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When smoke gets in our eyes Proulx, Guylène

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Institute for
Research in
Construction

**When smoke gets in your eyes
or
How would you react during a fire evacuation?**

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National Research
Centre Canada /
Centre national
de recherches Canada

Canada

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Presentation Outline

- Research into Human Behaviour in Fire
- Most Common Response
- Pre-movement Time
- Movement in the Stairs
- Fire Emergency Safety Strategies
- Are You Prepared?
- Questions

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Research into Human Behaviour in Fire


- Study evacuation drills
 - Control conditions
 - Video camera
 - Questionnaire
- Study after fire events
 - Recreate the emergency
 - Interview survivors
 - Interview staff and rescue personnel

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Is Panic a Common Response?

- Frozen in fear
- Irrational response
- Mayhem
- Every man for himself




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Panic Is Not a Common Response Pattern

- Altruistic behaviour
- Small talk - Milling
- Help others
- Adaptive
- Rational



Courtesy of John Labriola, WTC 1 71st floor

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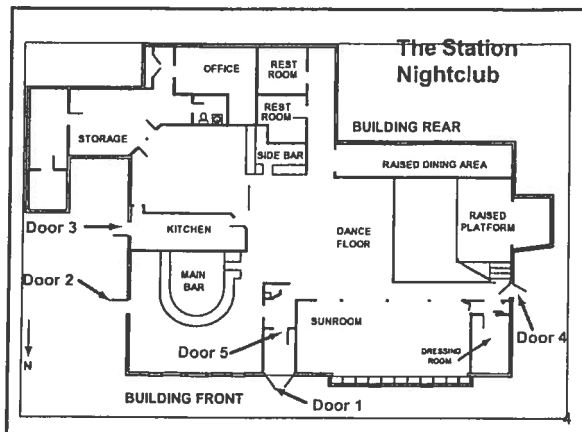
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If People Don't Panic, Then What?

In the initial moment

- Absence of response
- Commitment

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Chronology of the Event at The Station

Elapsed Time	Event
0	Pyrotechnics activated
9 s	Flame visible on wall
19 s	Flame progress on wall
20 s	Crowd began to react
25 s	Flame at ceiling
30 s	Band stopped playing
41 s	Fire alarm and strobes activated
60 s	Smoke at ceiling throughout room
71 s	Cameraman left by front door
102 s	Occupants piled up at front door

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Acknowledging the Unusual

- Investigating ambiguous cues
 - ↳ How many cues?
- Milling with others to discuss situation
 - ↳ How long?

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Initial Actions

- Role in the building
- Warning others:
 - Affiliation
 - Contact friends and family
- Fighting the fire
- Getting prepared to leave
- ↳ How long will this take?

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Pre-Movement Time in Past Drill Studies

- High-rise office evacuation drills
 - Mean pre-movement time observed
 - 0 min 36 sec London building
 - 1 min 3 sec Ottawa building
 - 1 min 2 sec Jean Talon building
 - 1 min 7 sec C.D. Howe building

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Pre-Movement Time in Past Fire Studies

- High-rise office fires
 - Mean pre-movement time estimated
 - 11 min 2 sec WTC 1993 Tower 1
 - 25 min 24 sec WTC 1993 Tower 2
 - 6 min 0 sec WTC 2001 Tower 1
 - 5 min 0 sec Cook County Fire 2003

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Pre-Movement Time in Highrise Residential Buildings

- 6 residential high-rises
- Unannounced evacuation drills
- Thursday, 19:30 summer (Building 6 winter)
- Firefighters' participation
- Video camera in corridors and stairwells
- Questionnaire and interviews



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Mean Pre-Movement Time

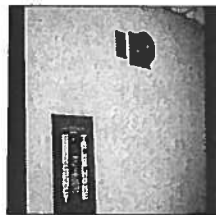
- Building 1 2 min 30 sec
- Building 4 3 min 08 sec
- Building 5 2 min 48 sec



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Mean Pre-Movement Time

- Building 1 2 min 30 s
- Building 2 8 min 22 s
- Building 3 9 min 42 s
- Building 4 3 min 08 s
- Building 5 2 min 48 s
- Building 6 5 min 19 s (winter)



