Lay people responses in radiological emergencies:
Insights from a literature review

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Integrating societal concerns and ethical considerations in emergency preparedness and response
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Introduction

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- Study undertaken in the framework of the European project CONFIDENCE.
- Based on a literature review on people's behaviour in radiological emergency situations.
- Understanding / anticipating lay people and emergency actors' sense making of uncertainties and their subsequent behaviour is critical to improving preparedness plans and communication strategies.

Theoretical background

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- Emergency plan as a socio-technical object (Rossignol et al., 2014)
- "When creating these [legal] systems [of protection], it is absolutely essential that the affected communities and individuals themselves can be at the centre of the process" (Fukushima Committee Booklet, 2015)

"Radiation Protection is informed by science, but driven by personal and social values"

Objectives

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Review of social science studies investigating **lay public behaviours following a nuclear accident**:

- methods used (sample, research techniques)
- theoretical frameworks
- main variables studied (dependent / independent variables)
- main findings

Research questions:

1. How do people (expect to) react to an emergency?
2. Are they willing to follow protective actions recommendations?
3. What is their perception of protective actions?
4. Which factors influence expected or real behaviour?

Method

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- Literature review using Google Scholar and Web of science → peer-reviewed articles (primary sources).
- Search conducted between April and May 2017.
- Keywords: “nuclear emergencies” and (“behaviour” or “reactions” or “protective actions”)
- Mendeley Desktop used to manage search results.

Method - Eligibility criteria

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Study component	Inclusion criteria
Date range	1979-2017
Publication characteristics	English language, peer-reviewed journal article
Study design	Empirical study (primary data source)
Population	General public / Affected populations
Focus	Lay people's responses during radiological emergencies
Outcome	12 papers

Method - Screening and data extraction

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- Two reviewers coded an initial sample of papers independently, with disagreements resolved by discussion and reference to a third reviewer when necessary.
- After screening, data were extracted from the selected articles using a standardised tabular summary for narrative synthesis.

Reference	Topic	Objective	Method	Sample	Model/theory	Dependent variable	Independent variables	Items	Main conclusions
31) Houts, P; Lindell, M; Hu, T; Cleary, P; Tokuhata, G; Flynn, C. (1984)	Evacuation behaviour in nuclear accidents (Three Mile Island).	The purpose of this analysis is to determine the degree to which variables postulated in the protective action decision model explain evacuation behaviour.	Data reported in this article was gathered from a survey conducted by Flynn in July 1979.	People living in a 55 miles radius from Three Miles Island facility (0-5, 6-10, 11-15, 16-25, 26-40, 41-55 miles). N=1505	Protective Action Decision Model (PADM).	Whether anyone in the household evacuated during the crisis.	a) Perceived severity of the hazard. b) Susceptibility to the hazard. c) Barriers to evacuation. d) The cost of evacuation. e) Other issues. Other factors not included in the PADM: f) - expectations about future evacuation orders g) Absence of an official evaluation h) Contradictory nature of the information available	a) - Did you feel that the situation at Three Mile Island was a threat to you and your family's safety? b) - Distance from TMI. - Whether someone in the household was pregnant at the time of the crisis. - If there were children under six years of age in the household. c) (whether a person stayed home because): - Not able to leave the job. - Lack of transportation. - No place to go. - Too sick or disabled to travel. d) - Costs of evacuation. - Dealt with ease of evacuation. - Where people stayed after they left. e) - Expectations about future evacuation orders. - The lack of an official order to evacuate. - The contradictory information provided to residents.	The results of these analyses are consistent with the protective action decision model. The severity and susceptibility variables were significantly related to household evacuation behaviour as predicted by the model. The reluctance of some households to evacuate in the absence of an official evacuation order appears to be related to the issue of source credibility. The mention of conflicting information as a justification for evacuation does represent a significant difference from previous disaster studies. The finding that conflicting information has an effect opposite to that reported in previous studies may be the result of unique features of radiation hazard, specifically, the inability of the individual to see or feel radiation. Therefore, people faced with the threat of a nuclear accident may resolve conflicts among experts by taking what appears to be the safest course of action; evacuation.

Findings I

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- 7 papers on reactions to real nuclear accidents (TMI, Chernobyl):
  - (Self)-Evacuation and self-relocation behaviour and influencing factors in TMI
  - Protective measures in the EU after Chernobyl

- 5 papers on anticipated public response to a radiological or nuclear emergency incident/accident:
  - Intended compliance with official advice
  - Potential factors affecting individual decision-making, e.g. evacuation
  - People's knowledge, views, perceptions, reactions, and concerns related to a nuclear/radiological terrorism event.

- Data collection: mostly surveys (only one focus group and one interviews)

Findings

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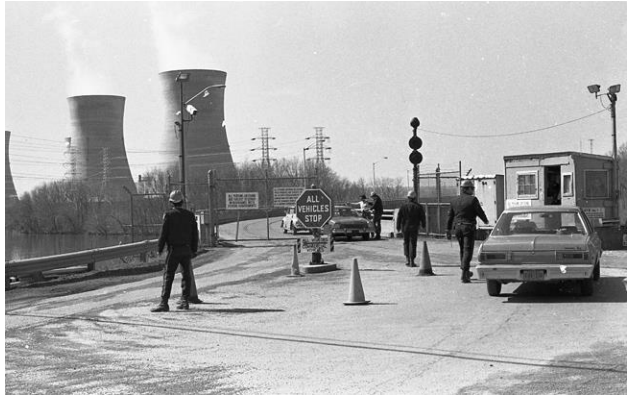
Studies dealing with real accidents:

- TMI (evacuation advised for pregnant women and small children within 5 miles, and shelter advice for people living within 10 miles radius)
  - Rather extensive evacuation; yet 40% did not evacuate in the 5-mile radius, while 56% did not evacuate in the 5-10 miles ring (Flynn, 1979).
- Reported reasons for:
  - ✓ Evacuating: perceived danger, confusion, fear of a forced evacuation (Flynn, 1979), concern for personal safety (Zeigler et al., 1981)
  - ✓ Not evacuating: waiting for an evacuation order, or being unable to leave their jobs (Flynn, 1979).



