Picture This

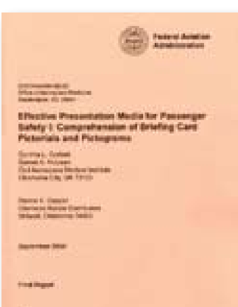
Illustrated safety briefing cards score poorly for comprehension.

REPORTS

Cabin Safety's Image

Effective Presentation Media for Passenger Safety I: Comprehension of Briefing Card Pictorials and Pictograms

Corbett, Cynthia L.; McLean, Garnet A.; Cosper, Donna K. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-08/20. Final report. September 2008. 58 pp. Figures, tables, references, appendixes. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2000s/media/200820.pdf> or from the National Technical Information Service.*



A picture is supposed to be worth a thousand words, but apparently not on passenger safety briefing cards, according to this study of comprehension.

U.S. Federal Aviation Regulations require airlines to give safety briefings and provide briefing cards to explain routine and emergency safety procedures to passengers. "The exact content and presentation media used for safety briefings and cards [aboard] transport airplanes are the responsibility of the airlines to implement, as long as the minimum safety information required by the FAA is delivered," the report says. The researchers cite several other studies showing that passenger attention to safety information is "waning" and that "many of the deficits in passenger knowledge of aviation safety information continue to prevail."

One study by the Australian Transport Safety Bureau using focus groups to evaluate safety briefing cards found that "effectiveness of the safety cards reportedly suffered from excessive graphical clutter, overly complex drawings and overly simplistic illustration, considered unrealistic or unclear."

In a further effort to test passenger comprehension of pictorial instructions, this study's researchers recruited 785 participants from high schools, government offices, cabin safety workshops and the SAE Cabin Safety Provisions Committee. The participants were about evenly distributed by gender and ranged in age from 15 to 63, with educational levels from current high school attendance to doctoral graduates. About 47 percent had taken between zero and two flights in the previous two years, and about 19 percent had taken more than 13 flights. Participants included some active-duty flight attendants.

Pictorials and pictograms selected from safety briefing cards currently used by airlines, as well as symbols approved by the American National Standards Institute (ANSI) and commonly found in buildings and transportation, were presented to participants in open-ended question format. The ANSI symbols were included to provide researchers with an estimate of subjects' general "symbol literacy."

The test booklet presented, for example, a series of illustrations showing oxygen masks dropping, a woman placing one over her nose and mouth, and then helping a child seated next to her to don a mask. The booklet said, "Fully describe what you think the counter [indications of elapsed time, in seconds, in successive drawings] is telling you? Why do you think it is important?"

Comprehension responses for each participant were graded for correctness, categorized as "certain," "likely," "arguable," "suspect," "opposite," "wrong," "none" — meaning the response was "don't know" — and "blank" — no response. "Categorized responses were then transformed, using a weighting algorithm, to yield pictorial/pictogram comprehension scores," the report says. "Pictorial/pictogram comprehension scores were further analyzed with respect to subject demographics, particularly gender, flight history, and cabin safety procedures knowledge and experience."

The results confirmed those of the earlier studies cited. Comprehension scores ranged from 28.8 percent to 96.3 percent, averaging 65 percent. Two international organizations with acceptability criteria for pictorial/pictogram information are the International Association for Standardization (ISO) and ANSI. Even with experienced travelers and aviation professionals among the participants, 45.8 percent of the scores satisfied the ISO acceptability standard and only 8.3 percent met the ANSI criteria. In comparison, the average "symbol literacy index" was 75 percent.

"Comprehension scores based on the individual question(s) for each pictorial/pictogram ranged from 28.8 percent [for 'flotation device usage'] to 96.3 percent [for 'no smoking in the lavatory']," the report says. Composite scores, derived from a combination of the responses to individual questions about the particular pictorial/pictogram, ranged from 39.8 percent ("warning") to 85.3 percent (for "seat belt usage").

