is happening on his radar screen lets him anticipate when “silences” in radio communications are likely to occur, if his radar screen indicates no impending activity he can anticipate when these optional exchanges of farewells are likely to be nonproblematic.

Excerpt 5: (New York Tracon RAC, January 15, 2009)

1 L116: biscayne six ninety nine?, contact departure one
two
3 (0.2)
4 BSK699: (twenty) eight five for biscayne six ninety nine (
)
5 (0.2)

6 L116: >good=day<

3.4 Summary

The routine RAC and flight crew interactions analyzed above differ from ordinary conversation in several ways. These short exchanges did not typically have greetings or farewells. If a greeting or farewell did occur, it was typically appended to a substantive message, rather than occupying a separate turn. Call signs (in the case of the plane) and institutional identifiers (in the case of L116) were used to identify specific planes and L116 rather than individual identifiers such as names or job titles. Transmissions did not have separate opening sequences, rather the call signs of the planes functioned both as summonses and as identifiers of the intended recipient of the transmission. Transmissions were short and concise, and typically used positional, truncated grammar without sentential structure. The meaning of the numbers spoken was determined by their position in the utterance. Interactions between L116 and the planes consisted of a series of two types of sequences: one initial climb sequence followed by one or more routing sequences. Turn taking and

the selection of next speakers were facilitated by the routinized structure of the transmissions, including the repeated use of call signs.

In the next section of this paper I will analyze how these routine interactional conventions were used, adjusted, or abandoned during an emergency situation. I will show that there was a transition to the speech exchange system of ordinary conversation, and at times to a “hybrid” form of interaction which combined elements of ordinary conversation with routine aspects of RAC/plane talk. I will argue that these conversational and hybrid exchanges were more practical and productive for managing the emergency situation than the continued use of highly scripted talk would have been.

4. RAC/Plane Interactions during the Flight 1549 Emergency

When the emergency with U.S. Air Flight 1549 began, the pilot’s exchanges with L116 were immediately transformed from the format described above in routine contexts to a style of speaking that was conversational or semi-conversational in structure. At times the participants used a hybrid format which included elements

of the organization of ordinary conversation (e.g., Sacks et al., 1974) and routine RAC talk (as described above). This transition can be clearly seen when the routine utterances AWE1549 and L116 produced prior to the emergency are compared to their post-emergency utterances. Excerpt 6 shows that in the pre-emergency utterances (e.g., AWE1549's utterances in lines 45-6 and 52) the pilot followed the interactional procedures used in the routine exchanges precisely. Similarly, L116's pre-emergency utterances (in lines 48-50, 61-62, and 66-67) also followed the routine conventions.

Excerpt 6: (New York Tracon, January 15, 2009)

45 AWE1549: cactus fifteen forty nine seven hundred climbing

fi:ve

46 thousand

47 (about 6 seconds)

48 L116: cactus >fifteen forty nine new york

- 49 departure=radar=contact climb< and maintain one
five
- 50 thousand
- 51 (0.5)
- 52 AWE1549: maintain one five thousand cactus fifteen forty nine
- 53 (about 52 seconds)
- 54 UNKN: (seventy) (unintelligible) (okay)
- 55 (0.2)
- 56 L116: (have a good) day
- 57 (about 4 seconds)
- 58 BTA2760: >new york jetlink twenty seven sixty< is five
thousand
- 59 turning (in your) right!, to one five zero
- 60 (0.2)
- 61 L116: jetlink twenty seven sixty climb maintain one zero
- 62 thousand

- 63 (about 2 seconds)
- 64 BTA2760: one zero thousand. jetlink twenty seven sixty
- 65 (about 21 seconds)
- 66 L116: cactus fifteen forty nine turn left heading two seven
- 67 zero?,
- 68 (0.1)
- 69 AWE1549: ah this is uh cactus fifteen thirty nine hit birds
- 70 we've lost thrust in both engines we're turning
- back
- 71 towards laguardia
- 72 (0.4)
- 73 L116: okay yea: uh you need to return to laguardia turn
- left
- 74 heading of uh >two two zero<
- 75 (0.3)
- 76 AWE1549: two two zero

77 (0.6) ((beep sound))

78 L116: tower stop your departures we got emergency

79 returning

80 (0.6)

Line 69 is the first radio transmission the AWE1549 pilot made after the emergency began. At the very beginning of this radio transmission the pilot said “mayday” three times—thus signaling an emergency (National Transportation Safety Board, 2010: 2). However, the “mayday” part of the message could not be heard by the RAC officer because another radio transmission occurred at the same time and blocked its reception; it was not audible on the New York Tracon recording.

