Uncertainties in human behaviour, cultural differences and social uncertainties

as a part of the tools and approaches to support the decision making process

Training Course

Use of uncertain information by decision makers at the various levels within the decision making process and its communication

Trnava, Slovak Republic, 13-15 May, 2019

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This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 662287.

Objectives of this lecture

- Reflect on the social uncertainties associated with the different phases of an accident
- Understand the links between expert and lay uncertainties
- Incite reflection on ways to cope with social uncertainties, in order to improve preparedness and response to nuclear emergencies

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Fukushima: Uncertainty is the new norm

Living with the 'known unknowns' for three years is taking its toll on residents near the damaged Daiichi plant.

Michie Masukura lost her family and home in the tsunami and now lives in temporary housing [D. Parvaz/Al Jazeera]

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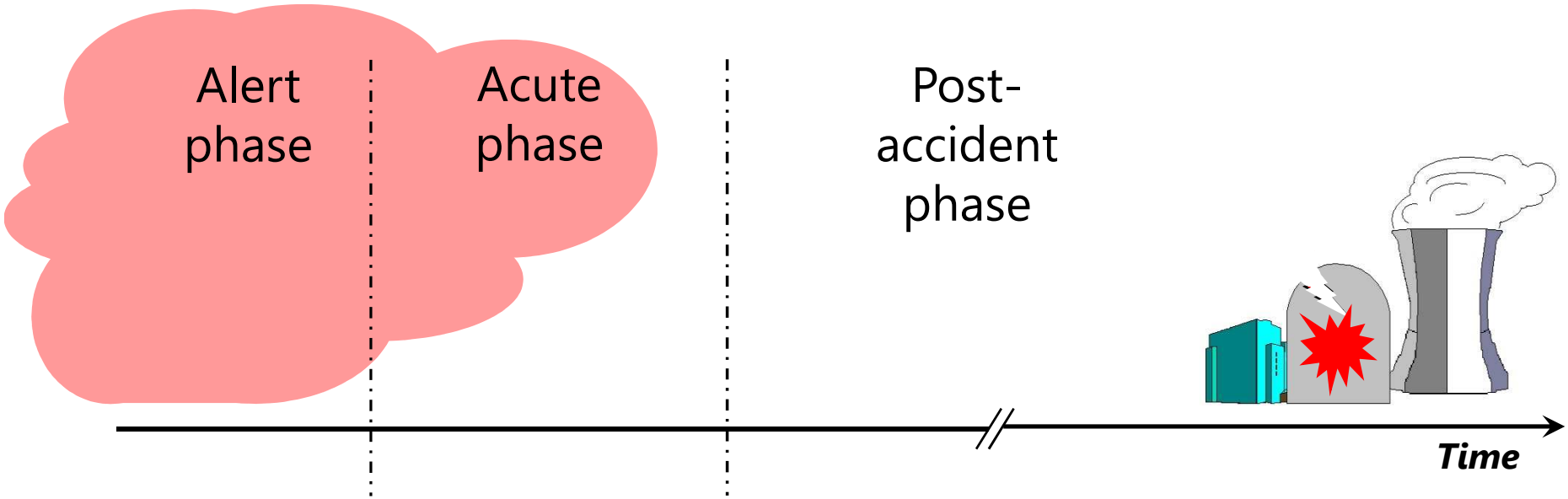
Timing of an accident



… what uncertainties do citizens face in an emergency situation?

…and what does this mean for emergency planning and response (EP&R)?

Drawing by: C. Vandecasteele, FANC

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What are people's first concerns when confronted with a nuclear emergency situation?

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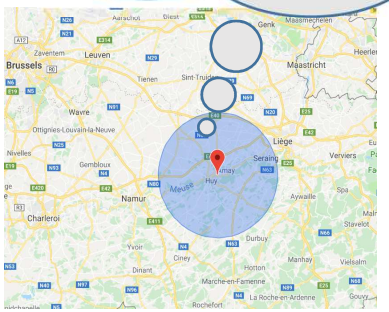
Main concerns /first reactions differ between countries and regions

Imagine we have just heard the news that a nuclear accident has taken place at a nuclear installation in your country or close to its borders and radioactivity has been released in the air. What would be your first concern?

<20 km Doel NPP

People: 17%
Risk: 18%
Take iodine pills: 14%
Stay/go indoors: 12%
Leave area: 11%



<20 km Tihange NPP

Risk: 30%
People: 14%
Stay/go indoors: 14%
Contamination: 10%

Also fatalistic views, e.g. “Stay at home and wait till I die or wait till the government does something”

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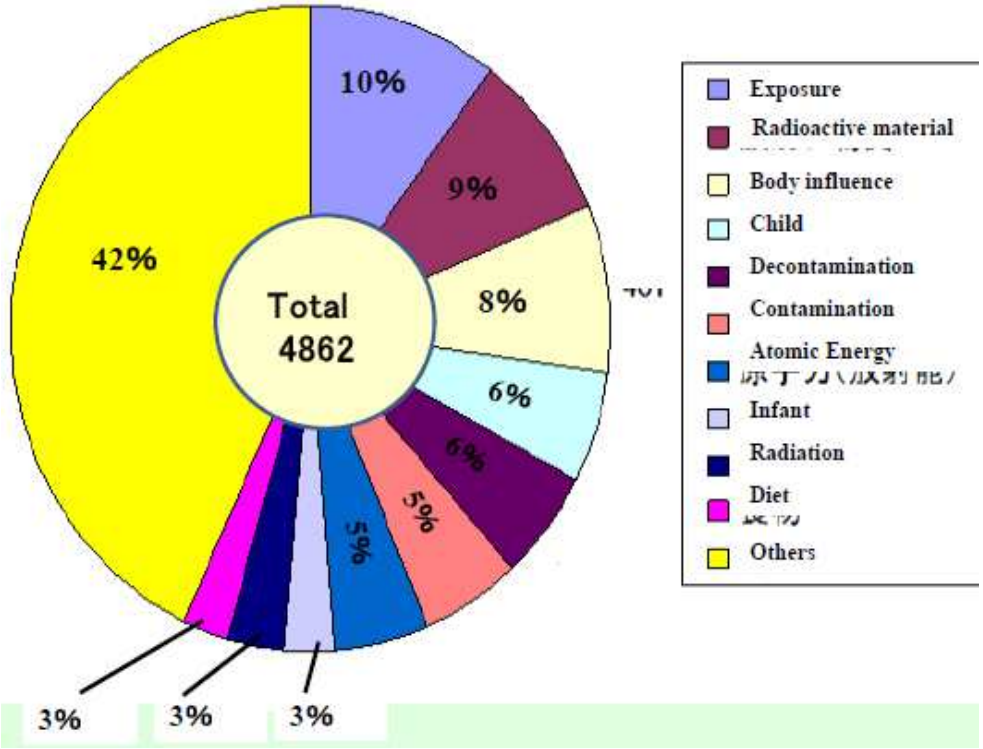
Main concerns after Fukushima (1)

