# EVACUATION STUDIES
-
# DESIGN,
# ANALYSIS,
# & SELECTED RESULTS

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# PRINCIPLES OF RESEARCH ETHICS

- THE ETHICAL IMPERATIVE:
  RESEARCH MUST BE PERFORMED TO ESTABLISH AND IMPROVE THE SAFETY OF AVIATION

- THE ETHICAL CONSTRAINT:
  RESEARCH SUBJECTS MUST BE PROTECTED

# EVACUATION STUDIES: DESIGN AND ANALYSIS PRINCIPLES

- RESEARCH IN EMERGENCY EVACUATIONS OF AIRCRAFT SHOULD ADHERE TO THE STANDARDS OF GOOD RESEARCH PRACTICES. THOSE STANDARDS INCLUDE THE FOLLOWING:

- SUFFICIENT SAMPLE SIZE
- USE OF APPROPRIATE SUBJECTS
- "CONTROL" OF RELEVANT VARIABLES
- DESIGNED TO ANSWER THE SPECFIC QUESTION OF INTEREST
- USE OF APPROPRIATE DESCRIPTIVE AND INFERENTIAL STATISTICAL ANALYSIS

# FACTORS EFFECTING EMERGENCY EVACUATIONS

| AIRCRAFT | ENVIRONMENT | HUMAN FACTORS |
|---|---|---|
| DESIGN | LIGHTING | PERSONALITY |
| CONSTRUCTION MATERIALS | SMOKE | MOTIVATION |
| CONFIGURATION | FIRE | PERCEPTIONS |
| SIZE | DEBRIS | PHYSICAL CHARACTERISTICS |
| ETC. | WEATHER | CULTURE |
| | ETC. | ETC. |

# EVACUATION STUDIES: DEMOGRAPHICS

- ✓ AGE
- ✓ GENDER (SEX)
- ✓ HEIGHT
- ✓ WEIGHT
- ✓ % BODY FAT
- ✓ HANDEDNESS
- ✓ FORWARD BEND
- ✓ SIDE BEND
- ✓ EDUCATION
- ✓ ACROPHOBIA
- ✓ CLAUSTROPHOBIA
- ✓ “EXPERIENCES”
- ✓ OTHER

# EVACUATION STUDIES: EVACUATION TIMES

- TOTAL EVACUATION TIME:
- TOTAL EVACUATION TIME / PERSON:
  TOTAL EVACUATION TIME DIVIDED BY NUMBER OF SUBJECTS.
- EXIT PREPARATION TIME:
  TIME REQUIRED TO PREPARE AN EXIT FOR EGRESS.
- EVACUATION TIME / PERSON:
  TOTAL EVACUATION TIME MINUS EXIT PREPARATION TIME / PERSON.
- FIRST PERSON EVACUATION TIME:
  TIME REQUIRED FOR FIRST PERSON TO EGRESS THE AIRCRAFT CABIN.

# CAVEAT
# EVACUATION STUDY RESULTS

- ✓ The studies discussed in this presentation were conducted by the Human Factors
  ield University, UK.

  UK.

  ns.
  c to the conditions under which they were
  ed. External validity has not been established.

  hed.
  hout detailed consultations with Claude Lewis of
  s of Transport Canada, Dr. Helen Muir of Cranfield
  ield University, and Dr. Neal Latman of NSL
  tes.

# EVACUATION STUDY RESULTS: SEAT BELT RELEASE DIFFICULTY

- ✓ Did the subjects have any difficulty quickly removing their seat belt?

  "YES": MEAN = 7.5%
  RANGE = 0 TO 24%

- ✓ No learning curve has been observed.
- ✓ Not the same people each time.
- ✓ Could it be handedness / seat belt release orientation? Other cause(s)?

# EVACUATION STUDY RESULTS: LIGHTING / EVACUATION TIMES

- ✓ STUDY 1: TYPE 1 EXIT / EMERGENCY SLIDE.
  EVACUATION SLOWER IN EMERGENCY COMPARED TO FULL LIGHTING.
  (N = 4, p = 0.05)
  BUT: No significant effect on perception of ease-of-use of emergency slide or evacuation down aisle.

