COMMUNICATIONS-RELATED INCIDENTS IN GENERAL AVIATION DUAL FLIGHT TRAINING

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BACKGROUND AND MOTIVATION

A recent survey of the Aviation Safety Reporting System (ASRS) database on incidents involving General Aviation (GA) aircraft revealed that one third of the GA incidents were associated with communications difficulties. These problems included failure to comply with ATC clearances, communications equipment malfunctions, and poor radio technique. The results of this survey suggested to our research team that GA communications issues were an appropriate topic for further ASRS research. We were also aware that past ASRS research has not focused on this subject.[2]

The 1996 Nall Report, published by the Aircraft Owners and Pilots Association (AOPA) Air Safety Foundation, further focused our attention on dual instruction.[3] Although flight instruction, overall, was one of the safest operations in General Aviation, according to 1995 accident statistics, there was a notable concentration of fatalities and accidents during dual instruction: The only fatal go-around accident, four of the five fatal maneuvering accidents, and five out of seven non-fatal maneuvering accidents occurred during dual instruction.[4] This cluster of accidents and fatalities in dual flight instruction raised the question of whether problematic communications, both inside and outside the aircraft, might have played a role.

A final motivation for this study was research by NASA and others which has shown that in shared decision-making situations similar to those that occur in GA dual flight instruction, there is often a failure of individuals to take responsibility for actions, including communications. At the 1995 OSU Symposium, Prince and Stout presented the results of interviews with professional aviators from the military, air carriers, and GA. They reported that 30 percent of the GA instructors surveyed stated that they trained students to perform independently, as single pilots, and believed their task as flight instructor was to encourage independence, not team awareness.[5] An exaggerated emphasis on pilot independence during training arguably may exclude development of sound cross-cockpit communications procedures, and impair communications awareness and effectiveness.

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[2] ASRS research on General Aviation issues largely has been confined to weather-related topics, such as single-pilot IFR; pilot judgment issues; and flight phase-specific problems such as landing incidents.

[3] For the purposes of this study, *dual instruction* is considered primary or advanced flight training that involves a student or rated pilot who actively handles the aircraft controls (usually from the left seat of the aircraft, except in tandem configurations), and a certified flight instructor who observes the trainee's actions (usually from the right seat of the aircraft) and has the capability of intervening in control and communications actions.

[4] *The 1996 Nall Report: Accident Trends and Factors for 1995*, AOPA Air Safety Foundation, 1996, 21.

[5] Carolyn Prince and Renee Stout, "Situation Awareness From the Team Perspective." In *Proceedings of the Eighth International OSU Aviation Psychology Symposium*, Columbus, Ohio: OSU, 1995, 744.

OBJECTIVES

Our research goal was to examine a representative set of ASRS reports referencing communications-related incidents that occurred during GA dual instruction, with the following specific objectives:

- To identify the airspace, location, and operational context in which GA dual instruction communications incidents occurred (*external factors*);
- To determine the nature of problematic communications interactions that occurred (or did not occur) in the cockpit between instructor and trainee (*internal factors*);
- To identify contributing communications equipment and operational factors;
- To suggest strategies for improving communications management during GA dual flight instruction.

SCOPE

This research effort was limited to ASRS incidents involving powered aircraft with a maximum gross takeoff weight less than or equal to 14,500 pounds. Incident reports selected for the study had to directly reference the presence of a flight instructor onboard who was actively conducting dual flight instruction or a flight review.

Although we had no means of identifying database reports in which communications (or the lack thereof) between instructor and trainee contributed to an incident but were not reported, it was possible to retrieve reports in which communications factors were explicitly referenced as a contributing factor. Therefore a further requirement was that reports selected for the study contain specific references to verbal interactions between the flight instructor and trainee which contributed to the incident. Examples included directives or instructions; questions; recognition or announcements of a problem; predictions or warnings; status reports; information acquisition; statements referring to planning or goals; explanations; and non-pertinent conversations.