- Results* from a Q&A website in Japan (Kono et al, 2012)
  - Main concerns: exposure, radiation and radioactive material, effects on health, effects on children, diet, other



*Questions asked via dedicated website, active between March 2011 till February 2012, but inactive from May 26 to June 5, and from July 2 till August 21 due to overload

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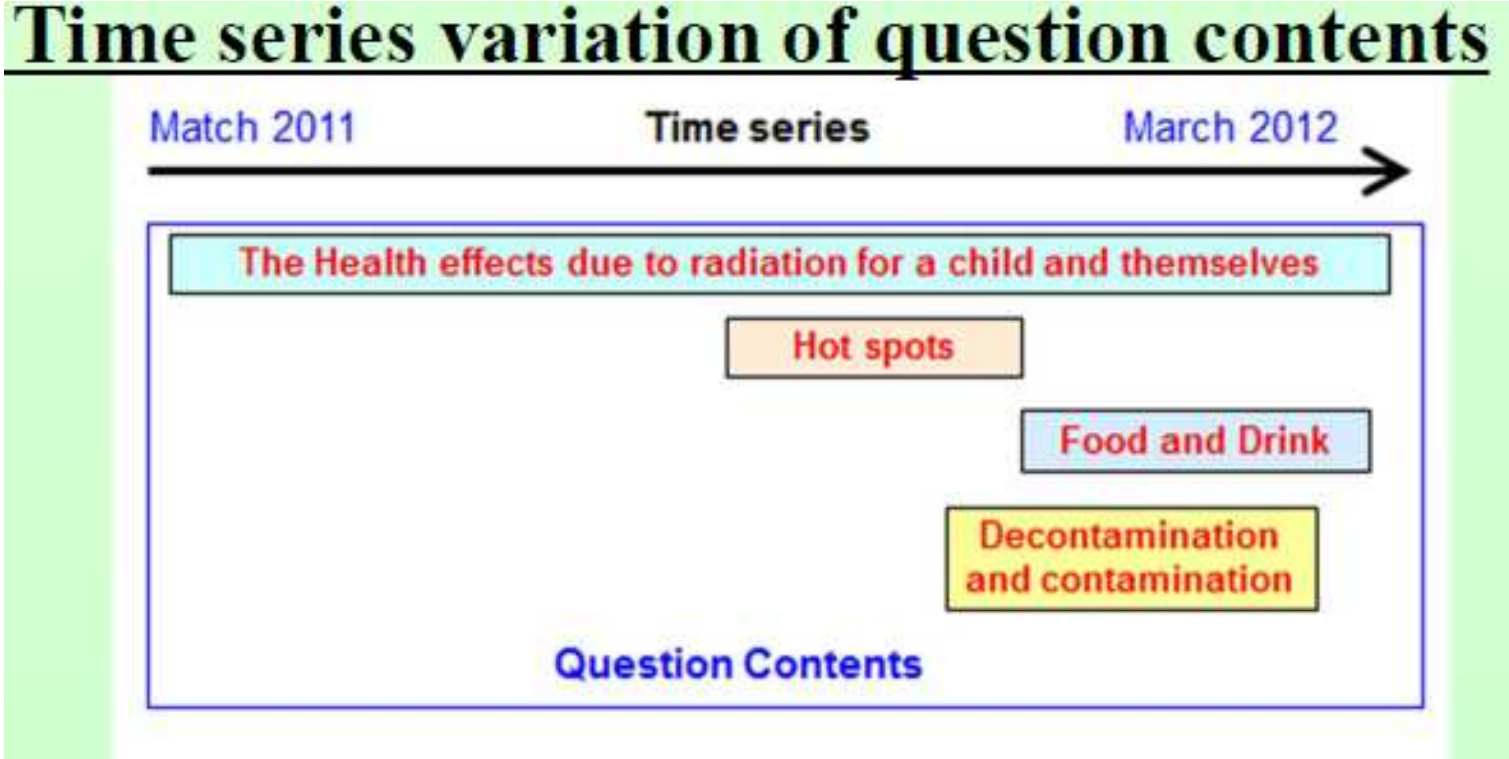
Main concerns after Fukushima (2)

- Results* from a Q&A website in Japan (Kono et al, 2012)
  - Main concerns: exposure, radiation and radioactive material, effects on health, effects on children, diet, other



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What do citizens believe about EP&R in European countries?

- A nuclear accident is perceived as disruptive, uncontrollable, with huge dispersion of radioactivity, damage to the region and infrastructure, severe health consequences
- Low awareness about EP&R plans and protective actions
  - Particularly for intake of stable iodine tablets
  - Uncertainty about whether it is better to stay / follow instructions or simply leave the area?
- Doubts about the effectiveness of plans in case of a major accident
- Evacuation:
  - Spontaneous: “as far as possible”, after consultation of meteorological conditions (sometimes in the wrong direction!)
  - Organised: Authorities to take the lead. In some countries agreement with evacuation of school children by authorities, in others people wish to gather children and other family member before an evacuation
- Sheltering
  - Many days? Or as short as possible?
  - Food and water in stock would not last for longer than a couple of days.
  - (Some believe that clean food will be provided from unaffected areas of abroad).

CONFIDENCE Deliverable D9.27 - Identification of mental models of uncertainty management in emergency situations, Zeleznik et al (2019).

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What do citizens believe about EP&R in European countries?

