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Studies Reveal Passenger Misconceptions About Brace Commands and Brace Positions

Many study participants were unaware of what command to expect before assuming a brace position. Some participants had inappropriate concepts of the proper brace position. These findings may be related to the lack of specific communication provided to passengers in preflight oral and videotape briefings, and on safety-information cards.

—
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Unanticipated survivable accidents on landing or takeoff provide little or no time to give passengers special instructions regarding brace positions. Yet passengers who assume a correct protective brace position have less likelihood of being injured during impact.

The U.S. National Transportation Safety Board (NTSB) identified several accidents in which passengers who were in brace positions sustained significantly less severe injuries than other passengers.¹

One of the accidents involved a de Havilland Canada Twin Otter, carrying 16 passengers and two crewmembers.² The aircraft struck terrain during a nonprecision instrument approach in instrument meteorological conditions. Most of the passengers were sleeping or reading and had no warning of the impending accident. One passenger, a 16-year-old male seated toward the rear of the cabin, awoke, looked out a cabin window and saw that the aircraft was going to strike trees.

The passenger immediately lowered his head and braced his arms and knees against the seat back in front of him. He suffered a fractured leg and wrist, and a scalp wound when his



seat broke loose from the floor during the impact sequence. He was the only survivor.

One NTSB recommendation prompted by the accident was for air carrier-passenger preflight briefings to include reference to the appropriate emergency brace position.

The value of proper bracing in accident survival recently was reaffirmed by the European Transport Safety Council (ETSC). In a report identifying impact-protection improvements that have considerable lifesaving potential, the ETSC recommended that three-point lap-and-shoulder

harnesses, rather than standard lap belts, be provided for passengers.

The ETSC said, "If all passengers assumed the brace position prior to impact, the additional benefits of a three-point shoulder harness would be small.

"In reality, however, for a variety of reasons, occupants generally do not assume a proper brace position, so a three-point lap-and-shoulder harness would be likely to improve occupant protection substantially."³

Two actions are needed to ensure that passengers will assume the best protective position:

- They must be told to assume a protective position; and,
- They must know the correct protective position for their seat location.

Passengers hear various commands. In a recent study,⁴ several airlines were asked what commands their crewmembers would give passengers before an impending landing accident. Common responses were: “brace”; “head down, stay down”; and “grab your ankles.”

One airline said that the cockpit crew would give the command “brace,” while the cabin crew would give the command “head down, stay down.”

Commands that passengers expect to hear vary. In another study,⁴ a briefing card was shown to 84 adults and they were asked what command they would expect to hear when ordered to assume one of the protective positions. The results are in Table 1.

**Table 1
Expected Commands to Assume a Protective Position in Aircraft Emergency**

Expected Command	Number (%)
“Get into an emergency [or crash] position”	44 (52)
“Head down”	14 (17)
“Lean forward” or “crouch forward”	8 (10)
“Brace”	6 (7)
“We’re going to crash” or “We’re going down”	4 (5)
No idea what command to expect	3 (4)
“Assume proper position”	2 (2)
Other	3 (4)
Total	84

Source: Daniel Johnson

Although “brace,” “head down, stay down” and “grab your ankles” are the only commands the contacted airlines train their crewmembers to give, only 24 percent of the 84 respondents said that they would expect to hear “head down” or “brace.” None said that they would expect to hear “grab your ankles.”

Thus, the commands that passengers expect to hear and the commands that crewmembers are trained to give apparently are not the same.

Passenger expectations vary when the command “brace” is given. Another study explored what emergency condition passengers would believe existed if crewmembers told them to “brace.” Two interviewers questioned a total of 51 people.

Among the 51 respondents, 34 (67 percent) flew regularly as passengers. These relatively experienced passengers had flown an average of five flights in the two years preceding the survey. The experienced group included 21 men (62 percent) and 13 women (38 percent), with an average age of 32 years.

The 17 respondents (33 percent) who were relatively inexperienced airline passengers included 14 men (82 percent) and three women (18 percent), and had an average age of 45 years.

An interviewer told each respondent the following:

“Assume that you are in an aircraft coming in for a landing. It’s nighttime, and you can’t see anything outside. There are other passengers aboard, but you are not traveling with any friends or relatives. You are near the ground but still in the air when you suddenly hear over the loudspeaker the command ‘brace, brace!’ Describe what you think is happening.”

As shown in Table 2, about 70 percent of the respondents said that they thought a crash landing was about to occur. Among the other respondents, about half said that they thought either turbulence or a bumpy landing was about to occur, and half said that they were not sure what was happening.