APPROACH

DATA SET

Initial query of the ASRS database revealed 582 incident occurrences from January 1988 through December 1996 which had the potential to meet the scoping criteria for this study. We screened a random sampling of these reports to aid in hypothesis generation and the development and refinement of a coding instrument.

Properties of ASRS Data.

ASRS data have certain limitations. Reporters to ASRS may introduce biases that result from a greater tendency to report serious events than minor ones; from organizational and geographic influences; and from many other factors. All of these potential influences reduce the confidence that can be attached to statistical findings based on ASRS data. However, the proportions of consistently reported incidents to ASRS, such as altitude deviations, have been remarkably stable over many years. Therefore, users of ASRS data may presume that incident reports drawn from a time interval of several or more years will reflect patterns that are broadly representative of the total universe of aviation safety incidents of that type.

METHOD

A final data set of 200 incidents were selected that met the scoping criteria for the study. Eighty-four percent of these reports were submitted by instructors; sixteen percent were submitted by trainees. This reporter distribution is almost identical to that of the ASRS database for all GA dual instruction incidents.

FINDINGS AND DISCUSSION

EXTERNAL FACTORS

Our research team coded the external factors (airspace, altitude, ATC control status, flight phase) that were thought to influence communications-related events in our data set.[6]

Environment for GA Communications Incident Occurrences

A strong pattern emerged from our analysis of the environment in which dual instruction communications-related incidents occurred: Half or more of the incidents occurred within the airport environs and airspace, within 10 nautical miles of the airport, at altitudes less than 1,000 feet.

As depicted by **Figure 1**, almost half of the dual instruction events occurred in Class D airspace, with Class E airspace next in the number of occurrences.[7] This concentration of incidents within Class D airspace was not surprising, as both primary and more advanced types of instruction are airport-centered: primary instruction involves recurrent landing practice and pattern work, while more advanced flight instruction often involves approaches to an airport or related navigational aid, and takeoff/landing practice. In slightly over half of all events, the incident also occurred within a 10-nautical mile range of the airport (**Figure 2**) and at altitudes less than 1,000 feet AGL (**Figure 3**).

Figure 1. Airspace Involved

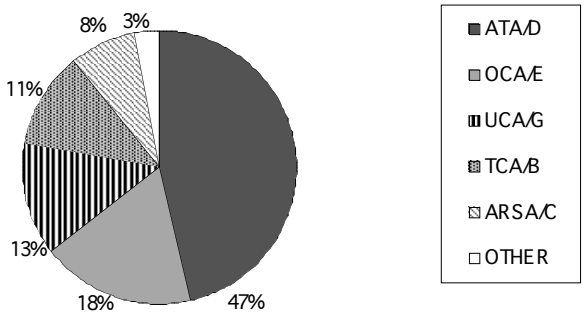
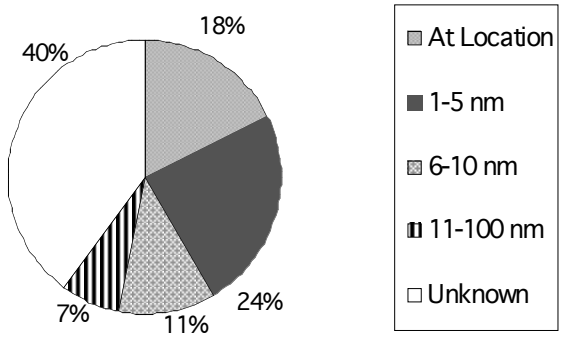


Figure 2. Distance From Airport (Miles)



Consistent with the numbers of incidents in the study set that occurred on or near airports, and at low altitudes, communications-related incidents were most prevalent during the approach/descent phases (167 citations, 47 percent) and landing phase (103 citations, 29 percent) of flight.[8] The concentration of incidents in these flight phases is doubtless due to the fact that more approaches and landings are performed in dual instruction than in other types of GA operations.

