

EVACUATION AND HUMAN FACTORS: A REVIEW OF RESEARCH

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DEFINITION OF EVACUATION

The use of the term “evacuation” in this presentation refers to “simulated evacuations” performed under controlled, specific conditions.

The specific results presented are not intended to be automatically generalizable to all real emergency aircraft cabin evacuations.

SEAT BELTS

Perceived Difficulty with Quick Removal:

Mean = 10 %

Range = 2 – 21 %

No improvement was found with additional experience.

EVACUATION SLIDE

Perception of incorrect use of the evacuation slide:

Mean = 10 %

Range = 5 – 22 %

Learning curve was present. Learning curve exhibited a very low retention over time.

CABIN CREW 1

**Perception of cabin crew
during evacuations:**

Aided: 62 % (40 to 75 %)

Hindered: 5 % (2 to 10 %)

Neither: 34 % (20 to 58%)

CABIN CREW 2

Passengers evacuated exits controlled by different cabin crew at different rates:

Crew A = 1.53 sec/person

Crew B = 1.63 sec/person

100 passenger load = 10 sec longer evacuation times.

[13 trials of 53 people each]

CABIN CREW 3

Cabin Crew-Passenger Interactions: [Evacuation Slide]

- 1.) crew physically restrained or pushed passengers to regulate flow at exit.
- 2.) crew placed hand on shoulder or arm of passenger causing rotation or twisting in about 30% of exits.
- 3.) crew gave verbal cues to “wait” or “jump” to regulate flow at exit.

FELLOW PASSENGERS

Perception that fellow passengers hindered evacuation:

**Hindrance = 25 to 53 %
Dependant on conditions**

Seat climbing often cited and seen as a cause of hindrance.

CABIN LIGHTING

- A.) Full or Emergency Lighting did not appear to effect perceptions of difficulty in any evacuation scenario tested.**

- B.) Full or Emergency Lighting did appear to have a significant effect on evacuation times. Full lighting was about 0.05 sec/person faster. Cabin load of 100 people would result in 5 additional seconds for evacuation under emergency lighting.**

AISLE vs SLIDE

Evacuation down aisle was consistently perceived as twice as difficult as exiting down the evacuation slide.

On a scale of 1 (very easy) to 10 (very difficult):

Aisle = 4.4 (bottle necks)

Slide = 2.2

BAGGAGE IN THE AISLE

There was a small, but significant increase in perceived difficulty of exiting down an aisle with baggage litter than without on the first of multiple trials. [4.3 vs 3.6]

That perceptual difference disappeared in the second and later trials. Initial perception, probably due to the novelty of the situation rather than the difficulty.

AISLE CONFIGURATION

There was no significant effect of aisle configuration [straight vs zigzag] on average evacuation times or perception of difficulty of exiting cabin.

SEAT CONFIGURATION AND OPENING TYPE III HATCH

Seat configurations examined:

OSR-8": outboard seat removed & 8" pitch.

NOSR-13": normal seat configuration & 13" pitch.

Perception of difficulty: No significant effect.

OSR-8 = 3.4

NOSR-13 = 3.8

[n = 8]

SEAT CONFIGURATION AND UNLATCHING TYPE III HATCH

Seat Configurations:

OSR-8": outboard seat removed & 8" pitch.

NOSR-13": normal configuration & 13" pitch.

Perception of difficulty: Not statistically significant, but $n = 8$.

OSR-8" = 2.6

NOSR-13" = 4.8

SEAT CONFIGURATION AND DISPOSING OF TYPE III HATCH

Seat Configurations:

OSR-8": outboard seat removed & 8" pitch.

NOSR-13": normal configuration & 13" pitch.

Perception of difficulty: No significant effect.

OSR-8" = 7.5

NOSR-13" = 7.3

n = 8

CAUSES OF DIFFICULTY IN DISPOSING OF TYPE III HATCH

Percentage of perceived causes of difficulty:

- 1. Hatch too large = 50 %**
- 2. Hatch handles in poor position = 25 %**
- 3. Not enough room to move = 25 %***
- 4. Hatch too heavy = 0%**
- 5. Hatch off balance = 0%**
- 6. “Other” = 50 %**
- 7. No significant difference between OSR-8” & NOSR-13”. What about an OSR-13”?**

EVACUATION TIMES THROUGH A TYPE III HATCH

- **1.49 Seconds** – mean evacuation time per person.
- **8.3 Seconds** - mean evacuation time for first person (hatch opener) to evacuate.
- **1.18 Seconds** – mean evacuation time per person after first person evacuation.

UNDERSTANDING EVACUATION INSTRUCTIONS

- **Perceived that they understood the evacuation instruction:**
- **Mean = 98 % (Range 93 to 100 %)**
- **Perceived that they used the emergency evacuation slide as instructed:**
- **Mean = 91 % (Range 75 to 100 %)**

CABIN CREW AND EVACUATION TIMES THROUGH TYPE III HATCH

Mean evacuation time per person:

Cabin Crew Present = 1.54 seconds.

