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AN INVESTIGATION INTO METHODS OF BRIEFING PASSENGERS AT TYPE III EXITS

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AN INVESTIGATION INTO METHODS OF BRIEFING PASSENGERS AT TYPE III EXITS

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Abstract

Cranfield University was commissioned by the Safety Regulation Group of the UK Civil Aviation Authority (CAA) to identify whether an additional specific briefing for those passengers occupying seats adjacent to Type III exits would be both advantageous and operationally practicable. Specifically, it was intended to obtain data to indicate whether variations in exit briefing influenced the behaviour of passengers occupying a Type III exit row in deciding on how to operate the exit and the consequential effectiveness of operation during simulated accident conditions.

A total of 56 groups of three participants was tested. All groups contained participants of both sexes. In half of the groups there was a single female and in the other half a single male participant. In all instances the minority sex participant was seated adjacent to the exit.

The following four different briefing conditions were evaluated: no-briefing, minimum briefing, verbal briefing and written briefing.

The no-briefing condition involved participants occupying the Type III exit row not being given any information relating to the operation of the exit.

The minimum briefing condition simply informed participants occupying the Type III exit row of their responsibility regarding the operation of the exit and the location of the exit operation diagrams.

The verbal briefing and written briefing conditions provided the participants seated in the Type III exit rows with more specific details on exit operation as well as the location of the exit operation diagrams. The content of the verbal and written briefings was identical.

The tests were conducted in a narrow-bodied cabin simulator. The test protocol involved participants entering the simulator and being shown to their seats. They were then given one of the four briefing scenarios before being offered some reading material. Following this, participants heard the sound of the engines for five minutes before they were given the evacuation command. Participants were not given any direction from the cabin crew to open their exits. The performance of the participants was documented using video cameras with internal time bases, and questionnaires.

The research identified the benefits of providing passengers with more detailed information about the operation of the Type III exit. Comparison between no-briefing or minimum briefing trials and those where more detailed information was provided indicated that the latter resulted in significantly less hesitation in the time to operate the exit. Whilst there were no significant differences amongst the groups, in the time taken to make the exit available, the verbal/written briefings did lead to a greater number of participants correctly operating the Type III exit and the total time to operate the exit also improved significantly. The use of these exit briefings was also shown to be beneficial in making participants aware that the exit operation was their responsibility, and as a consequence increased the number of them that studied the exit diagrams.

Difficulties were identified in ensuring that untrained passengers carefully assess the environment, outside the aircraft cabin, prior to operation of the Type III exit.

Contents

APPENDICES

1 INTRODUCTION

Type III exits are used on a large range of sizes and types of civil aircraft. Historically, Type III exits have differed from airframe main doors by comprising a hatch that is not attached to the airframe. Once released from the aperture, the mass of the exit must be supported by the passenger who should then rotate the exit hatch and jettison it through the opening. Although Type III exits have been found to be extremely effective, the weight and unusual operation, has led to passengers having some difficulty in making such exits available in emergencies. In certain accidents problems have occurred with the operation of these exits (e.g. King Salmon, Alaska 1987 and Manchester 1985 (Refs.1 and 2). These problems have led to the regulatory authorities making changes to the requirements regarding the seating configurations adjacent to these exits (Ref.3).

Investigations, funded by the regulatory authorities, have been undertaken into the influence of a reduction in the weight of the hatch on exit operation time (Ref.4) and into changes to the operating mechanism of the hatch on ease of operation (Ref.5).

2 OBJECTIVES AND APPROACH

The broad objective of the programme of research was to identify whether a minimum briefing for those passengers occupying seats adjacent to Type III exits would be advantageous. Specifically, it was intended to obtain data to determine whether variations in exit briefings influenced:

(i) The behaviour of passengers occupying the Type III exit row;

(ii) Their decision on whether to operate the exits;

(iii) The effectiveness of exit operation; and

(iv) Operational practicability.

3 METHODOLOGY

3.1 Research Design

The influence of different exit briefings on participant exit operation performance was investigated. Members of the public were recruited to take part in a research programme in which groups of three participants were required to operate the Type III exit once. Although the participants were told that they would be taking part in cabin safety research they were not informed about the precise nature of the test. Participants were however, forewarned that they may be required to lift a weight equivalent to that of a heavy suitcase.

Participants were seated in the exit row adjacent to the Type III exit and were given one of four exit briefings (see Appendix A for transcripts of the briefings) prior to being given a specific normal pre flight briefing.

(1) **No-briefing**. The participants were seated in the exit row. Exit operation placards were on the back of the seat in front of the exit and on the passenger safety card (see Appendix B).

(2) **Minimum briefing.** The participants were informed by the cabin crew, that they were seated next to an exit, which they may have to operate in an emergency. In addition, their attention was drawn to the exit operation placards on the back of the seat in front of them and on the passenger safety card.

(3) **Verbal briefing.** Once seated, the participants were informed by the cabin crew that they were seated next to an exit, which may have to be operated in an emergency. In addition, their attention was drawn to the exit operation placards on the back of the seat in front of them and on the passenger safety card. They were also given verbal instructions on when the exit should be opened and how to operate it, as well as a clear indication that the exit is a hatch and not a hinged door. The cabin crew also pointed to the items described in the briefing (operating handle, window, hand recess in exit hatch). Guidance as to the weight of the hatch and where to dispose of it was also given. Once the cabin crew had completed the briefing, participants were asked if there were any points that needed clarification.

(4) **Written briefing.** Once seated, the participants were presented with a written briefing, which provided exactly the same information as in the verbal briefing. The passenger safety card and placards on the seat backs were also brought to their attention. After the pre-flight safety briefing demonstration, the cabin crew gave participants the opportunity to ask any questions about the information.

Table 1 shows the experimental conditions and number of groups utilised. In total 56 groups of participants took part, fourteen groups of three "passengers" in each of the four exit briefing conditions. The groups' composition was always mixed, and the minority sex participant was always seated next to the exit. So, in half of the groups a female participant was seated next to the exit and in the other half a male participant was seated next to the exit.

Table 1 The experimental test conditions

Condition	Number of groups
1) No-briefing	14
2) Minimum briefing	14
3) Verbal briefing	14
4) Written briefing	14

3.2 Equipment

3.2.1 *The cabin mock-up*

The experimental tests took place on board the single-aisle cabin simulator in the College of Aeronautics at Cranfield. Ten rows of triple seats were located on both sides of the cabin fuselage. A fully functioning Type III exit was fitted half way down the starboard side of the cabin fuselage (see Appendix C for aircraft plan). The seat rows adjacent to the Type III exit were arranged in accordance with AN79 1989 (Ref. 3), paragraph 4.1.1.

The seats fore and aft of the Type III exit were at a seat pitch of approximately 38 inches (97 cm) with a vertical projection between the seats of 13 inches (33 cm). This vertical projection was used so that the exit seat row did not extend beyond the exit centre line thus complying with paragraph 4.1.1 in AN79 (see Appendix C). The seat back of each seat that formed the boundary of the access route to the Type III exit was restricted in its movement in accordance with AN79 1989 paragraph 4.3 (Ref. 3).

Figure 1 The cabin simulator

3.2.2 *The Type III exit*

The dimensions of the exit hatch in the cabin simulator were representative of those on a narrow bodied transport aircraft. The Type III exit hatch weighed 21.5 kg. The vertical step-up from the floor to the bottom of each exit inside the cabin was 13.5 inches (34.4cms), identical to that of a Boeing 737 aircraft. The step-down height from the bottom of each door onto the wing was 15 inches (38cms) which although is identical to a Boeing 737, is considerably less than the maximum 23 inches (58.5cms) allowed (Ref. 6).

In accordance with the Type III exit operating instruction requirements, the word 'PULL' was written in red on this handle mechanism and at the top of the

exit there was a red arrow pointing downwards on either side of the handle (Ref. 7).

In accordance with AN79 1989 Paragraphs 4.2 and 5.6 (Ref. 3) requirements, placards illustrating the operating method for the Type III exit were located on the back of each seat in the row forming the access to the exit during all the trials. These illustrations, in order to comply with AN79, were identical to those on the passenger safety card. The illustrations depicting the operating method of the traditional exit were based on those currently used on Boeing 737 aircraft.

3.3 Data Acquisition

Video cameras were located inside and outside the cabin, in order to record the manner in which participants opened and disposed of the Type III exit hatch. The cameras were fitted with a time base function and microphones to provide the information required for the data analysis.

A short questionnaire and debrief was used to identify any problems experienced by participants when opening the exit and evacuating onto the wing. In the questionnaire participants were asked to assess the clarity of any instructions that they had received and to rate the ease with which they were able to open the exit (see Appendix D). The debrief was used to collect further information about any difficulties the participants had experienced and to investigate any interactions amongst participants prior to, or during the operation of the exit.

3.4 Participants

The experimental programme involved the recruitment of volunteer members of the public. The participants were recruited by local advertising to take part in tests aboard the cabin simulator.

To ensure that participants who took part in the research were representative of the UK population, height and weight criteria were employed. Table 2 shows the criteria for the 50th percentile UK males and females. None of the participants had previously operated a Type III exit.

Table 2 Fiftieth percentile height and weight (males and females)

	50th percentile height	50th percentile weight
Males	175cm	70kg
Females	161cm	64kg

3.5 Procedure

The participants were assigned to one of the four briefing conditions, such that there were equal numbers of male and female dominated groups in each. A member of the research team, trained and dressed as a cabin crew member, briefed each group of participants about the nature of the test upon their arrival at the College of Aeronautics. In order to maximise the realism, the participants were not told about the precise nature of the test but were forewarned that they might be required to lift a weight equivalent to that of a heavy suitcase (potential participants with health problems were screened out during

recruitment). Participants were then asked to complete a consent form indicating that they understood the general nature of the study and that they believed they were physically able to take part in the test.