In Sanne’s (2003) discussion of Air Traffic Control (“ATC”) interactions, he notes that because these are radio communications rather than telephone calls, only one party can be heard at a time and simultaneous talk is not possible. If a radio transmission is initiated after another person has started a transmission on the same frequency, that part of the message will not get through (see also Cushing,

1994; Prinzo and McClellan, 2005). If a pilot has an emergency they are supposed to officially declare it by saying the word “emergency” (Cushing, 1994). The AWE1549 pilot did not use these words; perhaps he did not realize that the “mayday” part of his transmission had not been heard.

After the obscured “mayday” announcement, the first audible verbalization the pilot produces is a deviation from routine format--a hesitation marker: “Ah” (line 69). Line 69 also differs from routine format in that the pilot uses sentence structure (“this is uh cactus fifteen...”) rather than relying on positional grammar. The pilot does produce his call sign, but he produces it with an error (1539 instead of 1549). This error, and other subsequent errors in the plane’s call sign by both the pilot and L116 remain uncorrected during the emergency. Apparently there were no other planes in the sector with similar call signs, so the identity of the plane with the emergency was never in question. In this case the differences in call signs (at times 1549, 1539, or 1529), were not consequential. Previous research has shown how mistakes or ambiguity in call signs can result in confusion (Cox and Vinagre, 2004; Cushing, 1994).

The pilot continues by producing a statement of the problem (“hit birds we’ve lost thrust in both engines.”; lines 69-70). Note that the pilot then states what he is doing rather than requests permission to change direction (“we’re turning back towards laguardia”; lines 70-71). This statement turns the usual procedure on its head and both displays and accomplishes the non-routine nature of the situation.

L116’s response to this transmission displays an orientation to the pilot’s definition of the situation as constituting an emergency. L116 immediately acknowledges the pilot’s statement (“okay yea:”; line 73) and implicitly approves the pilot’s plan to return to the airport with a partial repeat of his utterance (“uh you need to return to laguardia”). L116’s repetition here displays that he has heard and understood the essential part of the pilot’s message. There is no pause or completion intonation after this sentence--L116 immediately adds the directions the pilot needs to accomplish this return (“turn left heading of uh >two two zero<”; lines 73-4).

Note that like the pilot’s previous turn in lines 69-71, L116 also responds in sentential format and abandons the positional grammar and other conventions of

routine RAC exchanges. He neither self identifies nor repeats the call sign of the plane. Instead, he uses indexicals (e.g., the pronoun “you”) to convey that he is addressing the prior speaker rather than the unaddressed overhearing audience members—the other planes in the sector. The last part of the utterance is produced more closely to the typical, routine format of RAC talk. He uses words to characterize the type of instruction, followed by the numbers which contain the precise information needed (“turn left heading of uh >two two zero<”; lines 73-4).

In his response, the pilot uses the routine, “scripted” format to confirm his receipt of this instruction (“two two zero”; line 76). Note however that this transmission differs from routine transmissions in that the pilot does not repeat his call sign. Although the other planes are still an overhearing audience, and confusion as to who is speaking or who is being addressed is still potentially possible, the call sign is not necessary here because the public display that an emergency situation is in progress warrants a dyadic exchange between L116 and AWE1549. Now that all parties know that there is an emergency situation the other planes stay quiet when they can. It is the shift from the routine speech exchange system of routine RAC

talk to the speech exchange system of ordinary conversation which enables L116 and AWE1549 to ignore the other planes and conduct a dyadic exchange without continually repeated self and other identifications. In the speech exchange system of ordinary conversation, utterances are presumed to refer to their prior utterance unless marked otherwise (Sacks et al., 1974). Note that while the use of pronouns in pilot/ATC radio transmissions can result in problematic miscommunications (Cushing, 1994), in this non-routine context the use of pronouns helps the participants communicate more efficiently and distinguish for themselves and other listeners who is being selected as next speaker. It thus assists with turn allocation by indicating to potentially listening other planes that it is each other who are being selected via these pronouns, not other planes.