Cabin Crew Absent = 1.44 seconds.

Statistically Significantly Different

Mean evacuation time for first person to exit:

Cabin Crew Present = 9.09 seconds.

Cabin Crew Absent = 7.43 seconds.

Statistically Significantly Different

SEAT PITCH AND EVACUATION

- Perception that seat pitch hindered evacuation:
- 29" seat pitch = 41 % perceived hindrance.
- 36" seat pitch = 31% perceived hindrance.
- Statistically Significant Difference ($p=0.001$).

EVACUATION SLIDE DIFFICULTY

Perception of most difficult part of using the emergency evacuation slide:

- 1.) Getting off at the bottom = 36 %**
- 2.) Jumping on at the top = 34 %**
- 3.) Sliding down too fast = 11 %**
- 4.) Keeping balance when sliding = 7 %**
- 5.) Sliding down in general = 7 %**
- 6.) Fear of falling off the side of slide = 3 %**

EFFECT OF PLACEMENT OF TYPE III HATCH ON EVACUATION 1

Q. Did anything within the cabin hinder your evacuation?

Condition 1 (No Hatch) = 54 %

Condition 2 (Horizontal Placement in Exit Row) = 66%

Condition 3 (Vertical Placement in Exit Row) = 80 %

EFFECT OF PLACEMENT OF TYPE III HATCH ON EVACUATION 2

Q. On a scale of 1 (very easy) to 7 (very difficult), how difficult was moving between seats in exit row?

No Hatch = 2.85

Horizontal Placement of Hatch = 3.2

Vertical Placement of Hatch = 3.7

$p < 0.05$

EYE-TRACKING AND PUPILLOMETRY CHARACTERISTICS

- **Eye-tracking (Point-of-Regard):** Ability to determine what a person is looking at. Includes “what,” “how long,” & “scan path.”
- **Pupillometry:** Ability to measure the change in pupil diameter and, thereby, emotional status, mental activity, arousal, and attitude of subject towards POR at a subconscious level.

EYE-TRACKING AND PUPILLOMETRY

APPLICATIONS: [Passengers & Crew]

- 1.) Evaluation of Pre-Flight Briefings and/or Briefing Cards.**
- 2.) Evaluation of use of emergency equipment.**

TRANSPORT CANADA PERSONALITY PROFILE [TCPP2]

Transport Canada Personality Profile Questionnaire [TCPPQ2]

- A.) 40 questions**
- B.) Answers by Likert-type scale of 1
(never) to 7 (very often)**
- C.) Less than 5 minutes to complete**
- D.) Computer program scoring**
- E.) Aim to understand psycho-dynamics
of behavior.**

TRANSPORT CANADA PERSONALITY PROFILE [TCPP2]

TCPP2 is derived from the TCPPQ2.

Reliability:

Short Term Dependability Coefficient:

@ 10 Days = 0.91 to 0.79

Long Term Stability Coefficient:

@ 30 Days = 0.72

@ 90 Days = 0.62

TRANSPORT CANADA PERSONALITY PROFILE [TCPP2]

VALIDITY OF TCPP2

Based on concurrent criterion comparing the TCPP2 to Cattell's 16 Personality Factor (16PF).

Mean Correlation Coefficient = 0.55

[Comparable to other major personality profiles.]

TRANSPORT CANADA PERSONALITY PROFILE [TCPP2]

- | | |
|---|--|
| <ul style="list-style-type: none">• Ego Strength• Assertiveness• Impulsive• Conscientious• Venturesome• Apprehensive | <ul style="list-style-type: none">• Controlled• Tense• Extraversion• Anxiety• Decisive• Independent |
|---|--|

EVACUATION METHOD AND GROUP CHARACTERISTICS 1

- Seat Climbers vs. Non-Seat Climbers
- Physically and Psycho-dynamically different.
- Physically – age, sex, flexibility, % body fat.
- TCPP2 – Restlessness, Confidence, Impulsive, Assertiveness, Venturesome.
- Discriminant Analysis: ($p = 0.0004$)
- 68% Correct Classification of Seat Climbers.
- 62% Correct for Non-Seat Climbers.
- Implication of waiting in line in aisle!

EVACUATION TIMES AND GROUP CHARACTERISTICS 2

- **During evacuations trials, groups naturally fall into “fast” and “slow” categories.**
- **Mean evacuation times: seconds/subject.**
- **Fast: Trial Days 3 & 5 = 1.23 [1.22 & 1.24]**
- **Slow: Trial Days 1 & 6 = 1.43 [1.44 & 1.42]**

EVACUATION TIMES AND GROUP CHARACTERISTICS 3

- **Group/TCPP2**
- **Assertiveness:**
[p = 0.0009]
Fast Group = 16.0
Slow Group = 14.7

- **Group/TCPP2**
- **Goal-Directed:**
[p = 0.0002]
Fast Group = 12.8
Slow Group = 11.5