The participants were then shown to the seats that they would occupy for the duration of the test (the minority sexed participant was always placed next to the exit). Once seated inside the cabin, participants were given the briefing condition assigned to their group (see Appendix A). They were then given a standard pre flight safety briefing which included a demonstration of the method of operation of the seat belt, oxygen mask, life jacket as well as the location of the Type III and other exits (See Appendix E for transcript).

The cabin crew member then checked that the participants' seat belts were fastened securely before offering them some light reading material. The crew member then positioned herself at the rear of the cabin. The participants then heard a sound recording of an aircraft starting up and taxiing to a runway (duration of 5 minutes) before hearing the command to evacuate. The cabin crew member then operated the forward port exit and gave no further instructions to the participants unless they attempted to evacuate from this exit. In this instance she told the participants to use their nearest exit.

The test continued until the participants successfully opened the Type III exit hatch, disposed of it and evacuated the aircraft. After the test, each participant was asked to complete a short questionnaire before taking part in a verbal debrief.

Before the participants left the site they were reminded of the high safety level of air travel and advised that they should get back in touch with Cranfield if they experienced any physical or emotional problems as a result of participating in the tests.

4 RESULTS

4.1 Individual characteristics of the participants

The mean age of all the participants was 31.96 years; 31.98 years for males (with ages ranging between 20 and 50 years) and 31.94 for females (with ages ranging between 21 and 49 years). The male participants had a mean height and weight of 173.58 cm and 76 kg (standard deviation 6.86cm. and 10.32kg. respectively). The female participants had a mean height and weight of 162.43cm and 65.93kg (standard deviation 7.41cm. and 11.41kg.respectively). Demographic details for each participant can be found in Appendix F.

4.2 The operation of the Type III exit

The participant's hesitation time to operate the exit and time to make the exit available were obtained from the video recordings. The camera's internal time base and audio recordings provided information on the time it took for each evacuation and the way in which the participants opened and disposed of the Type III hatch. The hesitation time was calculated from the call to evacuate to the point at which a participant's hand touched the operating handle. The exit availability time was calculated from the point at which a participant's hand

touched the operating handle to when the exit was available for evacuation.

In the following sections the participant who operated the Type III exit is termed the 'operator'.

4.2.1 *The influence of exit briefing on the numbers of participants looking at the Type III exit diagrams.*

As Figure 2 indicates, significantly fewer of the participants in the no-briefing Group studied the diagrams.

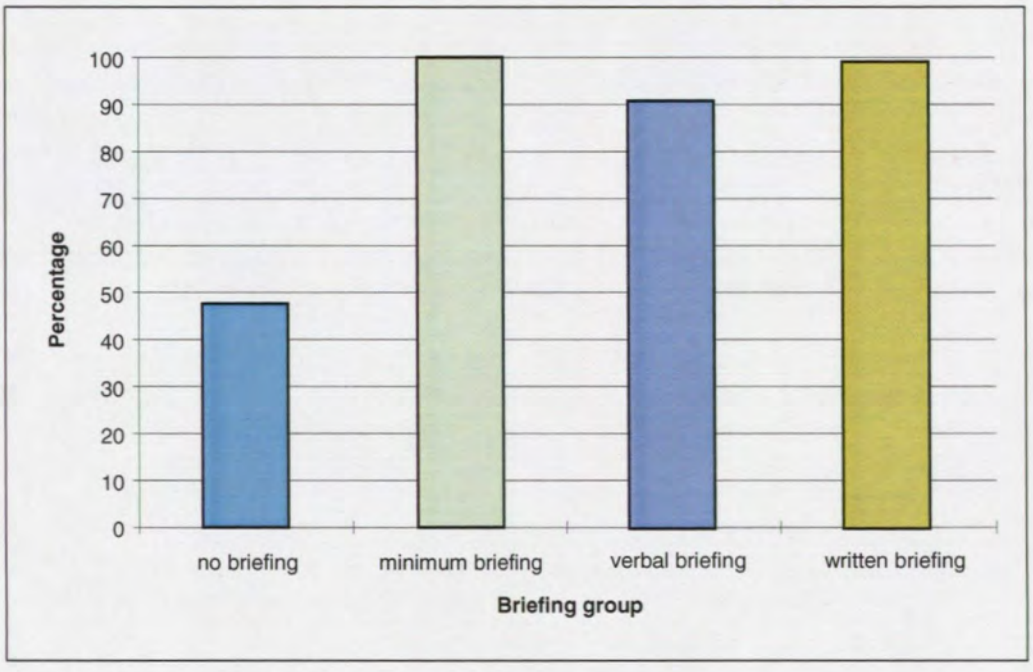

Figure 2 Percentage of participants studying exit operation diagrams

Of the participants who actually operated the exit, 90% reported looking at the exit operating diagrams on the passenger safety card – those who did not were all from the no-briefing Group.

4.2.2 *The influence of exit briefing on correct operation of the Type III exit*

Although most of the participants who operated the exit, had looked at the exit briefing information, 25% of the participants who operated the exit left the exit inside the cabin; either between the seats in the exit row or on the seats themselves. As Figure 3 indicates more participants who operated the exit in the written and verbal briefing groups correctly disposed of the exit. The difference in the briefing groups was shown to be statistically significant.[1,2] The sex of the participant that operated the exit was also found to have no influence on the correct operation of the exit.

[1] The Chi-square statistic compares the observed frequencies with theoretically predicted frequencies.

[2] (χ^2 = 15.528, df = 3, p= 0.01)

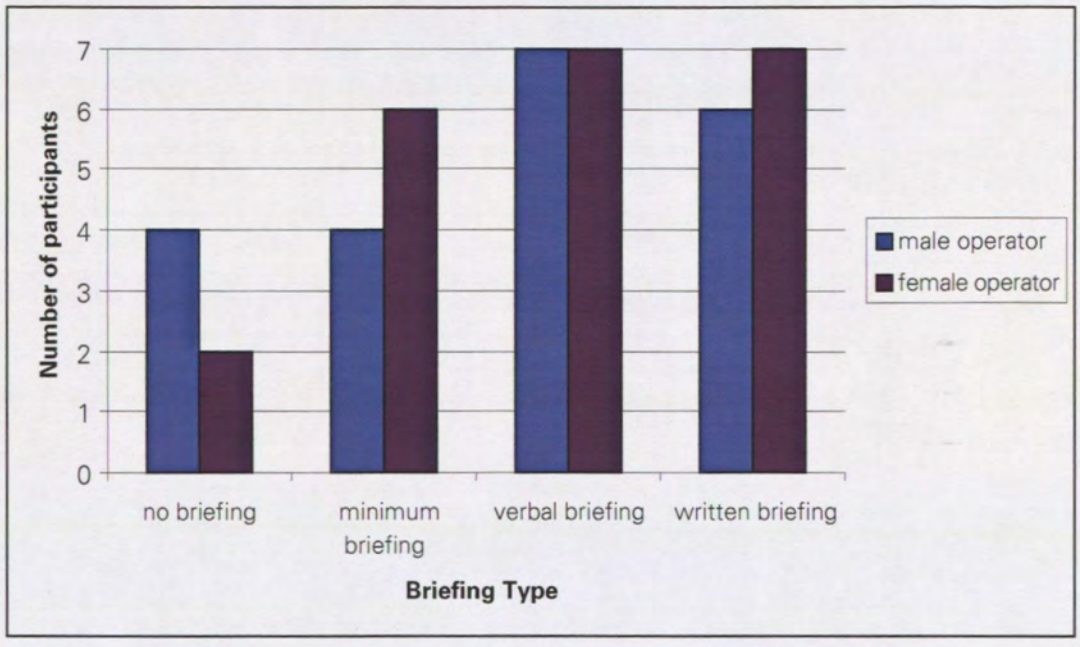

Figure 3 Number of operators correctly disposing of the Type III exit hatch

4.2.3 *The influence of exit briefing on total time to operate the exit*

The total time to operate the exit was calculated from the call to evacuate to when the exit was available for use. The mean times are shown in Table 3 and this is graphically represented in Figure 4. The raw data can be found in Appendix G.

Table 3 Mean exit total operating times (seconds) (standard deviations are shown in parentheses)

	No-briefing	*Minimum briefing*	*Verbal briefing*	*Written briefing*
Male operators	15.3 (5.9)	13.1 (6.4)	12.3 (4.8)	9.1 (2.8)
Female operators	13.6 (4.5)	11.8 (3.4)	10.8 (1.3)	10.3 (3.4)
Total	14.4 (5.1)	12.5 (5.0)	11.5 (3.4)	9.7 (3.1)