- Belief that authorities will try to hold back parts of information
  - To avoid chaos, panic, and uncontrollable reactions from the public
  - Cf. previous cases of lack of info and transparency.
- From citizens' point of view, key elements in the emergency plans are:
  - instructions for the population what to do in case of an accident,
  - guidance to pick up children,
  - channels for reliable information,
  - precautionary recommendations,
  - information about moving away from the area or to a safe location,
  - distribution of masks, iodine tablets and protective equipment,
  - dietary advice.

CONFIDENCE Deliverable D9.27 - Identification of mental models of uncertainty management in emergency situations, Zeleznik et al (2019).

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What are additional sources of uncertainty for citizens in an emergency situation?

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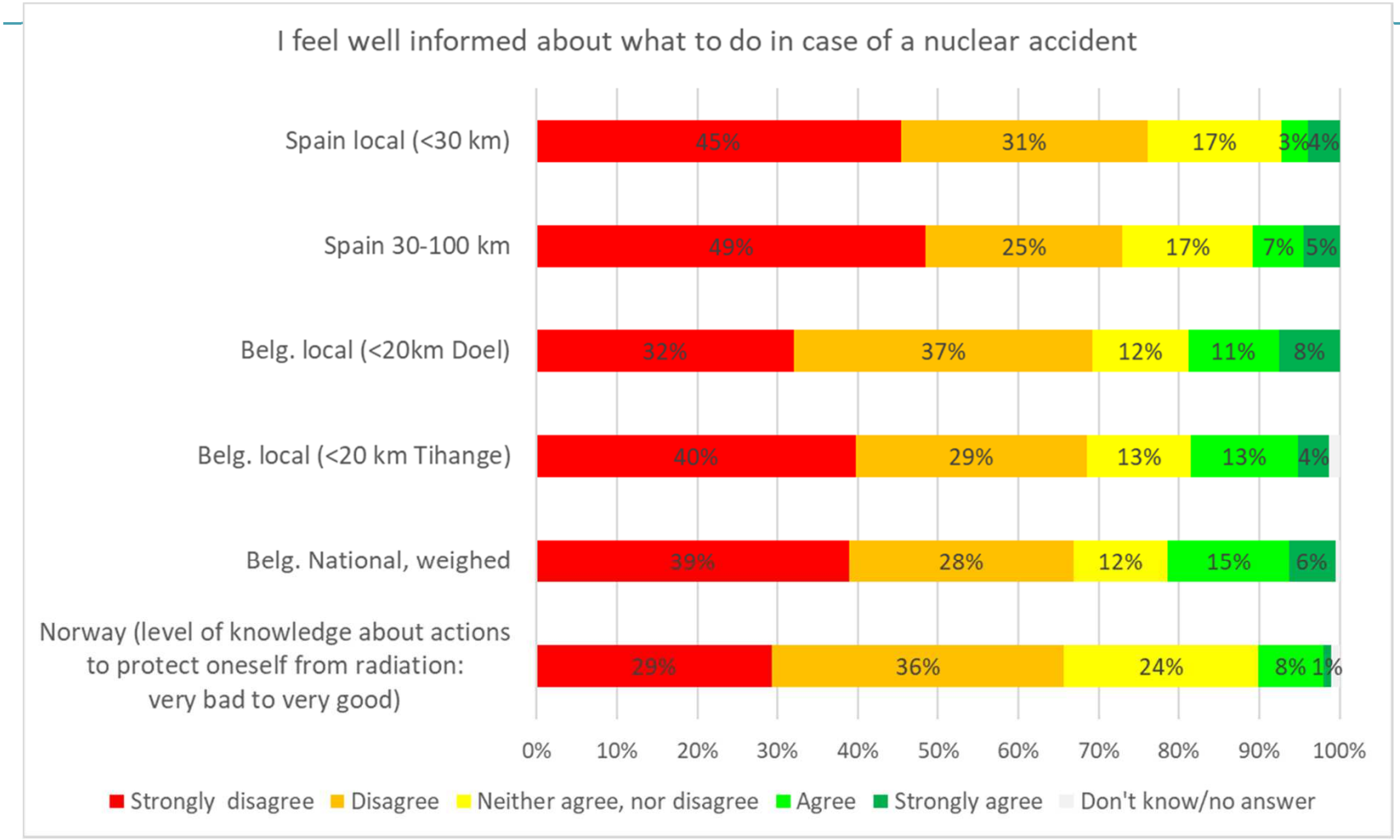
Low self-reported prior knowledge



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Technical issues

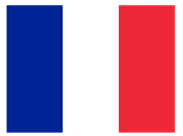
- Late detection, e.g. Asco, Fleurus
- Magnitude and range of the contamination (all cases)
- Measurement uncertainties
  - environmental monitoring (data and measurement quality, different instrumentation and measurement techniques, etc.)
  - health monitoring (e.g. thyroid measurements).
- Need for retrospective analysis and modelling, e.g. Asco (detected with delay of 4 months) and Tricastin (presence of prior release)
- Reporting, interpretation and justification of measurements
- Variability and inhomogeneity of measurements e.g. in Norway after Chernobyl and Asco, Spain
- Differences in intervention levels for protective actions

Case studies

Chernobyl (1986)

Fleurus (2008), Iodine release from isotope production facility

Asco (2007), release of radioactive particles from NPP



Tricastin (… - 2008), uranium leak into groundwater

Krsko (2008), unusual event

CONFIDENCE Deliverable 9.25: Case descriptions for characterization and response to uncertainty in past nuclear emergencies. Oughton, Perko et al (2018)

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Contradictory or ambiguous information

- Permissible limits have been exceeded, but it's not dangerous
- Any increase in radiation causes cancer, but it is insignificant.
- No health danger for locals, but radioactivity tests for citizens who want a check-up of their thyroid
- It is prohibited for citizens to use their self-harvested fruits and vegetables, but local farmers can sell their fruits and vegetables on the market.