Correlations among demographic variables were related to the "progressive expertise associated with advancing age, education and number of flights," the report says. No gender differences were found.

"The test booklet questions … received a wide range of responses, especially for pictorials that contained multiple elements and/or multiple actions," the report says. "The variety of responses was also greater for pictograms in which serial actions were not tightly linked pictorially. Participants also missed specific details in certain pictorials, especially when the details were not the main focus of the intended message. Often such details would only be identified by those who were not the main focus of the intended message."

Cabin safety specialists are, thus, faced with a paradox: Illustrated briefing cards are best understood by frequent fliers who have the least need for them. The report says, "The results indicate that safety briefing card pictorials/pictograms need to be designed and implemented with respect to novice passengers, i.e., those who do not have [greater] understanding of the design and operation of transport aircraft, emergency equipment and/or aircraft emergency procedures."

Safety briefing cards would benefit from "well-known educational principles and instructional techniques from outside aviation, whether produced by professional graphics designers or in-house airline cabin safety professionals," the report says. It also warns against a problem familiar to anyone who has tried to puzzle out furniture assembly or advanced audio and video equipment instructions, produced by an "expert system" in which the designers cannot put themselves in the place of the non-expert.

"Excessive graphical clutter, overly complex drawings and overly simplistic illustrations considered unrealistic or unclear suggest a reliance on briefing card designers who know the information so well that their attention naturally focuses on the elements that best portray the message and disregards information or structure that detracts," the report says. "Failure to test the comprehension of briefing card materials adequately obscures such shortcomings."

Illustrated briefing cards are best understood by frequent fliers who have the least need for them.

Although briefing cards are designed to be understood without reference to any particular language, the report says that some additional text would "focus attention, highlight concepts and simplify complex pictorials/pictograms." In addition, "standardization of validated safety briefing card information and presentation methods across the airline industry would provide not only a well-founded, consistent safety message, but also a degree of familiarity and, therefore, comprehension never before seen."

The Long and the Short of It

Analysis of Aircraft Overruns and Undershoots for Runway Safety Areas

Hall, Jim; Ayres, Manuel Jr.; Wong, Derek; et al. Washington, D.C.: Transportation Research Board of the National Academies, Airport Cooperative Research Program (ACRP) Report 3. 59 pp. Figures, tables, references, list of abbreviations. Available via the Internet at <onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_003.pdf> or from the Transportation Research Board of the National Academies.**

The report covers four areas:

- Research on accident/incident data for runway overruns and undershoots;
- An inventory of conditions related to each event;
- An assessment of risk in relation to the runway safety area (RSA); and,
- Discussion of alternatives to the traditional RSA.

"The traditional approach to mitigate risk associated with accidents or incidents is to enlarge the runway safety area, but many airports do not have sufficient land to accommodate standard [U.S.] Federal Aviation Administration or International Civil Aviation Organization recommendations for RSAs," says Michael R. Salamone, staff officer of the Transportation Research Board, in the foreword. "Airports that pursue this approach face extremely expensive and controversial land acquisition or wetlands filling projects to make sufficient land available."

The report uses a probabilistic assessment of the efficacy of the standard 1,000-ft/300-m RSA and looks at alternative possibilities for mitigating the risk of overruns and undershoots. "The report also assesses the factors that increase the risk of such accidents occurring, helps with understanding how these incidents may happen and suggests that aircraft overrun and undershoot risks are related to specific operational factors," Salamone says.

As derived from a database of 459 accidents and incidents, about 60 percent were landing overruns and 20 percent each were landing undershoots and takeoff overruns. Factors associated with the accidents and incidents, described as "anomalies," were categorized as aircraft system fault; wildlife hazards; weather conditions; human errors; runway surface conditions; and approach/takeoff procedures. These basic categories were themselves subdivided.