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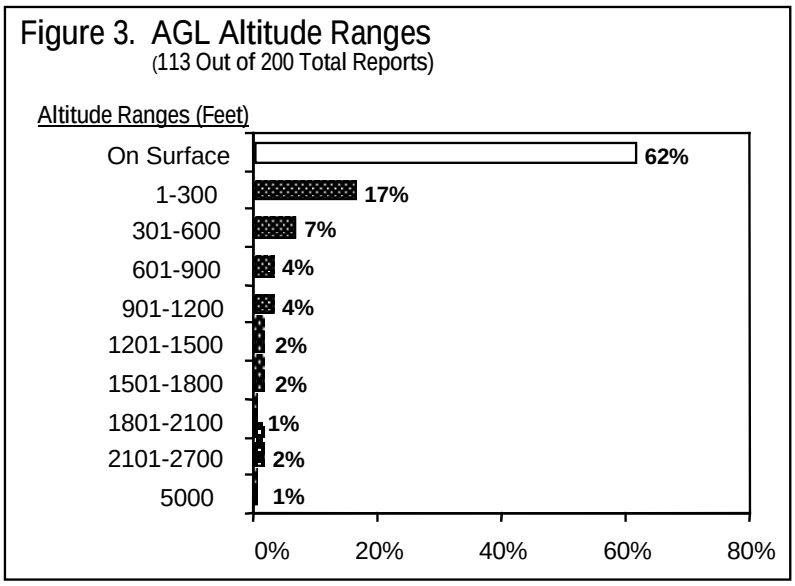
[6] A single incident occurrence reported to ASRS may involve more than one flight phase, event consequence, or type of airspace. Multiple factors of this kind in ASRS reports are referred to as *citations.* Subsequent references to these factors are therefore expressed as a percentage of total citations (which may exceed 100 percent) rather than as a percentage of total reports.

[7] There were a total of 300 airspace citations for the 200 incident reports in the data set.

[8] There were a total of 356 flight phase citations for the 200 incident reports in the data set.

Surface Versus Airborne Communications Incidents



One third of our data set (66 reports) described incidents involving aircraft operating on an airport surface, and conducting external radio communications. In our extensive experience as flight instructors, the amount of time spent *on the airport surface* in any type of dual instruction is generally small–usually 15 percent (or less) of an instructional period, even in primary instruction. The occurrence of more GA dual instruction incidents on the airport surface than expected suggests that airports may be a problematic environment for communications-related incidents.[9]

For both surface and airborne incidents that involved external radio communications, control tower communications were reported the most frequently. Of the 66 surface-based incidents, 47 (71 percent) cited communications with a control tower. Another 117 reports that involved airborne operations cited ongoing ATC communications. Of these, 52 incidents (44 percent) cited communication with towers, 39 incidents (33 percent) referenced communication with TRACONs, and 21 incidents (18 percent) cited communications with UNICOM or Centers. The prevalence of tower-communication reports in our study set reinforces the notion that effective management of instructional communications while monitoring Tower frequencies is crucial to the effective and safe conduct of dual training operations, both while on the surface and airborne.

INTERNAL FACTORS

All reports included in our study set were classified into broad groupings of verbal communication anomalies that occurred within the cockpit. Drawing on explicit references from the study reports, we classified the types of instructor/trainee statements, determined whether these statements were heard by the intended recipient, and evaluated the timeliness and appropriateness of responses these statements elicited. Additionally, we sought to identify the equipment and task or workload-related (operational) factors which played material roles in the events.

Cockpit Communications Anomalies

Figure 4 depicts the leading instructor communications anomalies, the leading trainee communications anomalies, and the three most frequently occurring *combinations* of instructor/trainee verbal interaction problems.