CONFIDENCE Deliverable 9.25: Case descriptions for characterization and response to uncertainty in past nuclear emergencies. Oughton, Perko et al (2018); Tomkiv et al (2018), RICOMET 2018

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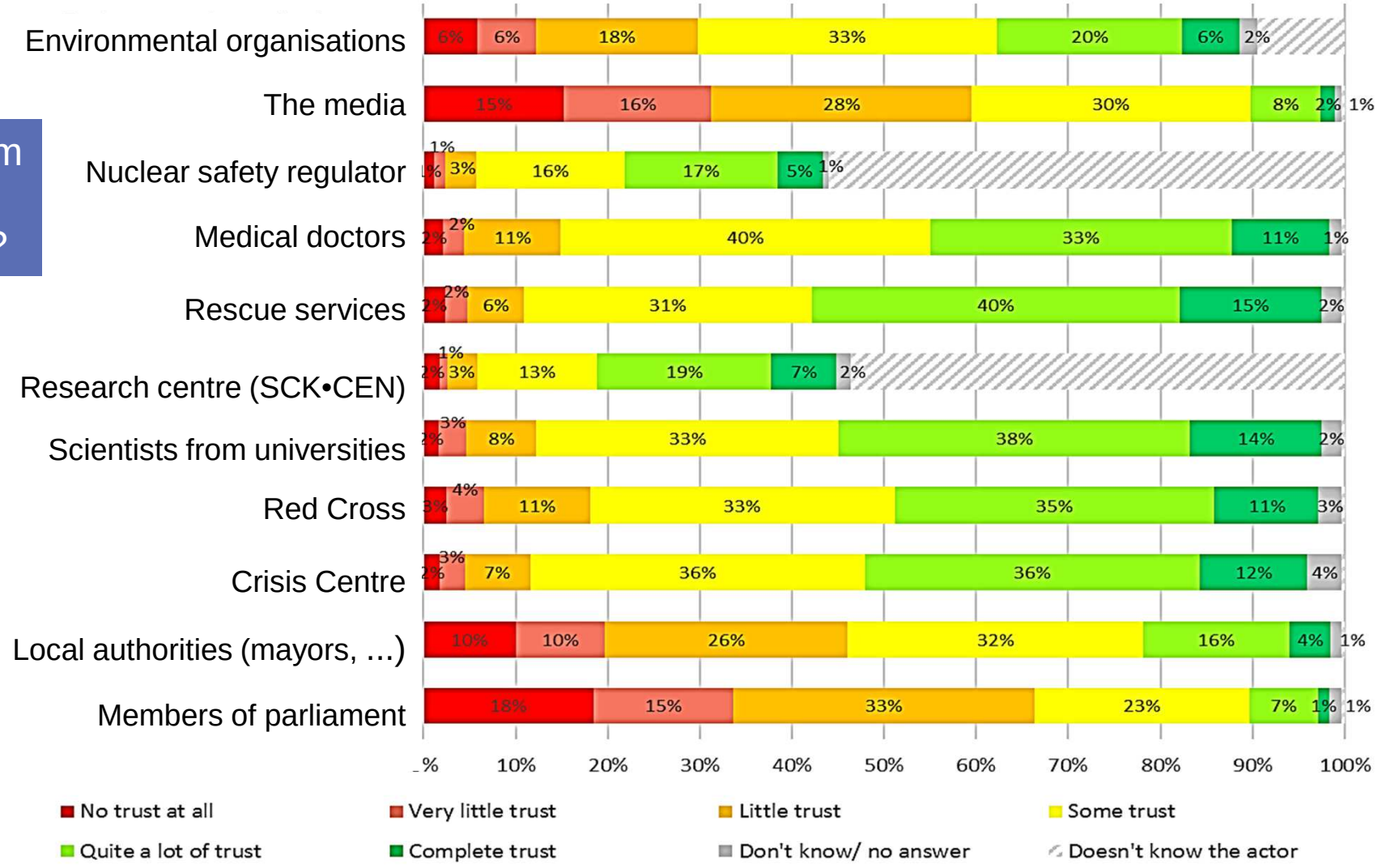
To what extent do you trust the following actors to provide correct and objective information about how to protect yourself in case of a nuclear accident?

Whom to trust?



Belgium, general public, N=1083, sample weighed for education, gender and age

Data source: H2020 CONFIDENCE project

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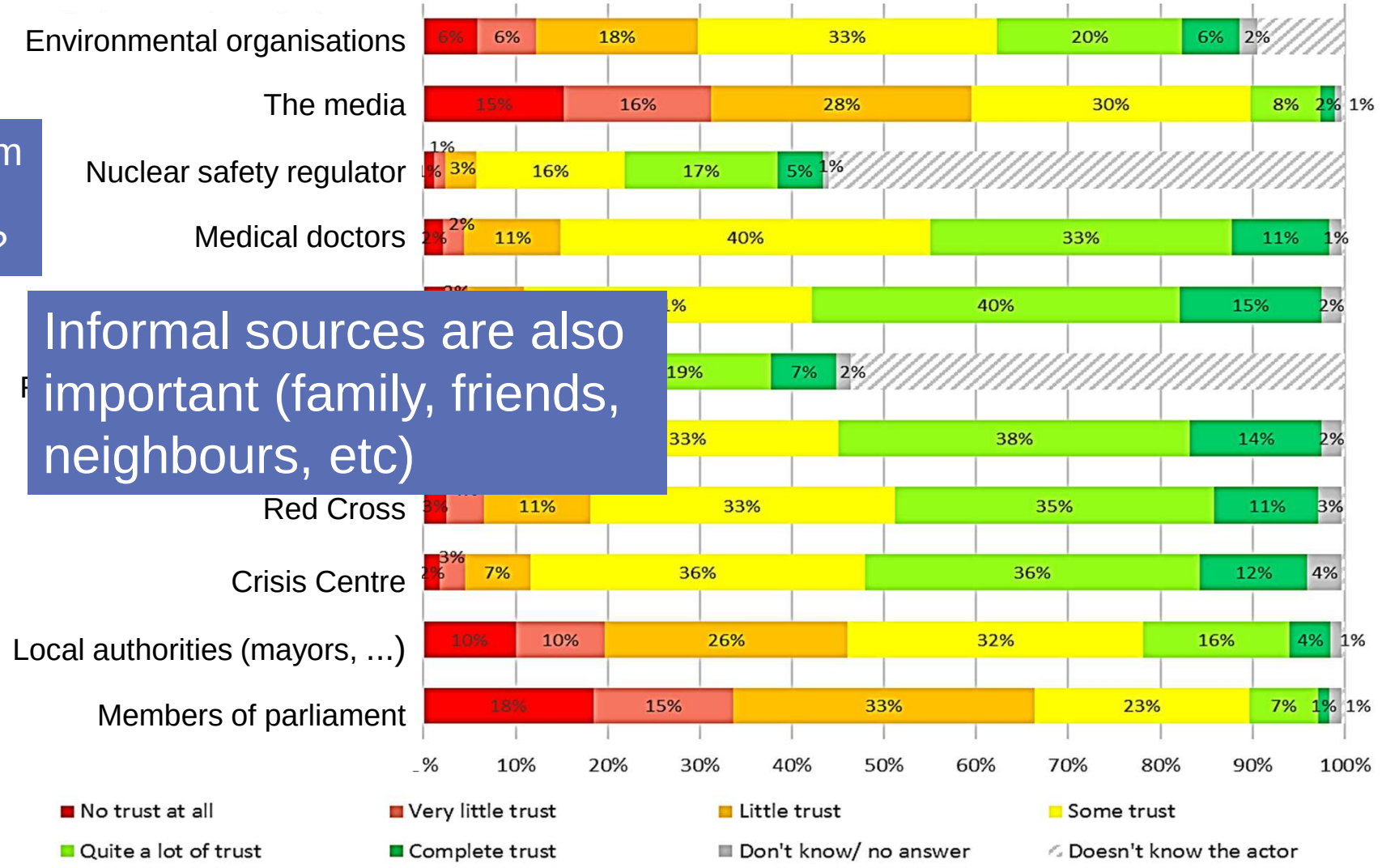
To what extent do you trust the following actors to provide correct and objective information about how to protect yourself in case of a nuclear accident?