- ✓ CONCLUSION: NEEDS FURTHER INVESTIGATION.

# EVACUATION STUDY RESULTS: LIGHTING / EVACUATION TIMES

✓ STUDY 2: TYPE 1 EXIT / EMERGENCY SLIDE.
NO DIFFERENCE IN EVACUATION TIMES BETWEEN EMERGENCY AND FULL LIGHTING. ($N = 12$, $p > 0.05$)

No significant effect on perception of ease-of-use of emergency slide or evacuation down aisle

✓ CONCLUSION: Consistent results. Probably no effect of lighting on evacuation times or selected perceptions.

# EVACUATION STUDY RESULTS: LIGHTING / EVACUATION TIMES

✓ STUDY 3: TYPE III EXIT.

NO DIFFERENCE IN EVACUATION TIMES BETWEEN EMERGENCY AND FULL LIGHTING. ($N = 8$, $p > 0.05$)

No significant effect on perception of ease of evacuation down aisle, unlatching exit hatch, opening hatch, or moving hatch out of the way.

✓ CONCLUSIONS: Consistent results.

Probably no effect of lighting on evacuation times or selected perceptions.

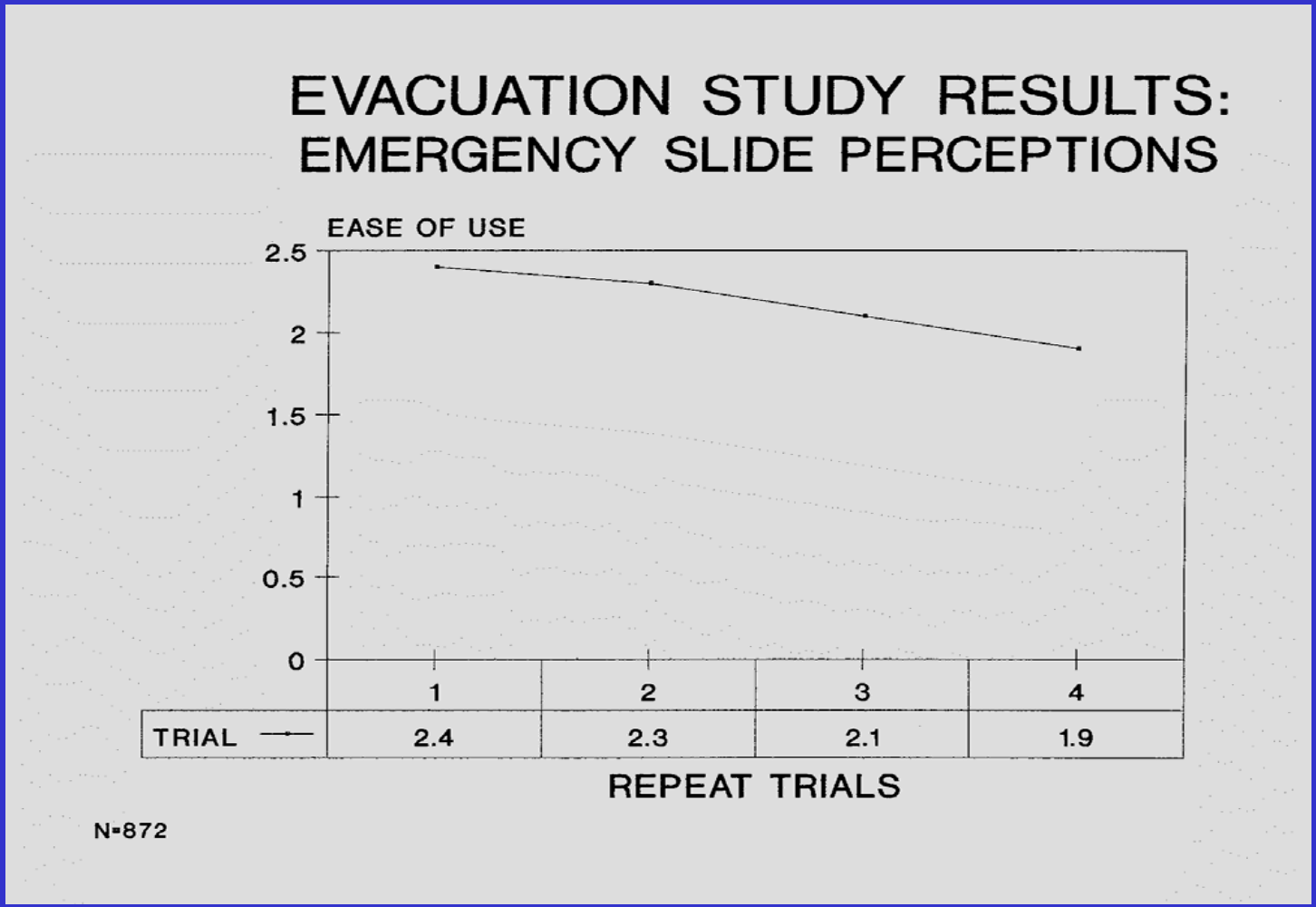
# EVACUATION STUDY RESULTS: PERCEPTIONS OF EVACUATIONS