Confusing, erroneous, or misleading statements were the leading type of instructor communications anomaly (30 percent of citations).[10] Delayed or withheld communications by instructors were the next

[9] To provide a context for this study finding, we searched for statistics on the numbers of total GA ground operations that occur daily and/or annually in the U.S. We discovered that the Boeing Company has done a study for insurance purposes of the amount of time an air carrier aircraft spends on the ground in maintenance. However, we were unable to find comparable data on the numbers of GA ground operations for any time period.

most frequent instructor anomaly (16 percent of citations), and a leading cause of delayed or inappropriate actions on the part of trainees. It is a common technique of flight instructors to allow the trainee to make mistakes in an attempt to develop independent actions and observe the trainee's level of awareness. However, especially during IFR operations, or when compliance with an ATC directive is doubtful, corrective verbal comments by the instructor have a significant impact on flight safety.

Top Three Combinations of Communications Anomalies

1. Instructor made confusing or misleading statements ***and*** trainee delayed action or acted inappropriately
2. Instructor heard but misinterpreted intra-cockpit coms ***and*** trainee delayed action or acted inappropriately
3. Instructor withheld or delayed comment ***and*** trainee delayed action or acted inappropriately

Figure 4. Cockpit Communications Anomalies

Regardless of the type of communications anomaly displayed by instructors, the effect on trainees most often was a delayed or inappropriate verbal or control response (39 percent of citations). Several reports indicated a lack of assertiveness on the trainee's part, and a failure to challenge the instructor even when the trainee believed the instruction was wrong. The following study report excerpt exemplifies how confusing and vague communication by both instructor and trainee can result in a safety incident:

> *Instructor said...'Uh, you can have control if you, uh, want it.' I probably replied 'OK' rather than the usual 'I have control.' I began to pull the nose up slowly when I thought I felt my instructor push forward on the wheel [and] relaxed...Nosewheel touched down first and we bounced...Fortunately we walked away...with an undamaged aircraft. 'Wishy washy' coms played a major role in this.* (ASRS Record #240165)

Communications Equipment Factors

We expected that a number of reports in the study set would describe problems with onboard communications equipment that contributed to incidents. One in five reports (21 percent) did identify such problems. The most frequently reported problems involved malfunctioning or improperly operated headsets, microphones, and installed radios. The following instructor's report illustrates both a pilot-induced headset problem, and a preoccupation with training that led to complete lack of situational awareness:

> *We had started flying using headsets, with the radios being monitored through the headsets. After the first landing the student stated he would prefer to continue without the headsets as he didn't feel comfortable wearing them. I said OK. We got involved in doing touch and goes (5) and I failed to notice that we had not heard from Tower during this time. When I did notice that the speaker button was not in the proper position, I made contact with the Tower. They (Tower) terminated the flight and I was instructed to call the Tower.* (ASRS Record #290210)

[10] 192 out of 200 reports (96 percent) described one or more communications anomalies that occurred within the cockpit during flight (as opposed to preflight, or post-tiedown, communications anomalies).

Operational Factors

In addition to our analysis of cockpit communications anomalies, we examined the types of operational factors that were present during dual flight training, and identified the leading *combinations* of factors associated with incident occurrence. We found that instructor critiques during ongoing maneuvers were the most frequent operational pattern (27 percent of citations), closely followed by maneuvers during ongoing communications with Tower (26 percent), and instructor critiques during ongoing Tower communications (20 percent of citations). The following description of a wrong-runway takeoff illustrates how an instructor's perception of task priority may have been distorted by the desire to critique the student:

> *We took off on [runway] 24 instead of 30, as the Tower subsequently informed us. As I reviewed the event later, with my student and in my own mind, I realized how I may have added to the uncertainty. I was busy pointing out airport markings and critiquing the flight to this point. The priority should have been communications with the Tower and standard procedure.* (ASRS Record #137322*)*

EVENT CONSEQUENCES

More than three-fourths of all the GA communications incident citations involved some ATC-related infraction or violation of FARs. Most often this was non-compliance with a clearance (51 percent of citations), but more than a third of all citations also involved clearance-related ground hazards, such as runway incursions (22 percent) and ground conflicts (10 percent). Aircraft damage was reported in 13 percent of citations.