Whom to trust?

Informal sources are also important (family, friends, neighbours, etc)



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The role of citizens' monitoring centres after the Fukushima accident

- Timely, actionable data
  - Respond to requests for measurement (cheap or free)
  - Individual cases
  - Own safety standard
  - Tailored to needs of local community
- Alternative, independent source of information
  - Community
  - Data sharing
  - Check and monitor official data
  - Provide analysis for citizens by citizens
- Place to communicate and to exchange
  - Release of feelings of anxiety

Shalom Disaster Support Center, Fukushima city. Photo: J. Kenens

Aizu Radiation Information Center, Aizu Wakamatsu city

Source: http://etsuya.cocolog-nifty.com/blog/2013/06/20136 13-7c6e.html

The Fortress of Hope in Nasu. Photo: J. Kenens

J. Kenens in CONFIDENCE Deliverable D9.25 and NERIS 2018

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Which uncertainties result from people's behaviour in an emergency situation?

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TABLE 2. Major Factors Covarying with Warning Response

Factor (1)	Response due to factor increase (2)	Level of empirical support (3)
Physical cues	Increases	High
Social cues	Increases	High
Perceived risk	Increases	Moderate
Knowledge of hazard	Increases	High
Experience with hazard	Mixed	High
Education	Increases	High
Family planning	Increases	Low
Fatalistic beliefs	Decreases	Low
Resource level	Increases	Moderate
Family united	Increases	High
Family size	Increases	Moderate
Kin relations (number)	Increases	High
Community involvement	Increases	High
Ethnic group member	Decreases	High
Age	Mixed	High
Socioeconomic status	Increases	High
Being female versus male	Increases	Moderate
Having children	Increases	Moderate
Channel: Electronic	Mixed	Low
Media	Mixed	Low
Siren	Decreases	Low
Personal warning versus impersonal	Increases	High
Proximity to threat	Increases	Low
Message specificity	Increases	High
Number of channels	Increases	Low
Frequency	Increases	High
Message consistency	Increases	High
Message certainty	Increases	High
Source credibility	Decreases	High
Fear of looting	Decreases	Moderate
Time to impact	Decreases	Moderate
Source familiarity	Increases	High

Sorensen, J. H. (2000). Hazard warning systems: Review of 20 years of progress. *Natural Hazards Review*, *1*(2), 119-125.

There are some differences between nuclear vs. natural hazard response!

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Risk characteristics	Influence	Explanatory scale
Personal control	Increases risk tolerance	controllable – not controllable
Institutional control	Depends upon confidence in institutional performance	trust, confidence in institution
Number of exposed	Decreases risk tolerance	catastrophic - chronic
Voluntariness	Increases risk tolerance	voluntary - involuntary
Mortality	Decreases risk tolerance	fatal – not fatal
Knowledge	Increases risk tolerance	new – established technology
Familiarity	Increases risk tolerance	familiar – not familiar
Dread / fear	Decreases risk tolerance	fear – no fear
Artificiality of risk source	Amplifies attention to risk Often decreases risk tolerance	human - natural
Blame	Increases quest for social and political responses	Degree of legal or social responsibility
Benefit	Increases risk tolerance	Benefit to self vs. unclear or inequitable
Effects on children	Decreases risk tolerance	Children specifically at risk

Source: Psychometric paradigm developed by Slovic, Fischhoff, and Lichtenstein Source of table T. Perko.