Findings

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Studies dealing with real accidents:

- Determinants of evacuation behaviour:
  - ✓ Socio-demographics: Distance from TMI, sex (females more likely to evacuate), pregnancy status, presence of small children (Flynn, 1979), stage in the life cycle, actions of friends and neighbours (Cutter & Barnes, 1982), age, years in the area (Prince-Embury, 1989).
  - ✓ Attitudinal: Perceived severity, susceptibility, barriers, and costs (Houts et al., 1984).

Findings

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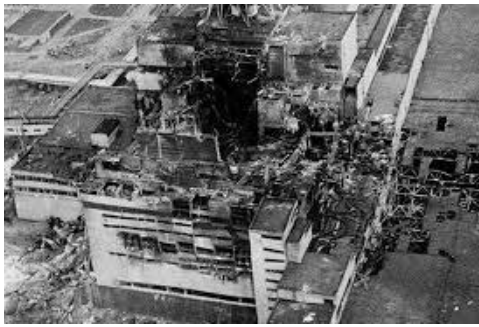
Studies dealing with real accidents:

- The level of Chernobyl fallout in 12 countries significantly correlated to the proportion of population who reported having taken countermeasures (e.g. washing fruit and vegetables, food selection) (Tonnessen et al., 2002).

Table 3. Protective Measures Taken and Responses to the Question about the Two Major Consequences: Percentages for Total Euro-Barometer (EB) Material ($N = 11,729$), and Lowest and Highest Percentages Observed Within the 12 Countries Surveyed

	EB total	Minimum	Maximum
Protective measures taken, if any:			
Did not take any particular measures	52	8	83
Carefully washed fruits and fresh vegetables which might have been contaminated	34	7	79
Did not eat some agricultural produce which might have been contaminated	28	4	73
Take (extra) precautions about your children's food	9	2	25
Did not drink water from the tap	6	1	18
Consulted a doctor	4	0	13
Avoided as much as possible leaving your home in the days following the announcement about the accident	4	0	13
Temporarily left the place where you lived for a less contaminated area	2	0	7
Others (specify)	2	0	3
The two major consequences of the accident:			
A greater awareness of the potential dangers of nuclear energy	57	26	72
A noticeable stepping up of the security measures in nuclear power	24	5	39
A serious threat to the health of the people of our country	22	6	47
The risk of upsetting some long-term ecological balances	21	10	34
Significant losses for farmers	19	5	39
Fears out of proportions to what actually happened	11	4	21
No consequences	6	1	21



Findings

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Emergency preparedness studies with hypothetical nuclear accident/ radiological incident scenarios:

Immediate most likely responses / reactions:

- Shoreham NPP: A relatively small portion of the population are likely to follow instructions (less than 1/3 of households) (Johnson & Zeigler, 1983)
  - ✓ Many would over-react (e.g. evacuate when not needed)
  - ✓ 25% of the population would depart spontaneously (Johnson, 1985).
- In the case of an hypothetical radiological incident in Sydney: Calling family members to check they are OK, seeking shelter indoors, calling emergency services, covering mouth to prevent inhalation of dust, and trying to get back home (Taylor et al., 2011)
- In the case of a potential nuclear accident in Hong Kong: Leaving the city (23%), following media news (22%), going home (21%), staying in place (16%) (Chung & Yeung, 2013).

Conclusions I

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What we found:

- Very few research in comparison with natural disaster emergencies
- Mainly research on responses to power plants accidents (TMI)
- Most studies focused on evacuation behaviour
- Surveys are the most used research technique
- Affected populations as the most studied samples (probably related to the focus on evacuation behaviour)
- Existing studies not sufficiently grounded in theory

Conclusions II

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Main results from existing studies:

- Evacuation and sheltering in place recommendations are not always followed
- Predictors for taking protective actions:
  - Socio-demographic: age, time of residence in the place, location of home relative to the plant
  - Attitudinal: attitudes toward nuclear power, risk perception, perceived severity, perceived susceptibility, perceived barriers for taking protective action (e.g. inability to leave the job), concern for personal safety, social norms (what friends and neighbours do)

Conclusions III

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Research gaps:

- New, empirical studies, with strong theoretical background (e.g. social psychology)
- Understanding the fundamental processes whereby people define reality in order to predict how they will respond to emergencies and warnings
- Societal concerns and information needs in emergency situations
- Acceptance and compliance with protective measures such as intake of iodine tablets, food bans on local products, and other behaviours (spontaneous departure, call emergency centres)
- Attention to radiological incidents
- Coupling results back to with emergency and risk communication plans

Forthcoming study in CONFIDENCE

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Explore relationships between:

- Dependent variable:
  - **Expected compliance with emergency protective actions**
- Independent variables (potential predictors):
  - descriptive norms (others performing the action)
  - hazard related attributes (efficiency of protective actions)
  - resource related attributes (effort needed, knowledge)
  - perception of risks from nuclear accidents
  - trust in information sources
  - socio-demographic variables
- Empirical research based on opinion surveys in Belgium, Norway, Spain

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Thank you very much for your attention

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