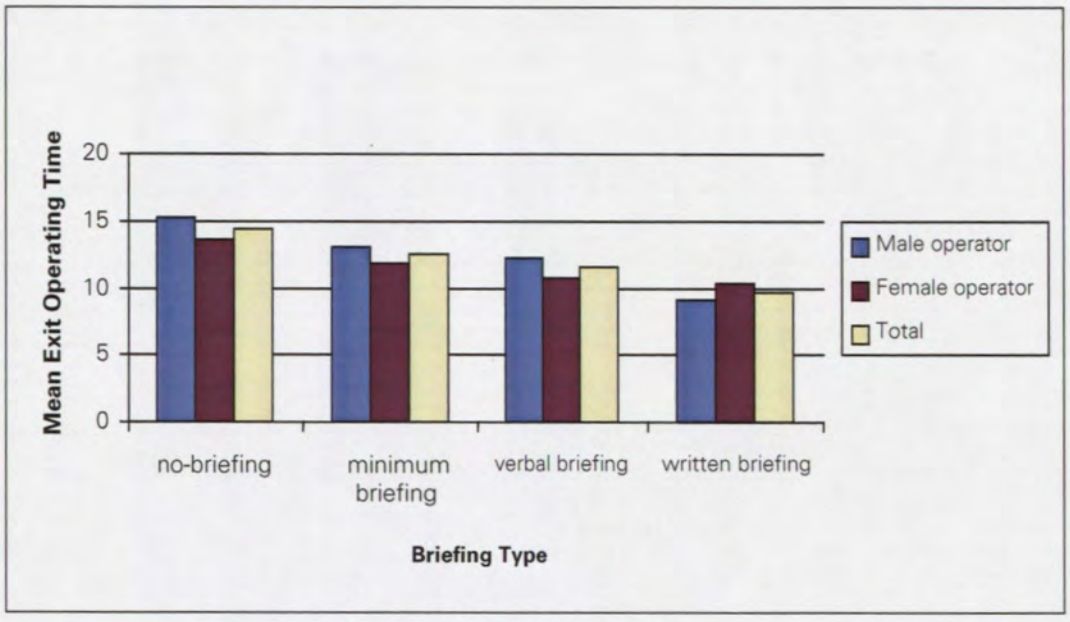

Figure 4 Mean exit total operating times (seconds)

It can be seen from Table 3 that the mean total times ranged from 9.1 seconds for male participants who operated the exit in the written briefing group, to 15.3 seconds for male participants who operated the exit in the no-briefing group. As the means suggest, statistical tests indicated that the total times taken by participants to operate the exit were significantly influenced by the type of exit briefing the participant had received. There were no significant differences between the male and female participants in the time to operate the Type III exit[3,4] (see Appendix G). Participants who had received a written briefing were significantly faster than those who had no-briefing.

4.2.4 *The influence of exit briefing type on exit operation hesitation time*

The total time to operate the hatch can be broken down into the hesitation time and the exit availability time. The hesitation time was calculated from the call to evacuate to the point at which a participant's hand touched the operating handle. The mean participant hesitation times to operate the exit are shown in Table 4. This is graphically represented in Figure 5. The raw data can be found in Appendix G.

[3] The F ratio is obtained by performing the technique of analysis of variance in order to establish whether any statistically significant differences exist between the data from a number of conditions. Whether the F ratio is sufficiently large to achieve significance will be influenced by the variability in the data and also by the number of conditions and replications of the test.

[4] ($F_{3,55} = 2.89$, $p = .045$)

Table 4 Mean exit operation hesitation times (seconds) (standard deviations are shown in parentheses)

	No-briefing	*Minimum briefing*	*Verbal briefing*	*Written briefing*
Male operators	7.9 (4.7)	6.3 (4.3)	4.4 (1.5)	2.9 (1.3)
Female operators	7.5 (3.4)	4.5 (2.5)	3.2 (1.3)	2.9 (0.9)
Total	7.7 (3.9)	5.4 (3.5)	3.8 (1.5)	2.9 (1.0)

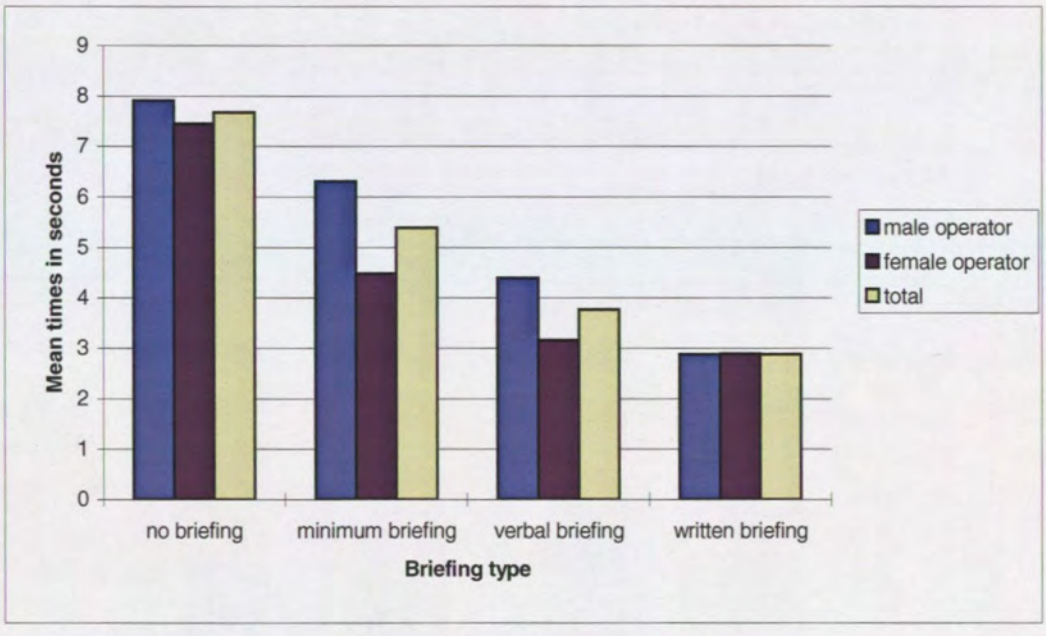

Figure 5 Mean exit operation hesitation time

It can be seen from Table 4 that the mean hesitation times for each experimental condition ranged from 2.9 seconds in the written briefing group, to 7.9 for male participants who operated the exit in the no-briefing group. Statistical tests indicated that the mean hesitation times taken by participants to begin operating the Type III exit were significantly influenced by the type of exit briefing a participant had received[5]. Individual comparisons of the means indicated that the time taken by participants to decide whether to operate the exit or not was significantly less in the written and verbal briefing groups than in the no-briefing or minimum briefing groups. The individual comparisons of means can be found in Appendix H.

The testing did not indicate significant differences, in the exit operation hesitation times, between male and female participants[6].

[5] ($F_{3,55} = 7.71$, $p=0.0001$).

[6] ($F_{1,55} = 1.34$, NS).

4.2.5 *The influence of exit briefing type on exit availability time*

The exit availability time was calculated from the point at which a participant's hand touched the operating handle to when the exit was available for evacuation. The mean times for the groups to make the exit available are shown in Table 5. This is graphically represented in Figure 6.

Table 5 Mean exit availability times – all groups (seconds) (standard deviations are shown in parentheses)

	No-briefing	*Minimum briefing*	*Verbal briefing*	*Written briefing*
Male operators	7.6 (3.6)	6.8 (3.2)	7.9 (3.8)	6.2 (1.8)
Female operators	6.1 (2.7)	7.3 (3.4)	7.6 (1.1)	7.4 (3.6)
Total	6.9 (3.2)	7.1 (3.2)	7.7 (2.7)	6.8 (2.8)

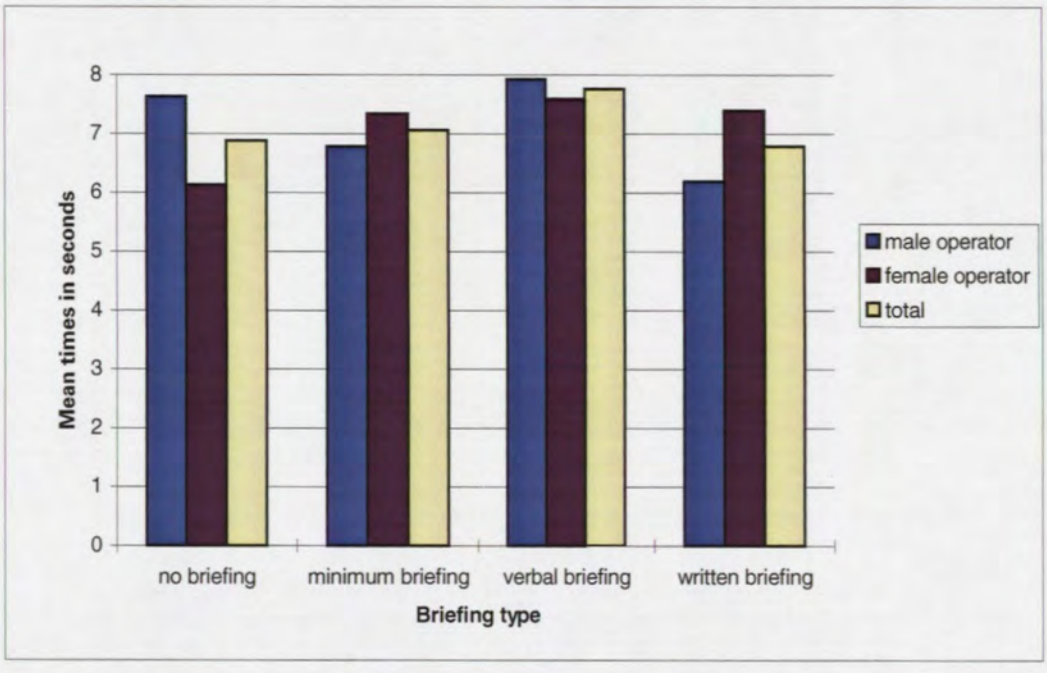

Figure 6 Mean exit availability times – all groups

As Table 5 indicates the mean time taken by the participants to make the exit available was not significantly influenced by the type of exit briefing they had received[7]. As section 4.2.2 indicates the number of participants correctly disposing of the Type III exit was significantly influenced by the type of exit briefing they had received. When participants failed to place the exit hatch onto the wing they often let it drop to the floor in the cabin, a strategy that was inherently quicker than placing the exit onto the wing. Whilst such a strategy led to an increase in the exit availability speed, it also meant that the hatch became a potential hindrance, obstructing passage through the exit. Table 6 shows the time taken by operators, that correctly disposed of the exit, to make the exit available. This is graphically represented by Figure 7.