Risk characteristics	Influence	Explanatory scale
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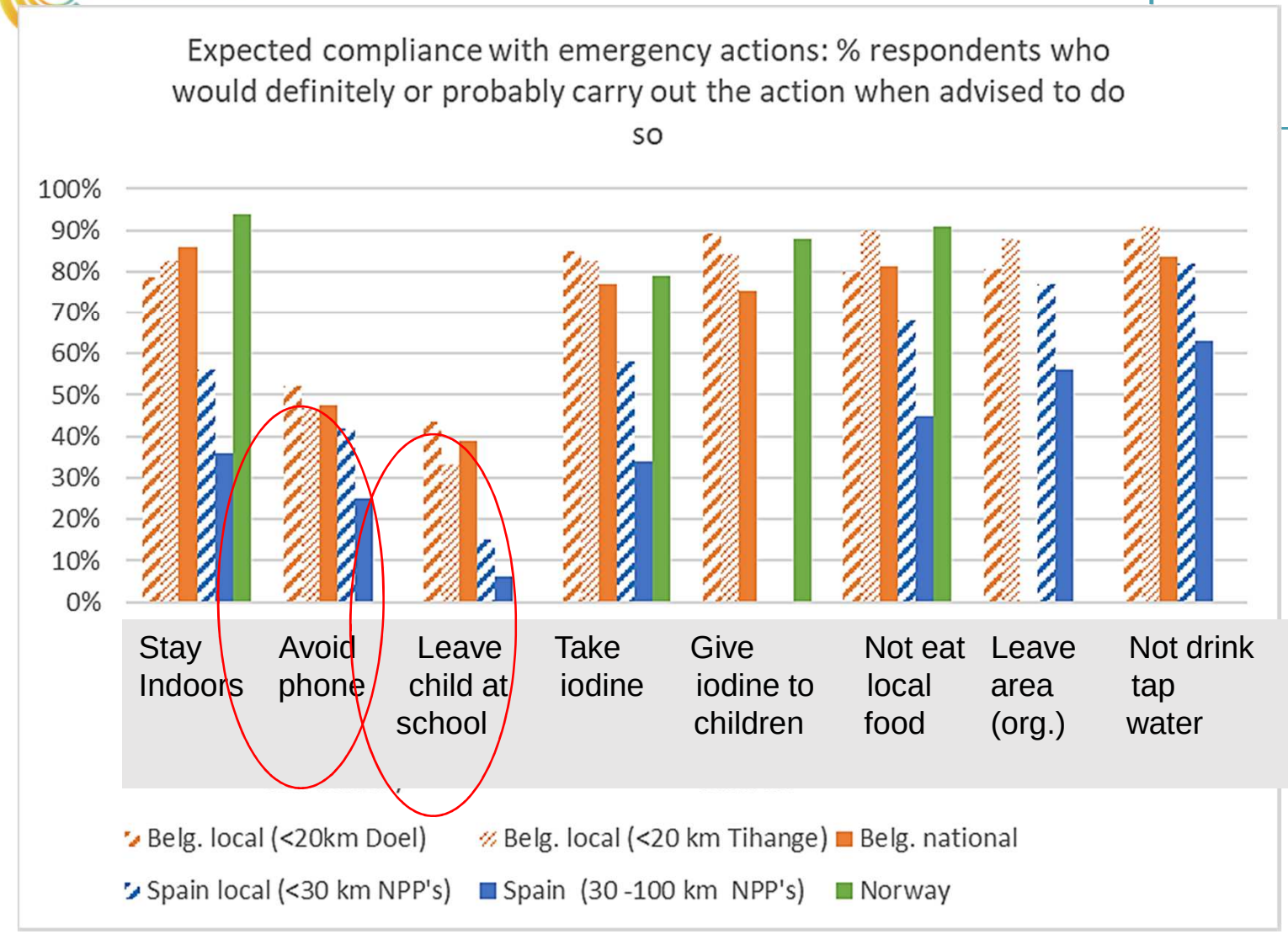
Artificiality of risk source		...natural
Blame		Degree of legal or social responsibility
Benefit	Inc... ...isk tolerance	Benefit to self vs. unclear or inequitable
Effects on children	Decreases risk tolerance	Children specifically at risk

Human behaviour is primarily driven by perception and not by facts, or by what is understood as facts by risk analysts and scientists (Renn, 2008)

Source: Psychometric paradigm developed by Slovic, Fischhoff, and Lichtenstein Source of table T. Perko.

Expected compliance with recommended actions varies for different publics



BE, ES:
Scale:
1=definitely not,
2=probably not,
3=maybe not,
4=maybe yes,
5=probably yes,
6=definitely yes;

NO:
1=definitely not
2=probably not,
3=*unsure*,
4=yes, probably
5=yes, definitely

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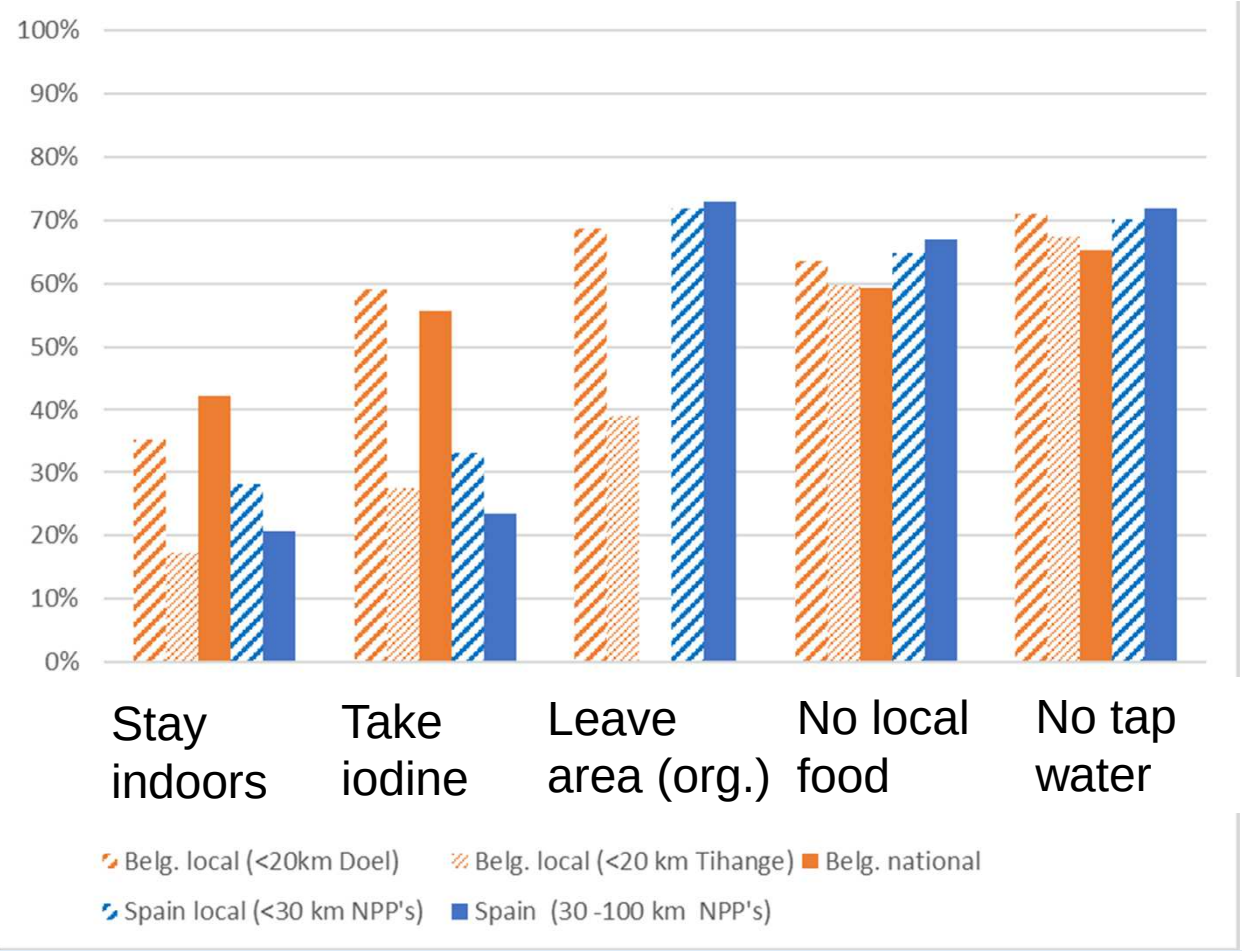
Large variations in perceived effectiveness of protective actions