**Table 2
Perceived Emergency Condition upon Hearing “Brace” Command**

Expected Condition	Experienced Number (%)	Inexperienced Number (%)	Total Number (%)
Crash landing	26 (76)	10 (59)	36 (71)
Turbulence	3 (9)	1 (6)	4 (8)
Bumpy landing	2 (6)	1 (6)	3 (6)
Unsure/other	3 (9)	5 (29)	8 (16)
Total	34	17	51

Source: Daniel Johnson

Thus, approximately 30 percent of the respondents would not have realized, if the command “brace” were given, that an emergency landing or an accident was about to occur.

Knowledge of appropriate brace positions varies. The 51 respondents then were shown a side view of three empty seats placed front to back, with a bulkhead in front of the most-forward seat. They were asked to imagine that they had boarded an aircraft and had not looked recently at a safety video or briefing card showing protective positions. They were asked to draw the positions that they would try to assume if they were in the front seat with the bulkhead directly in front of them; in a seat with another seat directly in front; and in any of the seats and holding an infant.

The respondents were told that drawing a stick figure — showing head, arms, trunk and legs — would be adequate. The interviewers discussed the completed drawings with each respondent to ensure that the interviewers understood what was depicted.

The appropriateness of the brace positions depicted in the drawings then was judged using the following criteria:

- A drawing was judged appropriate if the depicted position corresponded with one of the two brace positions included in an industry standard developed by the Society of Automotive Engineers (SAE).⁵ One of these positions shows an adult bent forward at the waist, with hands around or under the legs, and feet planted firmly on the floor beneath the knees (Figure 1). Acceptable variations for this study included having the hands in front of the legs, or over or in front of the head (Figure 2). The other SAE position shows the adult's head against the arms and the arms against a seat back or bulkhead. (There was no requirement for the drawing to show a seat belt.)
- A drawing was judged to be inappropriate if the figure was sitting upright or had the arms and/or legs extended straight out (Figure 3, page 4). Some respondents drew figures crouching on the floor or kneeling on the seat facing aft; these drawings also were judged to be inappropriate.
- For drawings of an adult holding an infant, a position judged appropriate *for purposes of this study* required only that the adult be bent forward and that the infant be held on the adult's lap (Figure 4, page 4). Acceptable variations included having the adult's arms around the infant, under the adult's legs or folded over the adult's head. (An unrestrained infant cannot be held safely in

many accidents. Because infants are allowed to travel unrestrained in air carrier aircraft, however, some positions are safer — at least for the adult — than others.)

The results are shown in Table 3, page 4.

A greater proportion of the experienced passengers among the respondents drew positions for the three seat conditions that were judged appropriate than did the respondents who were inexperienced passengers.