[7] ($F_{3,55} = 0.29$, NS)

Note: UK operators' procedures are for the exit hatch to be disposed of outside the aircraft and this is reflected in passenger safety cards and seat back placards.

Table 6 Mean exit availability times – correct operation (seconds) (standard deviations are shown in parentheses)

	No-briefing	*Minimum briefing*	*Verbal briefing*	*Written briefing*
Male operators	9.3 (3.8)	7.7 (3.9)	7.9 (3.8)	6.2 (1.8)
Female operators	8.8 (4.7)	6.5 (2.8)	7.7 (1.2)	7.4 (3.6)
Total	9.1 (3.6)	7.0 (3.1)	7.8 (2.8)	6.8 (2.8)

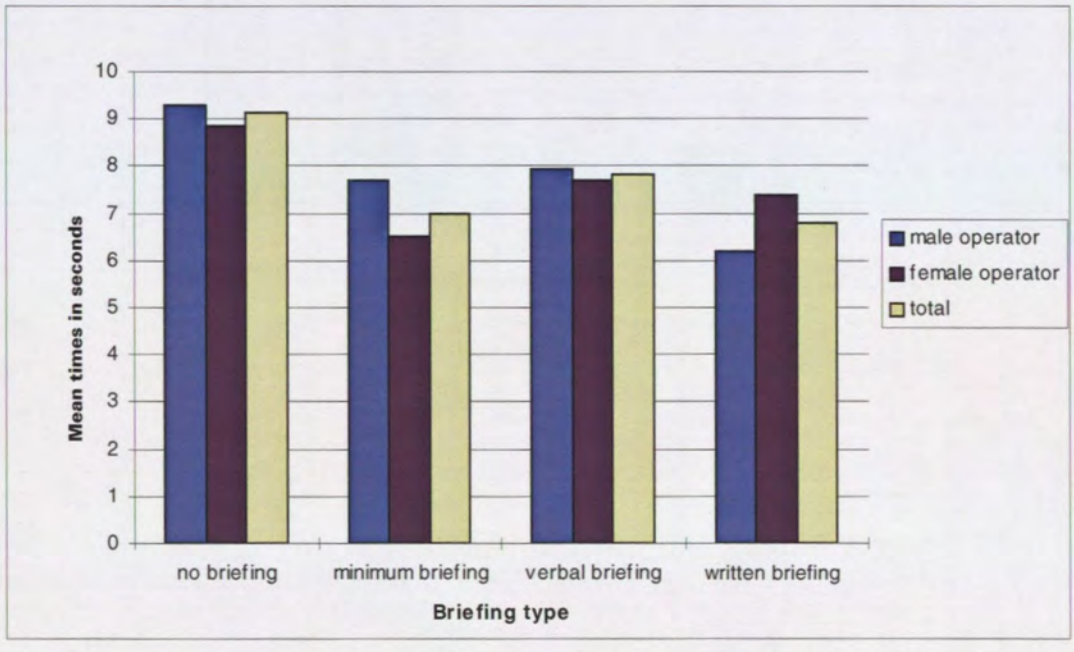

Figure 7 Mean exit availability times – correct operation

Statistical analyses indicated that, even when operators that failed to correctly dispose of the exit hatch were removed from the analyses, the exit briefing an operator had received did not significantly influence the speed at which they could make the exit available[8].

4.3 Type of assistance received by participants who operated the exit

Many of the participants who operated the exit received assistance from fellow participants. The type of assistance given ranged from verbal help, telling the participant who operated the exit what to do, to physical help in manoeuvring the exit. As Figure 8 shows, more female participants who operated the exit received help than their male counterparts. This difference between the sexes

[8] ($F_{1,43} = 0.77$, NS)

was shown to be statistically significant[9]. The type of briefing a group had received did not significantly influence whether or not the other participants offered any assistance to the participant who operated the exit[10]. In two instances, participants who were not seated adjacent to the exit operated the exit.

The participants who offered help reported that they did so because it became apparent that the participant operating the exit was struggling with the weight of the exit hatch, finding it difficult to manoeuvre through the aperture.

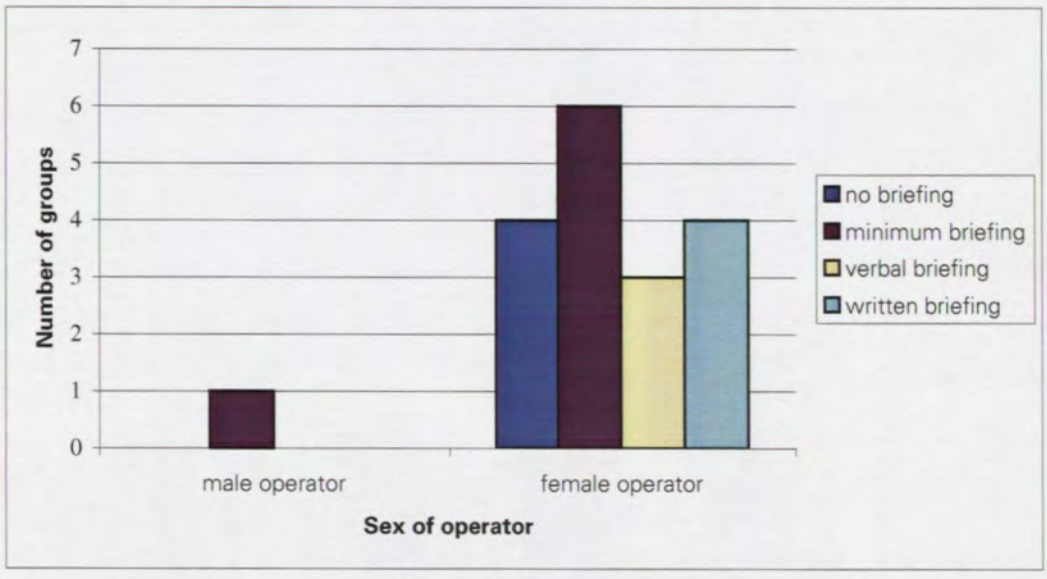

Figure 8 Number of participants who operated the exit receiving assistance from fellow participants

4.4 Participants perceived clarity of the exit briefing

Participants were asked to rate, subjectively (on a seven point scale with 1 indicating 'very unclear' to 7 indicating 'very clear'), the clarity of the exit briefing instructions they were given and the exit operating diagrams. The mean ratings are shown in Table 7.

Table 7 Mean clarity ratings of exit briefing and exit operating diagrams (standard deviations are shown in parentheses)

	No-briefing	*Minimum briefing*	*Verbal briefing*	*Written briefing*
Exit briefing	N/A	4.2 (1.8)	6.0 (1.4)	5.1 (1.8)
Exit operation diagrams	4.8 (1.6)	5.0 (1.3)	5.0 (1.4)	5.2 (1.7)

N/A = not applicable

Statistical analysis indicated that participants' ratings of briefing clarity were significantly influenced by the briefing condition[11]. Individual comparisons of the

[9] (χ^2 = 20.95, df = 1, p=0.001).
[10] (χ^2 = 2.947, df = 3, NS).
[11] ($F_{2,123}$ = 12.14, p = 0.001)

means indicated that participants rated the written and verbal briefings as clearer than the minimum briefing. Furthermore the verbal briefing was rated as clearer than the written briefing. The individual comparisons of means can be found in Appendix H.

4.5 Debriefing information

After each trial the group of participants were asked to discuss the various strategies they employed and any difficulties they experienced during the evacuation. Participants were asked whether they had made any evaluation of the external conditions prior to operation of the exit. None of the participants that operated the exit in the no-briefing group, had made any assessment of the external conditions and only 14.3 percent of participants who operated the exit in the minimum briefing group had made a "quick scan". 21.4 percent of the participants who operated the exit in the verbal briefing group and 46.2 percent in the written group had remembered to check conditions outside prior to operation of the exit.

Tables 8 and 9 show, for the participants who operated the exit, their perception of exit weight and method of operation.

Table 8 Operators perception of the hatch weight (figures indicate percentage of participants making each comment)

	No-briefing	*Minimum briefing*	*Verbal briefing*	*Written briefing*
No surprise	25	8.3	45.5	62.5
Heavier than expected	75	91.7	27.3	37.5
Surprised no concept of 'heavy' (?)	0	0	27.3	0

Table 9 Operators perception of the exit operation (figures indicate percentage of participants making each comment)

	No-briefing	*Minimum briefing*	*Verbal briefing*	*Written briefing*
No surprise about operation	10	23.1	83.4	77.8
Surprised, expected it to be hinged	80	69.2	8.3	0
Unclear about where to dispose of hatch	10	7.7	8.3	22.2

As Table 8 shows the participants who operated the exit and received the written or verbal briefing, were better prepared for the weight of the exit than those operators in the no-briefing and minimum briefing groups. They reported that because they were prepared for the weight they were able to support the hatch by the lower hand recess, stopping it falling to the floor.

Table 9 clearly indicates that as the exit briefing increased in content participants who operated the exit had a clearer understanding of how to manoeuvre the exit once the operating handle had been operated. Although exit diagrams were on the seat backs and on passenger safety cards, the majority of operators in

the no-briefing and minimum briefing groups failed to recognise that the exit hatch was not attached to the fuselage. Failure to comprehend this meant that many of the participants dropped the exit hatch to the floor or were not expecting to support and manoeuvre the exit through the aperture.