Although the study's report selection criteria had required that there be direct reference to verbal communications between instructor and trainee, no such requirement existed regarding ATC communications. The large number of ATC-related consequences was therefore unexpected. We believe that the high incidence of missed ATC clearances in the study set, and reporters' failure to comply with various clearance requirements, directly relate to several other patterns observed in the data: (1) the concentration of dual instruction incidents on or near airports, especially tower-controlled airports with their demanding communications requirements; and (2) the operational context in which dual instruction often occurs, specifically, the simultaneous occurrence of internal verbal or external radio communications with aircraft maneuvers and demonstrations.

It is clear that the dual instruction places heavy demands on the attention management and communications skills of both instructor and trainee, and that lapses in concentration may result in reduced situational awareness and safety consequences.

SUMMARY AND CONCLUSIONS

General Aviation flight instruction presents an environment with unique external and intracockpit communications requirements. This research identified key communications factors that contributed to incidents in the study set. The research team also developed some possible approaches to resolving the communications problems identified.

Almost half of all communications-related dual instruction incidents occurred within, or near, an airport environs, at an altitude less than 1,000 feet AGL. Ongoing communications with Tower were a prominent element of both ground and airborne incidents.

- ✓ In preflight briefings and ground instruction, instructors may wish to raise trainees' awareness that airport surface operations are vulnerable to safety incidents during dual instruction. They should also consider emphasizing the importance of standard phraseology in communications with ATC, and the active monitoring ATC frequencies–especially tower frequencies.

Trainees often delayed actions or acted inappropriately because instructors made confusing or misleading comments; misinterpreted trainees' comments; or delayed or withheld feedback on maneuvers.

- ✓ Our study data suggest the need for additional curriculum and training to improve the *clarity*, *economy*, and *judgment of priority* of verbal communications in dual training, especially for flight instructors. Trainees need to be able to express doubt or uncertainty, and also to admit mistakes. But it is also helpful for instructors to remember that every word counts–as well as the timing of training-related critiques. For example, it is more effective for an instructor to say "turn left 90 degrees," than to ask, "where are you going?" as the aircraft enters controlled airspace without a required clearance.
- ✓ Instructors should consider delaying critiques until after tiedown, whenever possible. This will allow maximum attention to be given to other aircraft operations, compliance with taxi clearances, runway and taxiway markings and signs, pedestrian activity (at non-tower fields), and aircraft equipment operating procedures. Instructors may make summary notes in-flight for use in post-flight debriefings. These notes may be reviewed prior to the next lesson's flight to reinforce instructional focus.

One in five study reports noted problems with communications equipment that contributed to the incident.

- ✓ The detection during preflight of aircraft equipment problems, especially with "renter installed" communications equipment such as intercoms and push-to-talk switches, can serve as a caution to delay the flight until qualified assistance can be found to ensure normal operation.
- ✓ Instructors may want to establish specific radio usage procedures to ensure that volume levels for ATC communications are louder than intercom volume levels, and that radio equipment is operating normally with periodic equipment tests (i.e., "radio checks").
- ✓ To enable quick recognition of external communications problems (i.e., stuck mike or volume level misset), an instructor may minimize intracockpit communications, especially at controlled airports during pattern operations.

A large majority of all incidents involved non-compliance with ATC clearances, or other ATC-related infractions and violations.

- ✓ In order to advise ATC and other aircraft of the instructional nature of a flight, the word "trainer" (e.g., Cessna *trainer* 54321) may be added to flight plans and radio broadcasts. The use of "trainer" can also serve as an attention cue that helps guard against missed clearances and readbacks. ATC already employs enhanced callsigns with suffixes such as /R (RNAV) and /H (Heavy).

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