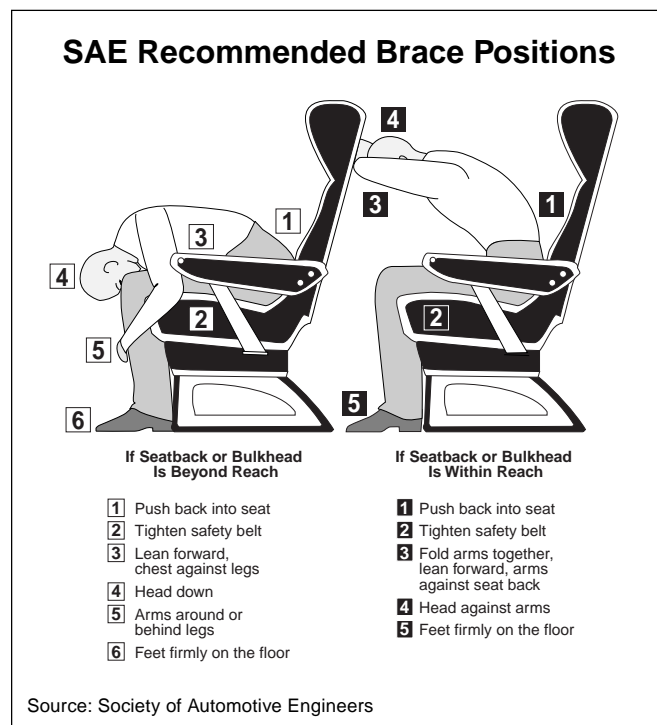


Figure 1

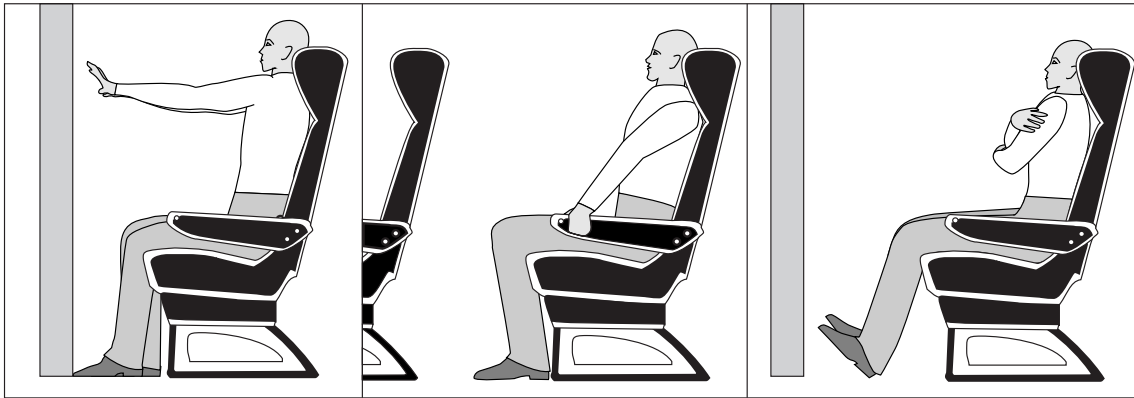
Representations of Test Subjects' Illustrations Of Brace Positions Judged to Be Appropriate



Source: Daniel Johnson

Figure 2

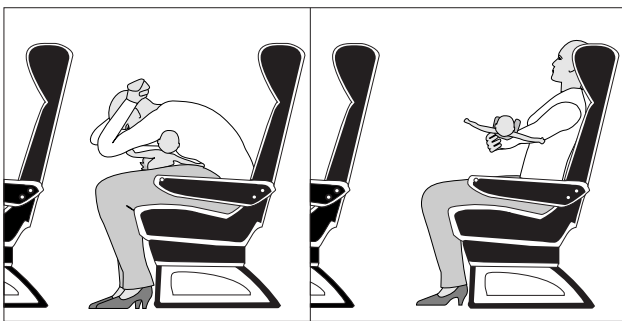
Representations of Test Subjects' Illustrations Of Brace Positions Judged to Be Inappropriate



Source: Daniel Johnson

Figure 3

Representations of Test Subjects' Illustrations of Brace Positions of Adult Holding Infant



Note: An unrestrained infant cannot be held safely in many accidents. For test purposes, the illustration at left was judged appropriate because it provides some protection for the adult; the illustration on the right was judged inappropriate.

Source: Daniel Johnson

Figure 4

The percentages of experienced passengers' drawings judged appropriate were: front seat, 53 percent; other seat, 59 percent; and infant-in-arms, 44 percent. The percentages of inexperienced passengers' drawings judged appropriate were: front seat, 29 percent; other seat, 41 percent; and infant-in-arms, 18 percent.

Statistical (chi-square) analysis showed that the difference in the proportions of appropriate drawings by the experienced and the inexperienced passengers was not significant. Thus, the experienced passengers apparently did not learn more or remember more than the inexperienced passengers about the appropriate brace position for any of the seat conditions.

Only about half of the respondents drew an appropriate brace position for any of the three conditions.

One limitation of these studies is that what people say they would do in a situation is not necessarily what they actually would do, especially if there are physical or time constraints limiting their intended actions. A few respondents said that they would huddle on the floor or kneel over an infant on the seat — actions that time probably would prohibit.

The study did not account for the effect of actions by others on an individual's behavior. For example, respondents who said that they would do nothing after hearing the command "brace" actually might imitate passengers who were in a brace position.

After taking these limitations into account, however, the following conclusions may still be drawn:

- Crew commands to assume a brace position during an unanticipated accident on landing or takeoff are not always the commands passengers would expect to hear.

Table 3
Correctness of Brace Position Drawings

	Front Seat Number (%)	Other Seat Number (%)	Infant- In-arms Number (%)
Correct	23 (45)	27 (53)	18 (35)
Upright (Incorrect)	15 (29)	19 (37)	21 (41)
Other (Incorrect)	2 (18)	1 (2)	2 (4)
No Idea (Incorrect)	4 (8)	4 (8)	10 (20)
Total	51	51	51

Source: Daniel Johnson

Expected commands are probably more easily understood than unexpected commands;

- One-third of the respondents indicated that the command “brace” does not communicate the message that an accident with possible impact forces is imminent. Whether other commands such as “head down, stay down” or “grab your ankles” would be more effective is questionable; and,
- Only about half of the protective positions drawn by respondents were judged to be appropriate. Some of the other drawings depicted positions — such as getting out of the seat — that would put the passengers at greater risk. The most common unsafe position depicted was sitting upright rather than bent forward. One person stated emphatically that placing one’s head against a stationary object such as a bulkhead or seat back would be unsafe. The reason for this misconception is not clear; perhaps it arises from equating aircraft travel to motor-vehicle travel, where sitting upright is an approved behavior. This body position, however, is unsuitable for air carrier travel because of the lack of shoulder harnesses and air bags in aircraft cabins.