In line 78, L116 initiates a phone conversation with LaGuardia ATC, in which he informs them of the emergency “returning” and orders them to stop their departures. After a brief phone conversation with LaGuardia ATC, L116 again contacts AWE1549 (Excerpt 7 below). L116 integrates his handling of the

emergency with Flight 1549 while continuing to monitor his radar screen and give instructions to other planes in his territory when necessary:

Excerpt 7: (New York Tracon RAC, January 15, 2009)

91 L116: cactus fifteen twenty ni:ne?, (0.4) if we can get it

to

92 you?, do you want to try to land runway one three?

93 (0.5)

94 AWE1549: we're unable. (0.2) we may end up in thuh hudson.

95 (about 6 seconds)

96 L116: jetlink twenty seven >sixty turn left zero seven

zero<

97 (0.2)

98 BTA2760: >left turn zero seven zero jetlink twenty seven

99 sixty<

100 (about 11 seconds)

101 L116: alright cactus fifteen forty nine it's going to be LEft
102 traffic to runway three one
103 (0.4)
104 AWE1549: unable.
105 (about 2 seconds)
106 L116: okay what do you need to land
107 (about 9 seconds)
108 L116: cactus fifteen forty nine runway? four? is available
if
109 you want to make left traffic to runway four
110 (0.5) ((background noise in pause))

Note that the exchanges between L116 and AWE1549 in Excerpt 7 are more similar to the organization of ordinary conversation than the format of routine RAC exchanges described above. L116 uses a hybrid format in lines 91-92, combining elements of ordinary conversation with some elements of routine RAC exchanges.

He uses positional grammar in the opening portion of his transmission which begins with the plane's call sign. Since he has been off the radio while he conducted the phone conversation with LaGuardia Tower, the call sign is used as a summons to resume the interrupted interaction with Flight AWE1549. L116 then formulates the information about what runway might be available at LaGuardia Airport as a question rather than as an instruction, making it clear that he is deferring to what the plane needs (lines 91-2). He also uses the pronoun "you" to indicate that AWE1549 is selected as next speaker rather than any of the other overhearing planes, a procedure consistent with the turn taking organization of ordinary conversation.

AWE1549's response in line 94 uses the format of ordinary conversation rather than the format of routine RAC talk. He does not identify his plane and does not use positional grammar. He relies on the indexicality of pronouns ("we're" and "we") to self-identify. In the speech exchange system of ordinary conversation, indexical pronouns can be used to refer back to the previous utterance. The addressed recipient of the utterance is the prior speaker unless marked otherwise.

On the other hand, when L116 communicates with another plane in line 96 he uses the routine format (“jetlink twenty seven >sixty turn left zero seven zero<”).

That plane’s response in lines 98-99 is also in routine format. Neither party mentions or acknowledges the emergency in progress. The only orientation to the unfolding emergency displayed in lines 96 and 98-99 is that both L116 and the pilot speak very quickly. The speedy completion of this routing sequence clears the radio channel for L116 to continue to deal with the unfolding emergency with Flight 1549.

In lines 101-2, when L116 next speaks to Flight 1549, he immediately switches back to a more conversational format (“alright cactus fifteen forty nine it’s going to be LEft traffic to runway three one”). By beginning the utterance with “alright” he signals the transition to the conversational format that he has been using with AWE1549. He follows this with the plane’s call sign, to clarify that he is addressing this transmission to AWE1549 rather than to the prior speaker (Flight BTA2760). He then provides AWE1549 with instructions for how to land at LaGuardia Airport.

Notice that instead of giving instructions he frames the message as an “informing” (“it’s going to be LEft traffic to runway three one”). The AWE1549 pilot’s response

to this is also indexical and in the format of ordinary conversation. His one word response “unable.” has no call sign and no request (line 104). It is an informing, and functions as a complete turn at talk in the context and situation in which it occurs.

As L116 must be aware, the cockpit crew of AWE1549 is busy trying to solve problems with the plane and does not have time for unnecessary conversation (see Falzon, 2009). L116’s response (“okay what do you need to land”) also uses a conversational format, using the pronoun “you” to identify prior speaker as selected next speaker rather than using call signs. He asks the pilot what he wants rather than tells him what to do. By beginning the turn with “okay” L116 acknowledges what AWE1549 has told him. He uses sentence structure rather than positional grammar.