- EVACUATION DOWN THE MAIN AISLE.
  PERCEIVED DIFFICULTY (1-10)
  MEAN = 4.4
- EVACUATION DOWN THE EMERGENCY SLIDE.
  PERCEIVED DIFFICULTY (1-10)
  MEAN = 2.4
- CONCLUSIONS: USE OF THE EMERGENCY SLIDE WAS PERCEIVED AS
  SIGNIFICANTLY EASIER THAN
  EVACUATION DOWN THE AISLE.

  ($p < 0.000000$)

  WHY?

# EVACUATION STUDY RESULTS: EMERGENCY SLIDE PERCEPTIONS



# EVACUATION STUDY RESULTS: EMERGENCY SLIDE PROBLEM AREAS

- GETTING OFF AT BOTTOM OF SLIDE: 36%
  (too low)
- JUMPING ON AT TOP OF SLIDE: 34%
  (?)
- SLIDING DOWN TOO FAST: 11%
- SLIDING DOWN IN GENERAL: 7%
- KEEPING BALANCE WHILE SLIDING DOWN: 7%
  (cabin crew?)
- SLIDING DOWN TOO SLOW: 3%
- FEAR OF FALLING OFF THE SIDE OF SLIDE: 3%
  (cabin crew?)

# EVACUATION STUDY RESULTS: EMERGENCY SLIDE PROBLEMS VIDEO

1. KEEPING BALANCE
2. FEAR OF FALLING OFF SIDE OF SLIDE

POSSIBLE CABIN CREW EFFECT

*VIDEO (COPY AVAILABLE ON REQUEST)*

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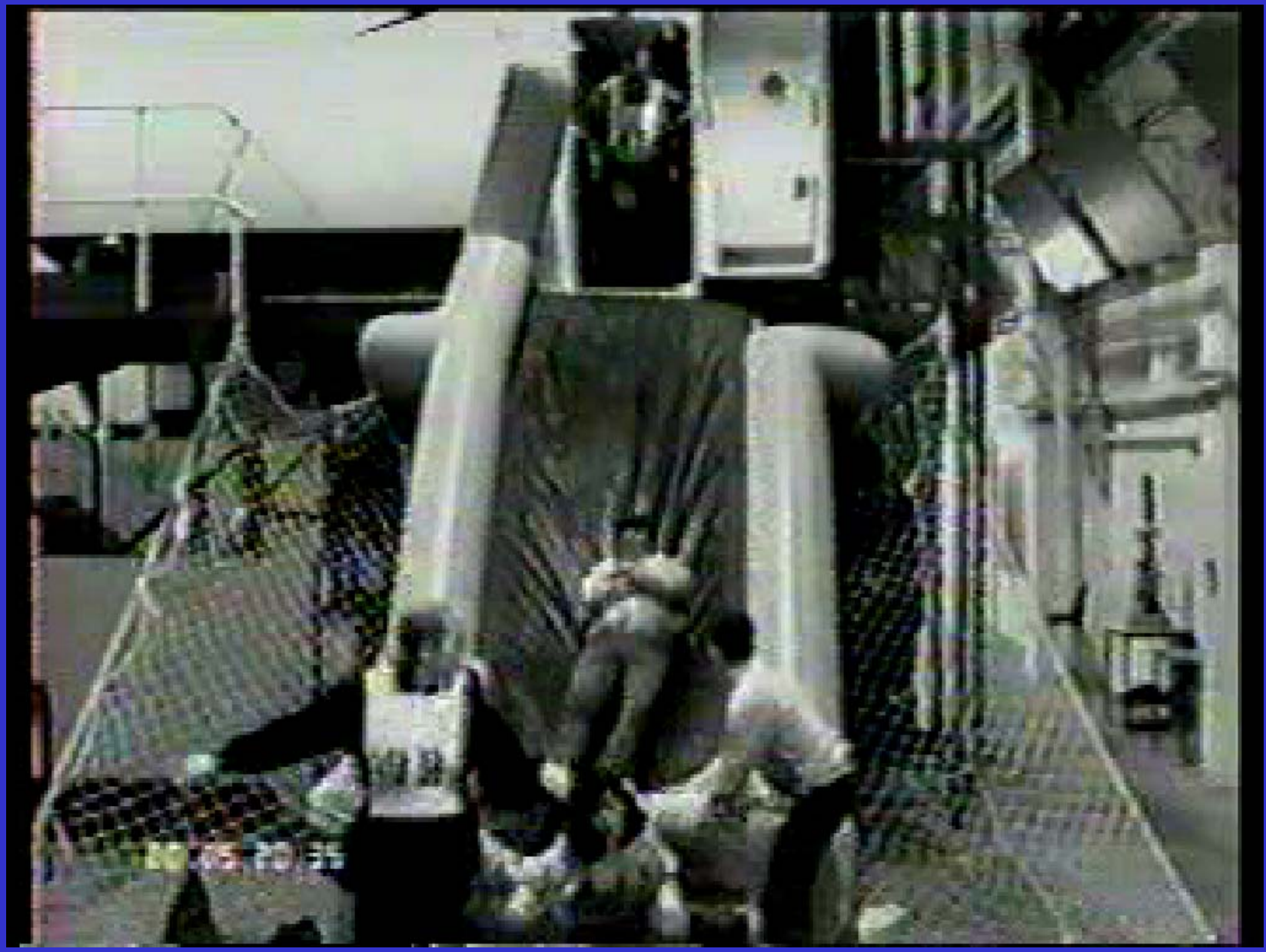

*VIDEO (COPY AVAILABLE ON REQUEST)*