Table 10 How did the exit briefing help you? (figures indicate percentage of participants making each comment)

	Minimum briefing	*Verbal briefing*	*Written briefing*
Paid more attention to exit diagrams on card/seat back	30	0	11.1
Knew that it was their responsibility to operate exit/felt empowered	40	69.3	22.2
Clear what actions to take	0	30.7	66.6
Didn't aid operation, not enough information	30	0	0

As Table 10 indicates, the majority of participants that operated the exit found the exit briefings as beneficial. The minimum briefing encouraged participants who operated the exit to look at the exit operation diagrams more carefully as participants were aware that it was their responsibility to operate the exit. Thirty percent of participants who operated the exit in this group reported that whilst they were aware that the exit operation was their responsibility, the minimum briefing did not help them perform the task. In the more detailed briefing groups all the participants who operated the exit perceived that the briefings had indeed aided them in performing the exit operation, making them feel empowered, providing clear instructions as to the appropriate steps to take.

As Table 11 indicates many participants who operated the exit found the exit operation diagrams difficult to understand. Two main complaints were made about the diagrams:-firstly many participants who operated the exit failed to comprehend where to dispose of the exit and secondly they did not understand the diagram indicating not to operate the exit if a hazard was present outside. The participants who operated the exit from the written and verbal briefing groups, that reported difficulty in understanding the diagrams indicating where to dispose of the exit, stated that this confusion was removed following the briefings.

Table 11 Clarity of exit operation diagrams (figures indicate percentage of participants making each comment)

	No-briefing	*Minimum briefing*	*Verbal briefing*	*Written briefing*
Very clear	26.6	21.4	87.5	90.9
Failure to understand where to dispose of exit	60	35.7	12.5	9.1
Failure to understand hazard warning	13.4	35.7	0	0

4.6 Operational practicability

The average time taken by the cabin crew member to give each of the exit briefings can be seen in Table 12. The times shown for the verbal briefing groups included time taken for the cabin crew to answer any questions that the participants may have had.

Table 12 Average briefing length in seconds

	Mean	Standard Deviation	Minimum	Maximum
Minimum briefing	19.5	3.7	16.4	30.8
Verbal briefing	67	3	62.4	70.4

As the results indicate, the verbal briefing took substantially longer to complete than the other briefing conditions.

5 DISCUSSION

The research programme identified difficulties that passengers could have in operating Type III exits. The participants were not briefed about the exact nature of the test prior to taking part, so the experimental condition simulated the ambiguity that may occur in an emergency.

5.1 The influence of exit briefing and subsequent exit operation performance.

The results clearly indicated the benefits of providing participants with an exit briefing to encourage them to refer to the exit operation diagrams. A large proportion of participants who failed to look at the diagrams was from the group that had received no exit briefing. Failure to look at the exit operation diagrams led to many of the participants being surprised about the way in which the exit operated. Many were surprised that the exit moved inwards, causing delay and difficulties in manoeuvring the exit hatch. The participants who operated the exit in the no-briefing group were also unclear about where to dispose of the exit hatch. Significantly more of the participants in this group left the exit hatch inside the aircraft where it could become a hindrance in a real emergency evacuation. The results clearly indicated that the verbal and written briefings could lead to more effective performance of the exit operation.

5.2 The operation of the Type III exit

The mean hesitation time for participants operating the exit clearly indicated the benefits of providing briefing for passengers seated in this area. Participants, that operated the exit and had been given either the verbal or written briefing, were significantly less hesitant about initiating exit operation than those participants who had received no-briefing or the minimum briefing. The participants in the verbal and written briefing groups reported feeling responsible for the operation and being empowered to operate the exit when hearing the command to evacuate. The majority of participants in these two groups reported that they knew that this was the cue to operate the exit and any ambiguity about the situation was removed. Those participants in the no-briefing group reported feeling unclear about whether they should operate the exit even when hearing the command to evacuate. Many participants in the

no-briefing group believed the cabin crew member would tell them specifically when to operate the exit or would come and perform the task. In two of the no-briefing groups the participants first reaction was to move towards the exit at the rear of the aircraft where the cabin crew member was stationed.

The type of exit briefing did not significantly influence the mean time taken by participants to make the exit available regardless of how the exit hatch was disposed. In some instances assistance from the other participants in the group helped to improve the speed at which the participant that operated the exit could make it available. If the participant operating the exit was struggling with the weight of the exit hatch or was unclear about what to do with it, another participant assisted, either verbally or physically. Assistance of this nature was provided on significantly more occasions when the participant operating the exit was female. This was primarily because the female participants that operated the exit found the most difficulty in dealing with the size and weight of the exit hatch. This probably accounts for no differences being found in exit operation times between males and females (a result prevalent in previous testing Refs. 4 & 5).

In two instances the female participant, responsible for operating the exit, did not attempt the task, but instead allowed it to be carried out by one of the males. They reported that having been told the exit was heavy and would require considerable effort they decided that they would not attempt the task.

5.3 Perceived clarity of the exit briefing

The subjective ratings for participants who operated the exit indicated that as the briefings became more detailed the instructions became clearer. The verbal briefing was given the highest ratings for clarity. This indicates the benefits that could be gained from a personal briefing, where the cabin crew member is able to make gestures and point to relevant parts of the exit. Participants reported that any part of the briefing that was unclear (or needed refreshing) could be clarified by looking at the exit operation diagrams.

5.4 Debriefing information

Participants that operated the exit, and who had not been told to make an assessment of the external conditions prior to operation of the exit, failed to evaluate whether it was safe to do so. Even the verbal and written briefing groups, that had been told to evaluate the conditions outside, less than half of the participants operating the exit remembered to do so. Many of the participants reported that they had simply forgotten to look and only remembered to do so once they had evacuated. They stated that once they were told to evacuate, their natural response was to escape. A number of the participants who operated the exit stated that if there had been fire or smoke outside the aircraft they would have noticed this and made a thorough check as to whether it was safe to operate the exit. This result shows the difficulties of ensuring that passengers seated in this area know not only how, but when to operate the exit.

Interestingly, only participants from the no-briefing and minimum briefing groups mentioned that the diagram on the safety placard, indicating that the Type III exit should not be operated if a fire was present, was unclear or could not be understood. It would appear that the verbal and written briefings had successfully overcome this potential problem.

5.5 Operational practicability

The average time taken by the cabin crew member to give the verbal briefing was significantly longer than the minimum briefing. However, even when participants sought further clarification or instructions, the longest verbal briefing took 70 seconds albeit for just one exit row on one side of the cabin. Verbal briefings given to both sides of the cabin and especially on aircraft with more than one pair of Type III exits (e.g. A320, B737-400, etc) are likely to take significantly more time.

6 CONCLUSIONS

1 The research indicated that providing passengers with additional detailed briefing information about the operation of the Type III exit increased the probability that the exit would be operated and disposed of quickly and correctly.

2 The total time to operate the exit (i.e. from the evacuation command to the exit becoming available) improved with more detailed briefings. This was primarily due to the fact that the more detailed briefings reduced the hesitation time taken by participants to start to operate the exit.

3 The hesitation time shown by participants between the evacuation command and their initiation of exit operation was shorter when participants had received additional either verbal or written briefing, than when participants had received minimum or no-briefing.

4 The participants who had looked at the exit operation diagrams prior to operating the exit appeared to have a clearer understanding of how the exit operated and where to dispose of the exit hatch.

5. There was no significant difference between the time taken for male and female participants to operate the exit. However, female participants who operated the exit reported finding the task more difficult and received significantly more assistance from other participants than their male counterparts.

6. The verbal and written briefings were rated by participants as being clearer than the minimum briefing. The verbal briefing was given higher ratings by participants than the written briefing.

7. It proved difficult to ensure that participants assessed external conditions prior to operation of the exit. However, participants in this experiment were aware that they were in an experimental environment. Passengers may be more likely to assess the external conditions prior to operating the exit in a real incident or accident.

8. The verbal briefing took significantly longer to give than the minimum briefing.

7 REFERENCES

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8 ACKNOWLEDGEMENTS

The programme of research was initiated, developed and funded by the United Kingdom Civil Aviation Authority.

Appendices

Appendix A Transcript of Exit Briefings

A1 Minimum briefing

I would like to make you aware that you are seated in an emergency exit row.

You may be required to operate this exit *(point)* in an emergency.

Please study the exit operation placards on the seat back *(point).*

Please remove the safety card from your seat pocket and study this prior to departure.

A2 Verbal briefing

You are seated at an emergency exit. You may be required to operate this exit (point) in the event of an evacuation.

Listen carefully to my instructions.

You must take no action unless you hear the command 'Evacuate, Evacuate'.

Look outside for hazard such as fire *(point to viewing window).*

If a fire is present do not open the exit.

To support the exit place your hand in the recess *(point).*

To open the exit, pull down on the operating handle *(point).*

The exit will fall inwards at the top.

The exit is not hinged and will come in towards you, away from the opening.

The exit is very heavy and will need effort to remove fully from the opening.

Once removed, throw the exit out of the aircraft. This will require considerable effort.

Exit the aircraft onto the wing and follow the arrows.

Move away from the aircraft.

Do you understand the instructions I have given you? Do you have any questions?