It was found that for landing overruns, the most frequent anomalies were contaminated and wet runways, sometimes in combination. "For contaminated runways, ice was the most predominant contaminant in the accidents and incidents evaluated," the report says. "Three additional factors with high incidence for landing overruns are long touchdown, high speed during the approach and the presence of rain."

In landing undershoots, the most frequent anomaly was low visibility, followed by rain, particularly for the accidents. Gusting conditions were also common. "As expected, approaches below the glide path are an important anomaly for this type of event," the report says. "Visual illusion was a significant factor only for landing undershoots."

Rejected takeoffs at high speeds led to the most takeoff overrun accidents and incidents. "The second most important anomaly was incorrect planning, such as aircraft overweight, short takeoff distance available and incorrect load distribution in the aircraft," the report says. "Basically, the factors are equally frequent for accidents and incidents, except for the presence of rain, gusting and crosswind conditions," the report says. "These were more important for accidents."

Aircraft system faults were found most frequently in takeoff overruns, showing up in 51 percent of incidents and 33 percent of accidents. They were least frequent in landing undershoots. Wildlife hazards were rare in any category, and absent in landing overruns. They were found in 5 percent of takeoff overrun accidents and an equal percentage of incidents.

The report calculates average costs for the types of accidents. "Most of the cost for landing overruns is attributed to loss of property or aircraft damage," it says. "On the other hand, loss of dollars due to injuries is significantly higher for landing undershoots, most likely due to the high speed and energy during these accidents."

Using mathematical models, the report "introduces a more comprehensive approach to evaluate the degree of protection offered by a specific RSA, and provides a risk-based assessment procedure that is rational and accounts for the variability of several risk factors associated with aircraft overruns and undershoots. In addition, this study provides risk models that are based on comprehensive evidence gathered from aircraft accidents and incidents in the United States and other countries. Information gathered from these events has been organized into a database that may be used for future studies on airport risk assessment."

Say Again

Pilot English Language Proficiency and the Prevalence of Communication Problems at Five U.S. Air Route Traffic Control Centers

Prinzo, Veronika O.; Hendrix, Alfred M.; Hendrix, Ruby. DOT/FAA/AM-08/21. Final report. October 2008. 32 pp. Figures, tables, references, appendixes. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2000s/media/200821.pdf> or from the National Technical Information Service.*

The report describes a study aimed at determining the degree to which deficits in English-language ability contributed to communication problems during a six-month period at five U.S. air route traffic control centers.

"Unlike readback errors and requests for repeats, communication problems that involved a breakdown in communication may require multiple exchanges between the pilot and controller before the problem is identified, understood and resolved," the report says. At worst, communication breakdown can pose a safety threat ("Language Barrier," *ASW*, 8/08, p. 41). But even without any immediate risk such as loss of separation, the extra effort required for clarification can take up controller and pilot time and attention that could be better used.

The report gives this example of a communication breakdown between a pilot and air traffic control (ATC):

ATC: "[Name] fifty, can you accept Runway two seven right full length, affirmative or negative?"

Pilot: "Be back, uh, [Name] fifty heavy."

ATC: "[Name] fifty heavy, I'm sorry, was that affirmative or negative for two seven right full length?"

[Pilot] "Negative, [Name] fifty heavy."

[ATC] "Okay, uh, one more time, sir, affirmative or negative, I'm missing part of your transmission."

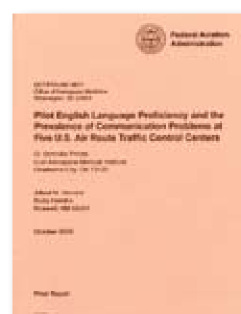
[Pilot] "Negative, [Name] fifty heavy, we cannot accept."

[ATC] "You cannot accept, negative, okay, thank you."

This exchange required seven transmissions in total during the busy approach phase of flight and while the controller might have been arranging the arrival of several aircraft. Neither the question nor the answer was especially complex; the extraneous effort resulted from poor understanding of the other's speech by one or both parties.