# EVACUATION STUDY RESULTS: DIFFICULTY OF TYPE III EXITS

| TASKS | PERCEPTIONS (1 to 10) |
|---|---|
| 1. UNLATCHING HATCH | 3.0 |
| 2. OPENING HATCH | 3.8 |
| 3. MOVING HATCH OUT OF WAY | 6.2 |
| 4. EXITING THROUGH EXIT | 4.3 |

**N = 12**

# EVACUATION STUDY RESULTS: PROBLEMS WITH TYPE III EXITS

- MOST COMMON PERCEIVED PROBLEM:
  NOT ENOUGH ROOM TO MOVE

- OTHER SIGNIFICANT PROBLEMS:
  HATCH TOO LARGE
  HATCH OUT OF BALANCE
  HANDLES IN AWKWARD PLACE

# EVACUATION STUDY RESULTS: VERTICAL PROJECTION DISTANCE

- "DID THE SUBJECTS PERCEIVE ANY PHYSICAL CHARACTERISTIC OF THE AIRCRAFT CABIN AS AN AID OR HINDRANCE TO THEIR EVACUATION"
- "SEAT PITCH" 29 INCHES — "SEAT PITCH" 36 INCHES

| 29 INCHES | | 36 INCHES |
|---|---|---|
| 13% | AIDED | 27% |
| 41% | HINDERED | 31% |

- $p = 0.01$
  Statistically significant difference

# EVACUATION STUDY RESULTS: VERTICAL PROJECTION DISTANCE

| "*AISLE* WIDTH" | AIDED (%) | HINDERED (%) |
|---|---|---|
| 29 INCHES | 2 | 17 |
| 36 INCHES | 8.7 | 9.2 |

p = 0.001
Statistically significant difference

N = 10 RUNS / 39 PER RUN