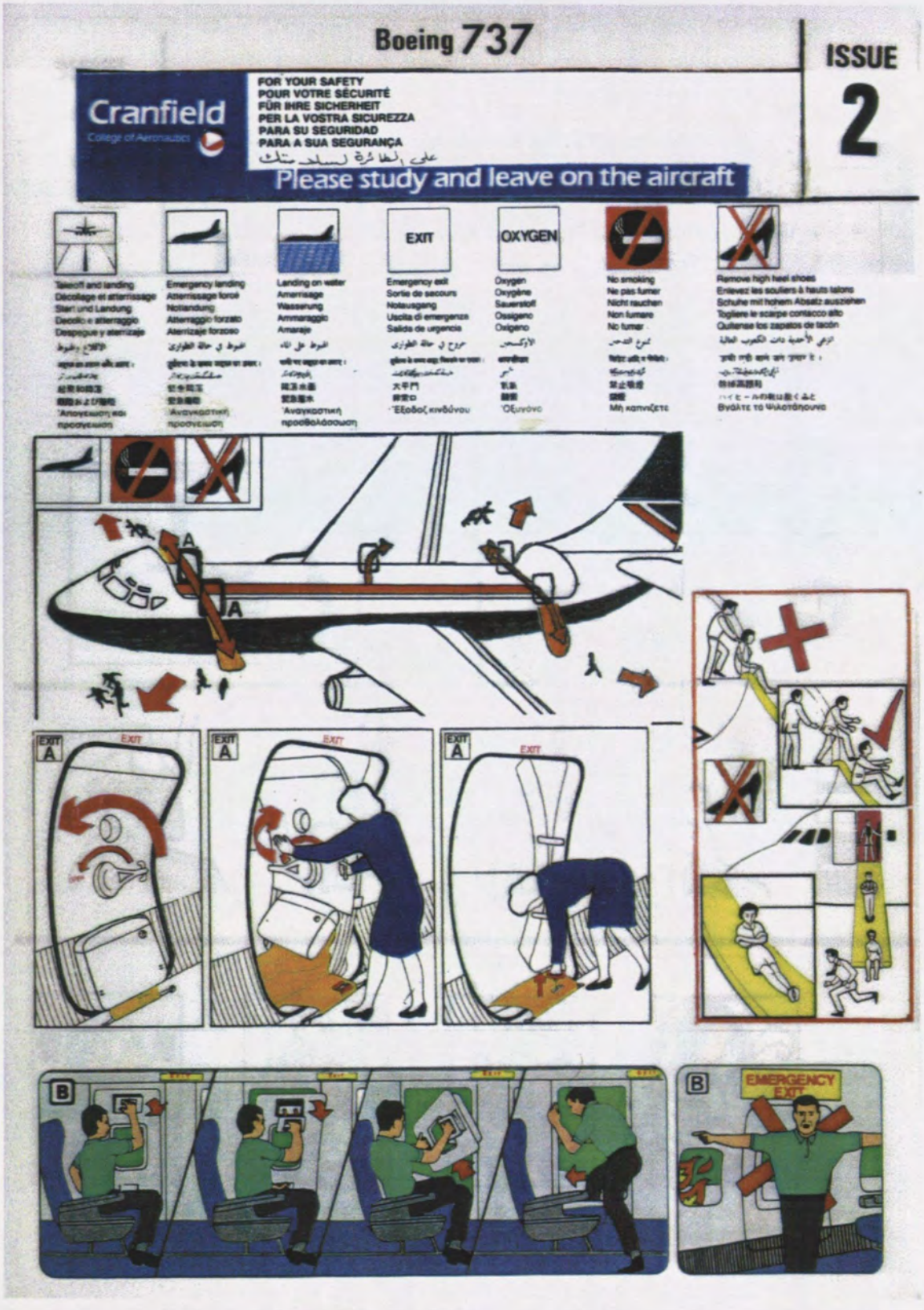
Please take the safety card from your seat pocket in front of you and study the instructions for exit operation. These instructions are also found on the seat back on front of you *(point).*

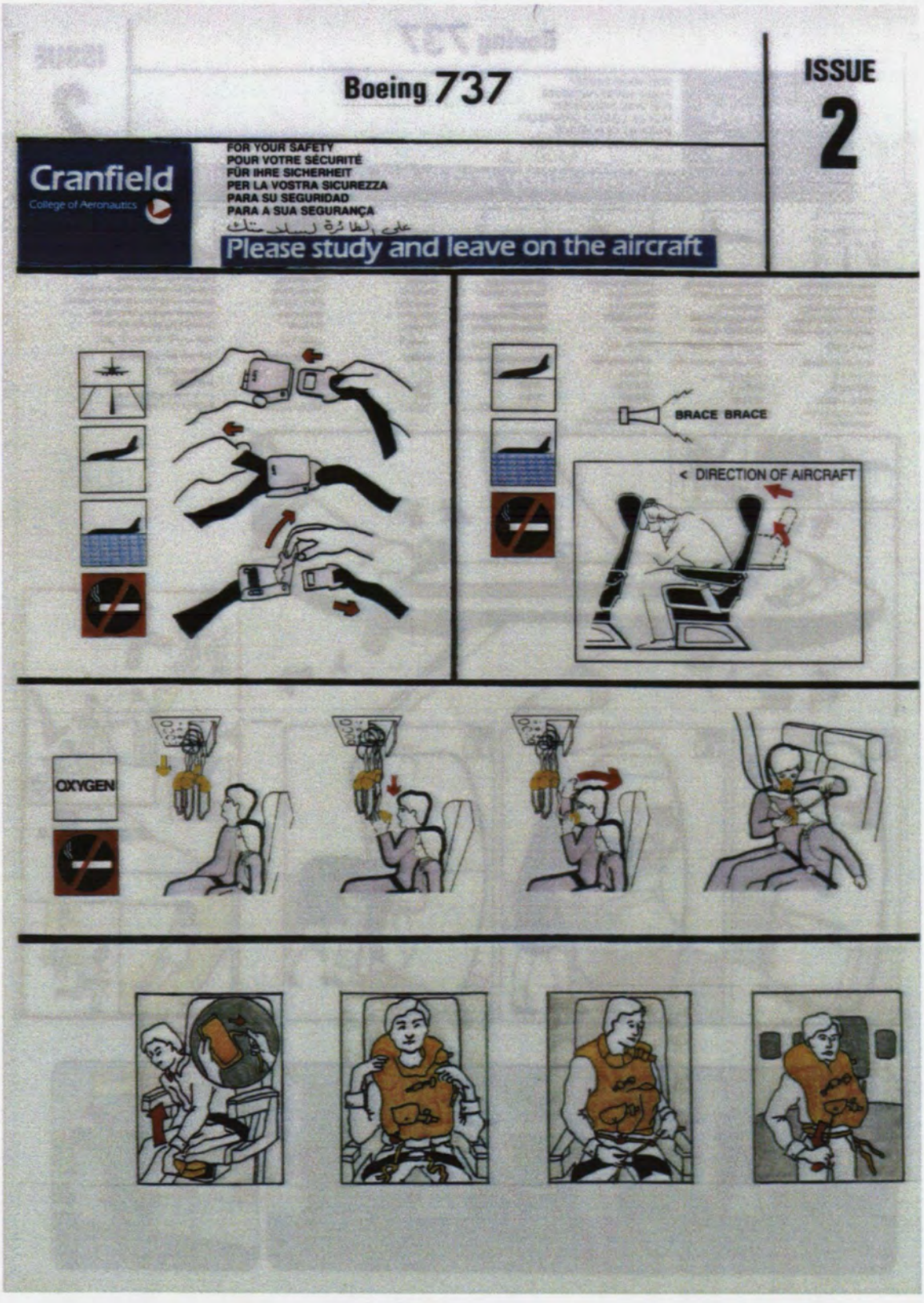
A3 **Written briefing**

EXIT ROW BRIEFING

- You are seated at an emergency exit. You may be required to operate this exit in the event of an evacuation.
- Carefully read the following instructions prior to departure.
- You must take no action unless you hear the command 'Evacuate, Evacuate'.
- Look outside for hazard such as fire, through the viewing window.
- If a hazard is present do not open the exit.
- To support the exit, place your hand in the recess at the base of the exit.
- To open the exit, pull down on the operating handle at the top of the exit.
- The exit will fall inwards at the top.
- The exit is not hinged and will come in towards you, away from the opening.
- The exit is very heavy and will need effort to remove fully from the opening.
- Once removed, throw the exit out of the aircraft. This will require considerable effort.
- Exit the aircraft onto the wing and follow the arrows.
- Move away from the aircraft.
- Ensure that you understand the instructions. If you have any questions please ask a member of cabin crew.
- Please take the safety card from the seat pocket in front of you and study the instructions for exit operation. These instructions are also found on the seat back on front of you.

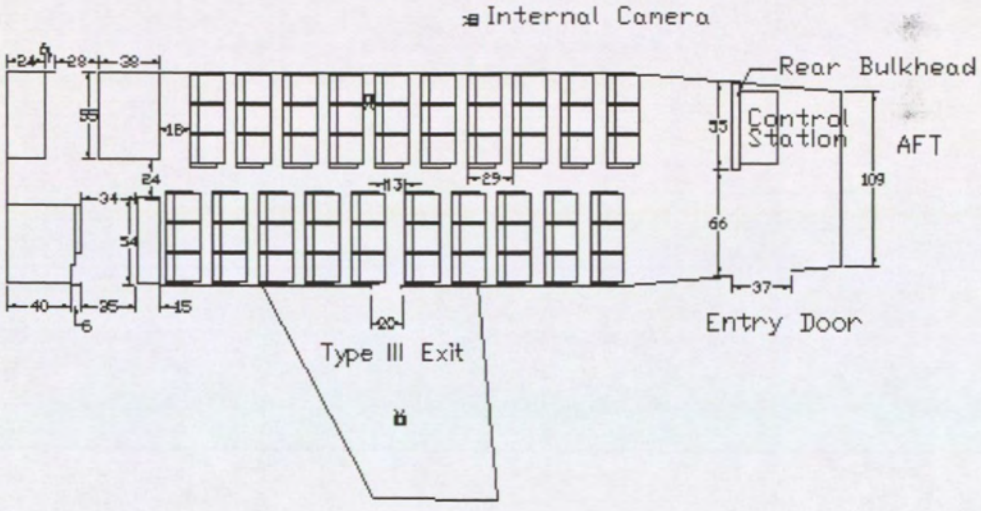
Appendix B Passenger Safety Card




Boeing 737
ISSUE
2
Cranfield
College of Aeronautics
FOR YOUR SAFETY
POUR VOTRE SÉCURITÉ
FÜR IHRE SICHERHEIT
PER LA VOSTRA SICUREZZA
PARA SU SEGURIDAD
PARA A SUA SEGURANÇA
على الطائرة لسلامتك
Please study and leave on the aircraft
BRACE BRACE
< DIRECTION OF AIRCRAFT
OXYGEN