When AWE1549 does not respond after about 9 seconds, L116 makes another attempt to assist the plane in finding a place to land: “cactus fifteen forty nine runway? four? is available if you want to make left traffic to runway four” (lines 108-9). L116 displays an orientation to AWE1549’s absent response by repairing his previous turn. Instead of asking an open-ended question he makes a suggestion.

L116 knows that the AWE1549 crew is working hard to handle the emergency on board, so missing or late responses are not treated as necessarily problematic. He uses the plane's call sign, but follows it immediately with a sentential utterance rather than positional grammar—a hybrid utterance.

The exchange continues in the format of ordinary conversation from lines 110 through lines 118 (Excerpt 8). After AWE1549 indicates that he wants to go to Teterboro Airport, L116 initiates a telephone call to Teterboro Airport in which he explains the emergency and gets permission for AWE1549 to land there (not shown).

Excerpt 8: (New York Tracon RAC, January 15, 2009)

110 (0.5) ((background noise in pause))

111 AWE1549: i am not sure if we can make any runway u:h what's

112 over to our right anything in new jersey maybe

113 teterboro?

114 (0.5)

115 L116: okay yea off to your right side is teterboro airport.

116 (about 4 seconds)

117 L116: do you want to try to go to >teterboro?<

118 (0.2)

119 AWE1549: ye:s.

120 (0.2)

After the break for the phone call, L116 again addresses AWE1549 (Excerpt 9). He uses the plane's call sign in line 137, and follows this with a routine instruction "turn right two eight zero" (line 137). This is followed by an informing: "you can land runway one at teterboro". This lets the plane know that permission has been obtained for them to land at Teterboro Airport, at the same time informing them which runway they can use. Note that in this part of the transmission L116 uses sentential structure. This is a hybrid utterance, beginning with routine RAC format and adding a sentential component at the end.

Excerpt 9: (New York Tracon RAC, January 15, 2009)

137 L116: cactus fifteen twenty nine turn right two eight zero

you

138 can land runway one at teterboro

139 (0.4)

140 AWE1549: we can't do it.

141 (0.5)

142 L116: okay which runway would you like at teterboro

143 (0.2)

144 AWE1549: we're gonna be in thuh hudson.

In line 140 AWE1549 states that he can not land at Teterboro Airport (“we can’t do it.”). This concise response uses sentential structure rather than positional grammar, omits the self-identification, and relies on the utterance’s indexical relationship with the prior turn to accomplish self-identification and specification of who the utterance is addressed to.

L116 makes one more attempt to help the plane land. In line 142 he acknowledges the prior turn with “okay.” This use of “okay” also functions as a pivot to tie prior talk with what he is going to do next (see Beach, 1993; Condon, 1986; Merritt, 1980; Sinclair and Coulthard, 1975, on uses of “okay”). Instead of giving orders or directions he asks what the pilot wants. This utterance relies on the organization of conversational interaction; it uses sentential structure, avoids positional grammar, and relies on its indexical relationship with prior talk to accomplish identification of recipient. In his response AWE1549 does not directly respond to L116’s question, but very concisely indicates that no runway will work for them (“we’re gonna be in thuh hudson.”; line 144).

After a few more brief utterances, L116 directs a transmission to one of the other planes in his sector. Excerpt 10 shows L116 giving instructions to Flight BTA2760 (lines 151-2). Note that both this transmission and the plane’s response in line 154 use the format of routine RAC talk precisely. Also note that both speakers speak quickly, which is consistent with an orientation to the need to keep

the air waves clear for further communications about the ongoing emergency with AWE1549.

Excerpt 10: (New York Tracon RAC, January 15, 2009)

151 L116: >jetlink twenty seven sixty contact new york one

two

152 six point eight<

153 (about 2 seconds)

154 BTA2760: >twenty six eight jetlink twenty seven sixty<

155 (about 4 seconds)

156 L116: cactus: ah- (1.0) cactus fifteen forty nine radar

contact

157 is lost you also got newark airport off your two

o'clock

158 (and/in) about seven miles

159 (about 8 seconds)

160 L116: eagle flight forty=seven eighteen turn left heading
two
161 one zero?

L116's next transmission in lines 156-8 is directed at AWE1549. Note that there is some hesitation and repair at the beginning of this utterance, but it starts with the plane's call sign. Since the prior utterances were with a different plane, the call sign serves to mark the transition back to the exchange with AWE1549 about the emergency. As soon as the call sign is completed L116 again uses sentential structure. This utterance can therefore be considered a hybrid utterance which combines elements of routine RAC talk and ordinary conversational conventions. Note that this utterance is framed as a suggestion or 'informing' rather than as an order, instruction, question, or request. Since AWE1549 is now off radar, they may have crashed or are in the process of crashing. In any case, L116 knows that they are not at liberty to respond. This utterance is therefore designed to not require a response (see Heath & Luff [2000] for a similar strategy in the work of journalists).