Perceived effectiveness of protective actions: % respondents who think they are quite a lot of completely effective



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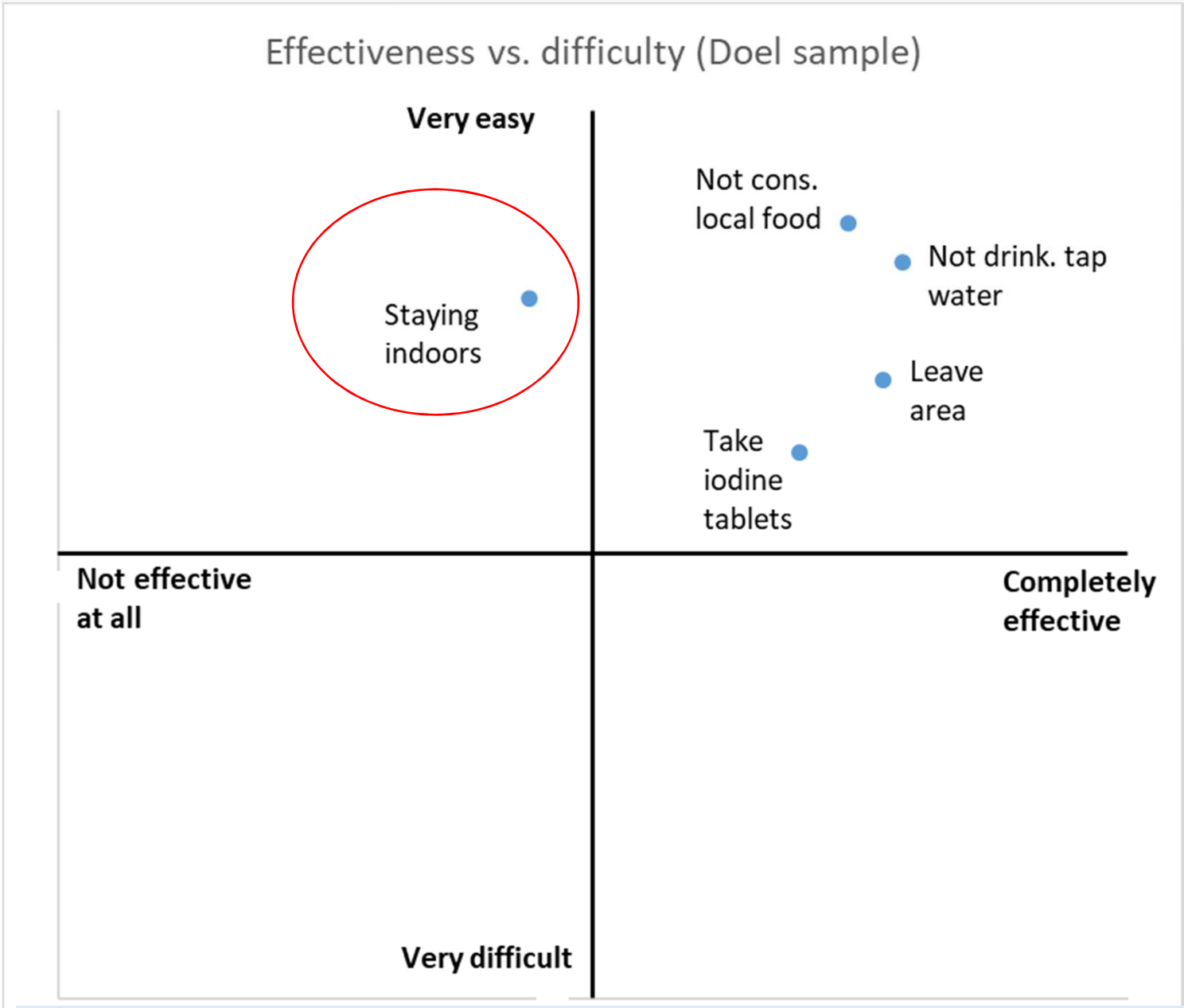
Difficulty vs. Effectiveness