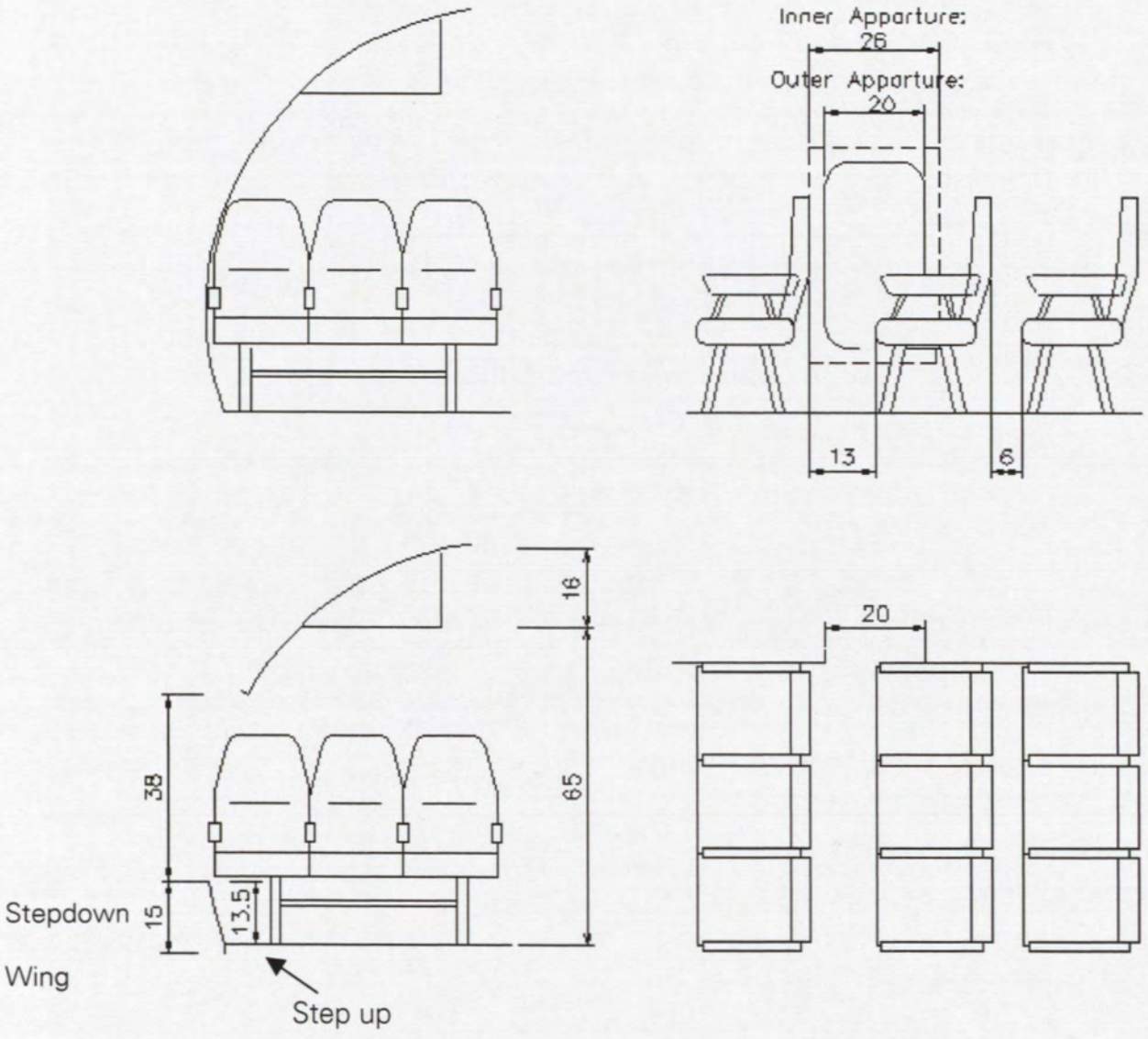
Appendix C Aircraft Configurational Diagrams

C1 Plan view of aircraft simulator



C2 Aircraft seating diagrams

The seat rows adjacent to the Type III exit were arranged in accordance with AN79 1989 (Ref. 3), paragraph 4.1.1



Appendix D Questionnaire

Verbal briefing
Please place a tick (✓) in the box of your choice

1. Did you pay attention to the safety briefing given by the cabin crew member?

Yes ☐
No ☐

If yes, did this aid your evacuation?

Yes ☐
No ☐

If yes, how did it aid your evacuation?

_____
_____

If no, why did it not aid your evacuation?

_____
_____

2. Did you pay close attention to the personal briefing given by the cabin crew member, indicating that you were seated next to the overwing exit and might therefore be required to operate it in an emergency?

Yes ☐
No ☐

If yes, did this aid your evacuation?

Yes ☐
No ☐

If yes, how did it aid your evacuation?

_____
_____

If no, why did it not aid your evacuation?

_____
_____

3. Did you study the safety card in detail?

Yes ☐
No ☐

If yes, did this aid your evacuation?

Yes ☐
No ☐

If yes, how did it aid your evacuation?

_____

_____

If no, why did it not aid your evacuation?

_____

_____

4. Did you study the diagrams on the safety card / placard showing the method of operating the overwing exit in detail?

Yes ☐
No ☐

If yes, did this aid your evacuation?

Yes ☐
No ☐

If yes, how did it aid your evacuation?

_____

_____

If no, why did it not aid your evacuation?

_____

_____

5. Did the diagrams on the safety card correspond to the safety briefing given by the cabin crew member?

Yes ☐
No ☐

If yes, in what way did they correspond to the briefing?

_____

_____

If no, how did they not correspond with the briefing?

_____

_____

6. What improvements could be made to the personal briefing, such that they would enhance your actions in the event of an emergency evacuation? (Please include suggestions)

_____

_____

_____

_____

_____

7. In operating the exit, please rate how easy or difficult you found the following by circling the number of your choice:

	Very Easy						**Very Difficult**
Using the exit's operating handle	1	2	3	4	5	6	7
The weight of the exit hatch	1	2	3	4	5	6	7
The size of the exit hatch	1	2	3	4	5	6	7
Exiting through the exit onto the wing	1	2	3	4	5	6	7

8. Can you please rate the clarity of the exit operation instructions given personally by the cabin crew member on a scale of 1 to 7. Please circle the number of your choice.

Very unclear Very clear
1----------2----------3---------4---------5---------6----------7

9. Can you please rate the clarity of the exit operation instructions given in the safety card found in the seat pocket and on the placards on the seatback in front of on a scale of 1 to 10. Please circle the number of your choice.

Very unclear Very clear
1----------2----------3---------4---------5---------6----------7

10. What additional aspects of the exit operation were a surprise to you?

_____

_____

_____

Thank you for your co-operation.

Appendix E Pre-Flight Briefing Demonstration Transcript

Boarding announcement and pre-flight safety demonstration

Ladies and Gentlemen.

Welcome on board. For your personal safety, any light articles which you have brought aboard the aircraft should be placed in the overhead bins or under the seats in front of you. Please ensure that hand baggage does not obstruct the aisles or any emergency exits. Passengers are asked to refrain from smoking until the no smoking signs have been switched off. Portable telephones may not be used at any time. Electronic items such as laptop computers may not be used for the duration of the flight.

After the doors are closed

Ladies and Gentlemen.

As the safety equipment on this aircraft may differ from that on other aircraft it is in your own best interest to pay attention to this safety briefing. In the seat pocket in front of you there is a safety card, which the Captain would like you to read carefully before take-off. This contains details of the demonstration.

The emergency exits are clearly marked and are being pointed out to you. There are the two doors at the rear of the cabin, and the over-wing exit located in the centre of the cabin. In the event of an emergency, floor level lighting will illuminate showing the routes to the exit.

For those of you unfamiliar with the operation of the seat belt, it is fastened and adjusted as demonstrated, and unfastened like this. We would like to advise passengers of the emergency oxygen supply onboard this aircraft. Should additional oxygen be required throughout the cabin, the panel above your head will open and masks like these will drop down. Remain seated, pull the mask towards you, place over nose and mouth and breathe normally. Adults should fit their own masks before assisting children.

Please now ensure that your tray table is folded away, your seat back is upright with the armrests down, and your seat belt is tightly fastened.

Thank you for your attention. We would like to wish you a pleasant flight.