Uncertainty regarding the appropriate brace position may result from the following communication problems:

- Flight attendants generally do not refer to the brace position in their preflight briefings;
- Some preflight safety videos do not depict the protective positions. Videos that do show the appropriate positions often fail to mention the command that passengers will hear; and,
- Although most passenger-safety-information cards show at least one protective position, they do not tell passengers what command they will hear.

An industry-wide effort should be made to increase passenger understanding of when and how to assume effective protective positions.

The first task is to standardize a protective-position command that is readily understandable and easy to follow. Commands such as “grab your ankles” may be easy to understand but difficult to follow because of cabin space limitations. The command “brace” is ambiguous. The command should be

Postaccident U.K. Research Yields Recommended Passenger Brace Position

Cabin Crew Safety presented a 1995 report by the U.K. Civil Aviation Authority (CAA) that recommended a brace position that reduces the potential for the passenger’s arms and legs to flail during impact.⁶ The recommended brace position came from research commissioned by the CAA after an accident involving a Boeing 737-400 on Jan. 8, 1989.

The B-737, operated by British Midland Airways on a scheduled flight from London to Belfast, was climbing through 28,300 feet when one fan blade in the no. 1 engine separated and damaged the engine. The engine began to surge and vibrate. The flight crew mistakenly shut down the no. 2 engine and then diverted to East Midlands Airport in Kegworth, England.

“The shuddering caused by the surging of the no. 1 engine ceased as soon as the no. 2 engine was throttled back, which persuaded the crew that they had dealt correctly with the emergency,” said the U.K. Air Accidents Investigation Branch (AAIB). “The no. 1 engine operated apparently normally after the initial period of severe vibration and during the subsequent descent.”

The B-737 was 2.4 miles (3.8 kilometers) from the runway when the no. 1 engine lost power. The aircraft struck the ground short of the runway and then underwent a second, major impact on a highway embankment. Of the 126 occupants, 39 were killed in the accident, eight died later from their injuries, 74 survived with serious injuries and five sustained minor or no injuries.

The investigation revealed that the positions the passengers were in during the initial impact appeared to have had a significant effect on the type and severity of their injuries. Many passengers were seriously injured when their legs flailed against seat backs and luggage-restraint bars.

Based on research performed after the accident, the CAA provided the following description of the recommended brace position for passengers in forward-facing seats aboard large airplanes:

- “UPPER BODY: Should be bent forward as far as possible with the chest close to the thighs and knees, with the head touching the seat-back in front. The hands should be placed one on top of the other and on top of the head, with the forearms tucked in against each side of the face. Fingers should not be interlocked.
- “LEGS: The lower legs should be inclined aft of the vertical [that is, angled behind the knee joints] with the feet placed flat on the floor.”

The CAA also recommended that passengers wear their seat belts as tight as possible and as low on the torso as possible.♦

— FSF Editorial Staff

directive (“lean forward, head down, stay down,” for example). The command should be tested to determine whether passengers will understand it.

The command should be printed on safety-information cards and presented in passenger-safety videos.

Finally, flight attendants should instruct passengers to read the passenger-safety cards and the information on protective positions, as recommended nearly two decades ago by the NTSB.♦

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About the Author

Daniel Johnson began his professional career in 1967 at Douglas Aircraft Co., where he performed research on passenger behavior in emergency situations, including land and water evacuations, cabin decompressions and turbulence upsets. His interviews of accident survivors and laboratory research contributed to a greater understanding of behavioral inaction (“freezing” or “negative panic”), a phenomenon in which people remain in their seats after an accident and do nothing to save themselves. Johnson has written many articles and a book on aircraft-passenger safety (Just in Case, Plenum Publishing, New York, New York, U.S.). His company, Interaction Research Corp., Olympia, Washington, U.S., designs, tests and produces safety cards for corporate, domestic and international operators.

Johnson earned a doctorate at Claremont Graduate School and has taught statistics at Pepperdine University and human factors and safety at the University of Southern California. He is a licensed psychologist and a certified professional ergonomist.

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