Communications were analyzed from 832 aircraft, of which 74 percent were operated by U.S.-based airlines. Aircraft call signs were used to identify transmissions by aircraft registry — U.S. and non-U.S. — and the official language of the country of registry — English or non-English. Communications therefore fell into three classifications: U.S.-English, non-U.S.-English or non-U.S.-other.

"The communication problems were classified into three major categories: readback errors, requests for repeat and breakdowns in communication," the report says. "For U.S.-registry aircraft transactions with one communication problem, 51 percent involved readback errors, 34 percent requests for repeat and 15 percent breakdowns in communication. In contrast, 23 percent of the [non-U.S.]-registry aircraft transactions with one communication problem were readback errors, 62 percent were requests for repeat and 14 percent involved breakdowns in communication. Of the transactions with multiple problems, more than 75 percent involved [non-U.S.]-registry aircraft."



In 64 percent of the readback errors made by pilots in the non-U.S.-other category, their accented English made it difficult for the controller to understand what was being said. "Of the

transactions involving a breakdown in communication, runway assignment and route clearance transactions were especially problematic for the pilots of [non-U.S.]-other registry aircraft," the report says. "The problem may be partially due to controllers' and pilots' use of plain language and the pilots' pronunciation and fluency. Notably, accent affected the intelligibility of 40 percent of the pilots' messages."

The report says that "when the registry of an aircraft was [non-U.S.] and its primary or official language was not English, not only did pilots spend more time communicating with ATC, they also exchanged more transmissions and had more communication problems in their transmissions. The additional pilot messages may have resulted from attempts to resolve some of the communication problems. In these situations, a pilot's English language proficiency — especially his/her accent — often resulted in the controller not being able to completely understand what the pilot was attempting to say."

Proficiency in English beyond the minimum specifications in the ICAO language proficiency scales "must be realized if communication problems are to decline," the report says.

WEB SITES

The School of Experience

Lessons Learned From Aviation Accidents Library, <accidents-ll.faa.gov>

The U.S. Federal Aviation Administration (FAA) recently launched an "online safety library that teaches 'lessons learned' from some of the world's most historically significant transport airplane accidents."

For the online library's introductory phase, the FAA identified 11 major accidents from 1959–2002 that "made an impact on the way the aviation industry and the FAA conduct business today." More accidents that shape policy will be added to the online library annually.

The Web site's introduction explains that accidents are arranged in predefined groups or "perspectives" to "illustrate the complex interrelationship of accident causes" — airplane life cycle, accident threats and accident common themes. For example, the "accident common themes" group identifies accidents by human error, flawed assumptions, unintended effects, pre-existing failures and organizational lapses.

Each accident entry contains links that open windows to specifics: an overview; a summary of the accident investigation report and a link to the full report; the accident report's recommendations; relevant regulations; cultural and organizational factors; unsafe conditions; safety assumptions; precursors; resulting regulatory and policy changes; resulting airworthiness directives; lessons learned; common themes; and a list of related accidents. Entries may contain graphics, photographs and links to Internet sites with additional information.

Researchers can locate accidents by reviewing the predefined groups, using the Web site's search/sort feature or selecting from lists on the site map. In addition to a list of all accidents in the database, the site map contains a list of videos and animations of accidents. Videos and animations with audio and audio transcripts explain causes and contributors. Two examples are an animation comparing the Air Florida Flight 90 takeoff in icing conditions from National Airport, Washington, D.C., to a normal takeoff on the same runway; and an animation and explanation of the fire that developed and spread on British Airtours Flight KT28M at Manchester Airport, England.

The Web site contains technical information for downloading and viewing. Contact information for submitting questions and comments is also provided.

Sources

* National Technical Information Service <www.ntis.gov>

** Transportation Research Board <www.national-academies.org/trb/bookstore>

— Rick Darby and Patricia Setze