Appendix F Participant Demographics

Group	Briefing group type	Sex	Age	Weight (kg)	Height (cms)
1	verbal briefing	female	21	68	162
		female	21	47	150
		male	23	65	165
2	written briefing	female	47	75	175
		male	37	73	162
		male	25	76	170
3	no-briefing	male	28	63	168
		male	21	69	175
		female	27	52	158
4	minimum briefing	male	32	86	183
		male	25	82	165
		female	26	52	150
5	written briefing	male	28	77	180
		female	44	51	155
		male	31	69	163
6	no-briefing	female	25	75	165
		male	25	75	178
		female	25	59	150
7	no-briefing	male	46	76	170
		male	32	78	170
		female	31	48	160
8	written briefing	male	31	63	175
		female	37	78	155
		female	32	63	165
9	no-briefing	female	38	63	155
		male	47	82	165
		male	22	69	175
10	written briefing	female	29	69	160
		male	40	82	170
		female	31	67	170
11	no-briefing	male	24	63	167
		male	27	63	175
		female	22	76	175
12	no-briefing	male	23	76	180
		female	49	66	165
		male	50	69	175
13	written briefing	male	40	89	165
		female	43	82	175
		male	29	82	169
14	written briefing	female	36	63	160
		male	32	84	180
		male	31	90	175
15	verbal briefing	female	27	82	170
		male	25	59	180
		male	27	76	170
16	verbal briefing	female	37	78	160
		male	32	60	170
		male	35	69	170
17	no-briefing	female	34	60	165
		male	20	86	180
		female	31	69	170

Group	Briefing group type	Sex	Age	Weight (kg)	Height (cms)
18	written briefing	Male	36	82	180
		Male	28	69	165
		female	23	72	170
19	no-briefing	female	33	63	180
		male	31	89	180
		male	22	70	175
20	no-briefing	female	22	71	160
		male	25	48	155
		male	42	76	175
21	written briefing	male	34	82	170
		female	41	69	155
		male	29	76	175
22	minimum briefing	male	34	63	173
		male	23	93	190
		female	27	57	160
23	minimum briefing	female	34	57	160
		female	39	57	151
		male	25	69	168
24	written briefing	male	28	86	177
		female	42	57	151
		female	22	79	165
25	minimum briefing	male	23	69	170
		male	24	69	170
		female	24	50	170
26	minimum briefing	female	39	80	160
		male	41	89	170
		male	45	81	190
27	minimum briefing	female	41	63	163
		female	34	63	165
		male	33	76	176
28	minimum briefing	male	23	94	180
		female	28	53	153
		male	23	67	170
29	minimum briefing	female	31	58	175
		male	38	70	170
		male	49	78	170
30	verbal briefing	female	40	51	156
		male	45	76	170
		female	39	68	163
31	written briefing	female	47	97	160
		female	31	75	163
		male	42	76	174
32	minimum briefing	male	28	76	178
		female	26	76	157
		female	31	68	168
33	minimum briefing	female	38	63	157
		male	38	76	161
		male	49	87	172
34	no-briefing	female	36	69	153
		male	31	66	175
		female	28	63	162
35	verbal briefing	female	22	54	162
		female	24	73	176
		male	29	63	171

Group	Briefing group type	Sex	Age	Weight (kg)	Height (cms)
36	verbal briefing	male	42	76	160
		female	33	60	158
		female	46	79	156
37	written briefing	male	29	66	168
		female	37	68	157
		female	23	81	167
38	written briefing	male	24	70	172
		female	44	57	157
		female	28	57	160
39	verbal briefing	male	31	86	177
		female	30	69	162
		female	34	50	155
40	written briefing	male	47	96	175
		female	46	86	153
		female	24	63	167
41	minimum briefing	female	34	57	156
		female	36	57	168
		male	34	69	173
42	no-briefing	male	46	82	181
		female	22	68	165
		female	33	76	159
43	verbal briefing	male	33	82	180
		female	22	76	173
		male	20	85	189
44	no-briefing	female	45	68	167
		female	39	57	160
		male	47	82	178
45	no-briefing	female	22	55	167
		male	28	75	179
		female	29	79	150
46	minimum briefing	female	48	79	170
		male	31	82	180
		female	30	69	168
47	minimum briefing	female	35	60	152
		male	35	98	183
		female	24	63	170
48	minimum briefing	female	23	55	169
		male	28	84	168
		male	39	57	169
49	no-briefing	female	24	98	168
		female	23	61	159
		male	33	69	163
50	verbal briefing	male	26	87	170
		male	50	82	179
		female	27	51	155
51	verbal briefing	female	31	66	167
		male	23	78	185
		female	37	53	150
52	written briefing	male	21	60	170
		female	33	69	173
		male	34	97	180
53	verbal briefing	female	22	50	163
		female	34	57	172
		male	22	69	183

Group	Briefing group type	Sex	Age	Weight (kg)	Height (cms)
54	verbal briefing	female	46	98	168
		male	40	72	172
		male	47	99	180
55	verbal briefing	male	20	76	180
		male	22	79	181
		female	22	79	178
56	verbal briefing	female	21	59	160
		female	21	59	160
		male	28	59	166

Appendix G Raw Exit Operation and Evacuation Times

* indicates correct disposal of the exit hatch.

Group no.	*Briefing type*	*Participant sex*	*Evacuation command to hand on handle*	*Evacuation command to exit available*	*Hand on handle to exit available*	*Hand on handle to first pax on wing*	*Hand on handle to last pax on wing*
1	*verbal briefing	Male	6.08	13.53	7.47	14.84	18.38
2	*written briefing	Female	2.30	5.44	3.14	8.50	11.88
3	*no-briefing	Female	3.62	9.16	5.54	10.60	12.36
4	*minimum briefing	Female	2.95	8.58	5.63	7.75	10.81
5	*written briefing	Female	2.21	15.76	13.55	15.73	20.63
6	no-briefing	Male	17.28	25.06	7.78	12.60	15.79
7	no-briefing	Female	3.89	7.84	3.95	8.28	11.67
8	*written briefing	Male	2.31	8.78	6.47	8.33	12.19
9	no-briefing	Female	13.50	18.36	4.86	9.55	13.84
10	*written briefing	Male	1.50	6.62	5.12	7.90	12.22
11	*no-briefing	Female	7.50	19.62	12.12	14.44	19.98
12	no-briefing	Female	6.85	12.47	5.62	8.50	12.56
13	*written briefing	Female	2.52	13.60	11.08	12.86	16.04
14	*written briefing	Female	2.68	9.58	6.90	8.96	13.08
15	*verbal briefing	Female	2.42	9.16	6.74	8.58	11.29
16	verbal briefing	Female	2.00	8.99	6.99	9.60	13.42
17	*no-briefing	Male	9.72	14.44	4.72	16.86	19.94
18	*written briefing	Female	2.64	8.48	5.84	7.56	9.92
19	no-briefing	Female	9.62	15.52	5.90	9.10	12.34
20	no-briefing	Female	7.20	12.14	4.94	10.10	13.24
21	*written briefing	Female	3.22	9.46	6.24	16.44	20.00
22	minimum briefing	Female	5.92	18.26	12.34	15.38	19.82
23	minimum briefing	Male	5.34	10.02	4.68	6.48	10.54
24	*written briefing	Male	3.18	9.56	6.38	11.76	15.88
25	*minimum briefing	Female	3.76	8.60	4.84	6.66	8.68
26	*minimum briefing	Female	3.00	13.08	10.08	11.86	16.80
27	*minimum briefing	Male	1.12	5.28	4.16	5.04	14.04
28	*minimum briefing	Female	3.46	12.64	9.18	10.32	15.30
29	*minimum briefing	Female	9.56	12.08	2.52	6.04	11.96
30	*verbal briefing	Male	3.32	8.82	5.50	6.98	11.13
31	*written briefing	Male	4.94	14.94	10.00	13.86	19.14
32	minimum briefing	Male	3.94	8.40	4.46	6.74	10.68
33	*minimum briefing	Male	10.06	23.30	13.24	14.78	18.10
34	*no-briefing	Male	5.00	12.56	7.56	8.06	12.04
35	*verbal briefing	Female	4.94	10.90	5.96	8.02	11.10
36	*verbal briefing	Male	5.14	17.50	12.36	16.51	21.21
37	*written briefing	Male	4.18	9.24	5.06	6.44	10.14
38	*written briefing	Male	1.74	6.78	5.04	8.04	10.76
39	*verbal briefing	Male	4.38	12.58	8.20	10.20	13.23
40	*written briefing	Male	2.34	7.62	5.28	8.06	11.32
41	minimum briefing	Male	2.40	9.94	7.54	10.68	14.50
42	*no-briefing	Male	4.56	16.82	12.26	13.98	17.94
43	*verbal briefing	Female	2.22	11.36	9.14	11.26	13.84
44	*no-briefing	Male	9.28	19.91	12.63	12.77	18.02
45	no-briefing	Male	4.78	9.08	4.30	11.42	15.18
46	*minimum briefing	Male	13.00	19.08	6.08	8.26	11.64
47	*minimum briefing	Male	8.32	15.66	7.34	11.44	16.86
48	*minimum briefing	Female	2.76	9.60	6.84	10.06	13.44

Group no.	*Briefing type*	*Participant sex*	*Evacuation command to hand on handle*	*Evacuation command to exit available*	*Hand on handle to exit available*	*Hand on handle to first pax on wing*	*Hand on handle to last pax on wing*
49	no-briefing	male	4.78	8.96	4.18	7.34	10.28
50	*verbal briefing	Female	2.08	10.74	8.66	10.96	16.06
51	*verbal briefing	male	1.66	4.88	3.22	5.22	7.74
52	*written briefing	Female	4.68	9.66	4.98	8.40	11.94
53	*verbal briefing	male	4.90	18.42	13.52	16.08	19.37
54	*verbal briefing	Female	4.20	11.82	7.62	10.32	14.20
55	*verbal briefing	Female	4.26	12.30	8.04	10.90	14.00
56	*verbal briefing	male	5.30	10.52	5.22	8.76	12.72

Appendix H Individual comparisons of means

Exit operation hesitation times
Post-hoc comparison of means at the 0.05 level (Tukey HSD)

Briefing Type	No-briefing	Minimum briefing	Verbal briefing	Written briefing
No-briefing			*	*
Minimum briefing				
Verbal briefing	*			
Written briefing	*			

*. Denotes pairs of groups significantly different at the 0.05 level.

Clarity of Exit briefing
Post-hoc comparison of means at the 0.05 level (Tukey HSD)

Briefing Type	Minimum briefing	Verbal briefing	Written briefing
Minimum briefing		*	*
Verbal briefing	*		*
Written briefing	*	*	

*. Denotes pairs of groups significantly different at the 0.05 level.