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Conclusions – Apartment Study

- Audibility is essential
- Training is essential
- Pre-movement is around 3 min
- Time to move is about 1 min
- Occupancy dependent

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Pre-Movement in High-Rise Residential Fires

- Forest Laneway fire around 15 min
- Ambleside fire around 5 min



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Conclusions on Pre-Movement

- Several initial actions
- Variable pre-movement time
- Information and training



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Selecting an Evacuation Route

- Familiarity with the building
- Training
- Looking at others
- Following instructions

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Factors Slowing Down Movement

- Stairwell size and crowd density
- Simultaneous evacuation of several floors
- Cell phones and BlackBerries
- Evacuees out of shape or overweight
- Footwear
- Smoke, water, debris, no signage, no lighting

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Improving Evacuation Movement

- Appropriate stairwell width
- Additional stairwells for the lower floors
- Education and training
 - Footwear
- Introducing photoluminescent wayguidance path marking



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Fire Emergency Safety Strategies

- Full evacuation
- Phased evacuation
- Protect-in-place
- Refuge area, refuge floor
- Safe elevators

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Full Evacuation

- Straightforward
- Long time in tall buildings
- Crowd on stairs
- Bottleneck to enter stairs
- People most at risk might not leave
- May be necessary in some emergencies

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Phased Evacuation

- 2-stage alarm (alert-evacuation)
- Voice communication essential
- Complex for occupants, needs training
- Efficient movement in stairs
- Total evacuation might be very long
- Works best in practice

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Protect-In-Place

- Only the people in the compartment of the fire evacuate
- All occupants stay in their compartment
- Seal cracks and openings
- Call to be rescued
- Be very patient

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Refuge Area

- Location safe from smoke and fire for 2 hours
- Accessible
- 2-way communication
- Close to a means of egress
- Chair, window in fire doors, etc.

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New Demographics and Anthropometrics

- Occupants with mobility impairments
- Elderly
- Overweight and obesity
- Out of shape
- Health issues



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Safe Elevators

- Technical considerations:
 - Smoke, heat, water, fire, power failure, etc.
- Management considerations:
 - Elevator functionality
 - Who can use the safe elevator?



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Improving Occupant Response During Fires: Provide Information

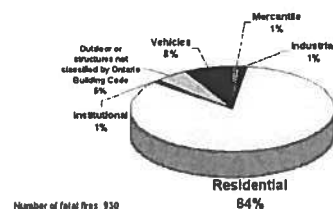
- Training prior to an event
- Information during the event
- Debriefing after an event



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Where Are You Most Likely to Experience a Fire?

Fatal Fires: Property Class



Ontario fatal fires:
10 years
1997 to 2006

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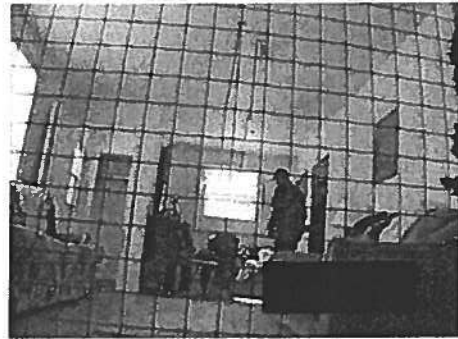
Residential Fires

- Most fires start:
 - Cooking
- Most fatal fires:
 - Smoker's material 42%
 - Cooking 18%
 - Candles 6%
 - Heating 5%
 - Electrical 5%



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Time to Escape a House Fire



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Are You Prepared?

- Install smoke alarms
- Plan to escape
- Choose a meeting place
- In the event of a fire
 - Crawl low under smoke
 - Close doors
 - Call FD from outside
 - Don't go back in



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Overall, People in Fires:

- Are rational, can think for themselves
- Are able to make decisions on the information available
- Will attempt to preserve themselves and loved ones
- Are helpful, courageous, cooperative

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Overall, People in Fires:

- Are not fire experts
- Lack experience with emergencies
- Will use a familiar plan of action
- Will follow instructions
- Are relatively cool and composed, the trauma comes after the event

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For More Information

- The National Research Council Canada publication website:

http://irc.nrc-cnrc.gc.ca/pubs/index_e.html

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