5. Conclusions

In this paper I have shown how the speech exchange system of routine RAC talk can be modified by participants in order to handle an emergency situation.

When the emergency began, the participants switched to a mode of communication which integrated aspects of ordinary conversation with the routine format for RAC/aircraft exchanges. This mode of interaction facilitates communication between the RAC officer and the crew of the plane which is experiencing the emergency, while at the same time signaling to all other planes in the territory which utterances are emergency-related and which are routine utterances potentially directed at them.

The interactional organization of the radio communications between L116 and Flight 1549 changed as soon as the emergency began. The structure of the radio transmissions shifted from a scripted format which relied on positional grammar and other routinized procedures to transmit information and identify addressed recipients, to the speech exchange system of ordinary conversation or a hybrid form

of interaction which combined elements of ordinary conversation with aspects of the scripted and routinized procedures typically in use. Since every RAC/aircraft communication is audible to all planes in the sector, all planes who overheard these messages were aware of the unfolding emergency. The use of call signs in every transmission was therefore no longer necessary, because other planes would know that transmissions dealing with the unfolding emergency were not directed to them. The L116 and Flight 1549 could therefore engage in a dyadic exchange, using ordinary conversational procedures to exchange turns of talk between them and relying on sequential position and indexical references to accomplish selection of next speaker rather than the call signs that were used in routine RAC transmissions. This hybrid format facilitated direct and efficient communication between the pilot of Flight 1549 and the RAC officer L116 so that they could quickly act together to manage the ongoing emergency. It was through the interactional organization of talk that the emergency was mutually identified and managed. Transmissions addressed to planes that were not involved in the emergency continued to be structured using routine procedures, including reciprocal repetition of call signs and

the use of positional grammar to distinguish elements of the transmission and concisely convey instructions.

Also note that the successful handling of the emergency by the RAC officer was made possible in part by the silence of the other planes at key points in the interaction. They displayed their orientation to the ongoing emergency by withholding talk when possible while the officer was dealing with the opening phases of the emergency. This cooperation is especially critical given that only one radio transmission in that frequency can be conveyed at a time; extraneous turns thus might obscure emergency-relevant utterances (as when the Flight 1549 pilot's "mayday" turn preface was obscured—see Excerpt 6 above) (Cushing, 1994; Prinzo, 2005; Sanne, 2003).

Air traffic communications are a critical aspect of air travel safety (Cushing, 1994; Nevile, 2004a). These interactions enable planes to fly into and out of busy airports without collisions and to receive timely help during emergencies. Problems in communications between crew members or the crew and the air traffic control personnel can increase the chance of accidents occurring. Research into how

emergency communications are handled and how they differ from routine air traffic communications is therefore important and should lead to research findings with direct applicability to the improvement of these interactions. Further conversation analytic research should be done in order to compare the radio transmissions between RAC officers and pilots in a number of emergency situations to see how different officers handle these transitions.

6. Appendix

Simplified version of Gail Jefferson's transcription conventions (see Atkinson and Heritage, 1984: ix-xvi):

Symbol	Definition
.hh hh	Inhalations and exhalations, respectively
ta::lk	Colons indicate a syllable is drawn out
that-	Dash indicates a word was cut off abruptly
<u>lot</u>	Underlining indicates stress or emphasis
YOU	Capital letters indicate increased volume
° cost°	Degree signs indicate decreased volume
(1.4)	Numbers in parentheses indicate length of pauses
(in	

	seconds)	
(talk)		Words in parentheses are tentative transcriptions.
()		Empty parentheses indicate non-transcribable talk
.,?!)		Punctuation generally indicates intonation, not grammatical structure.
heh, hunh		Laughter particles are transcribed as pronounced.
A: [a copy of it]		
B: [I have]		Brackets indicate simultaneous speech.
A: yeah=		
B: =in order		Equal signs indicate one word is placed immediately
		after another without pause or overlap.
A: are yuh gonna?		Words spelled as pronounced.
B: >right now<		Arrows indicate faster rate of speech.

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