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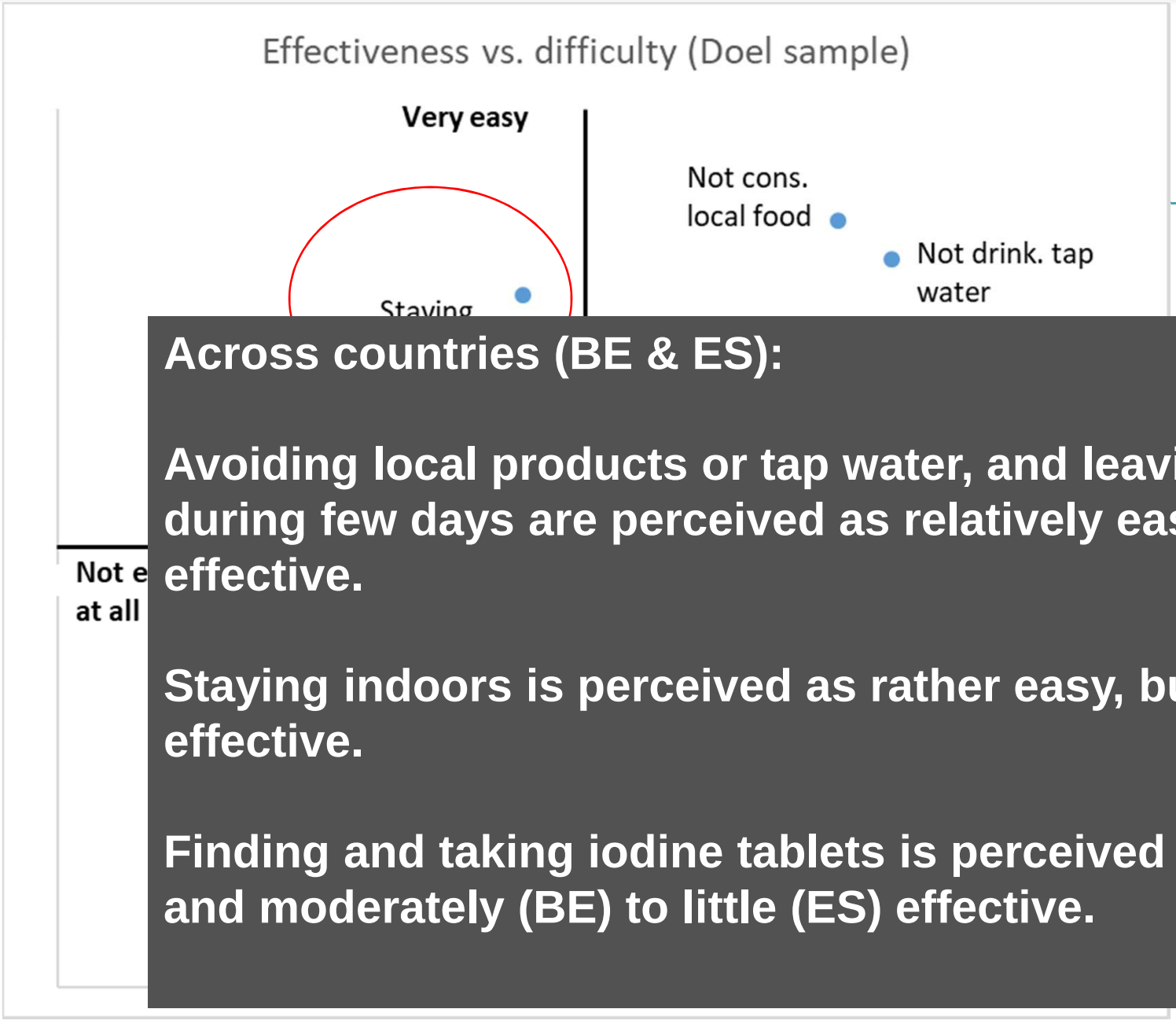
Difficulty vs. Effectiveness



Across countries (BE & ES):

Avoiding local products or tap water, and leaving the area during few days are perceived as relatively easy and effective.

Staying indoors is perceived as rather easy, but not so effective.

Finding and taking iodine tablets is perceived less easy and moderately (BE) to little (ES) effective.

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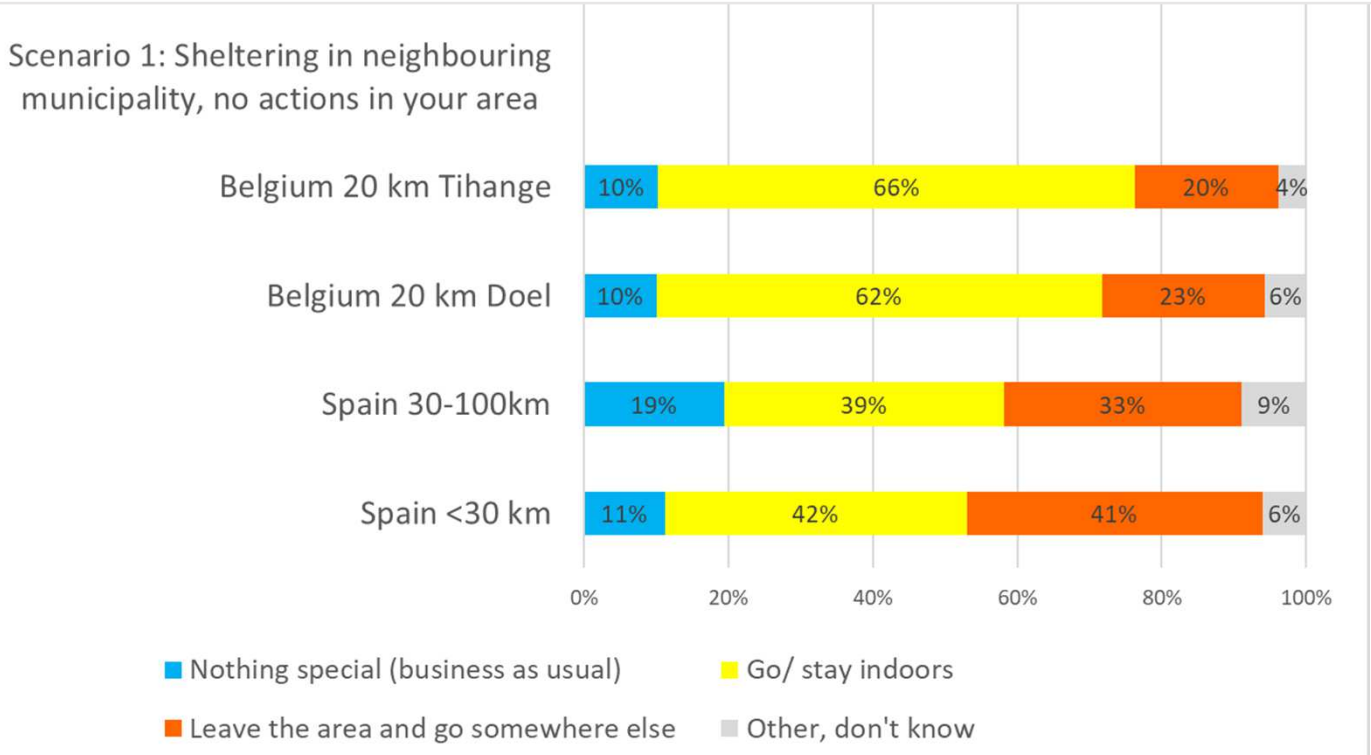
Expected behaviour in two hypothethical scenarios



No action vs. sheltering

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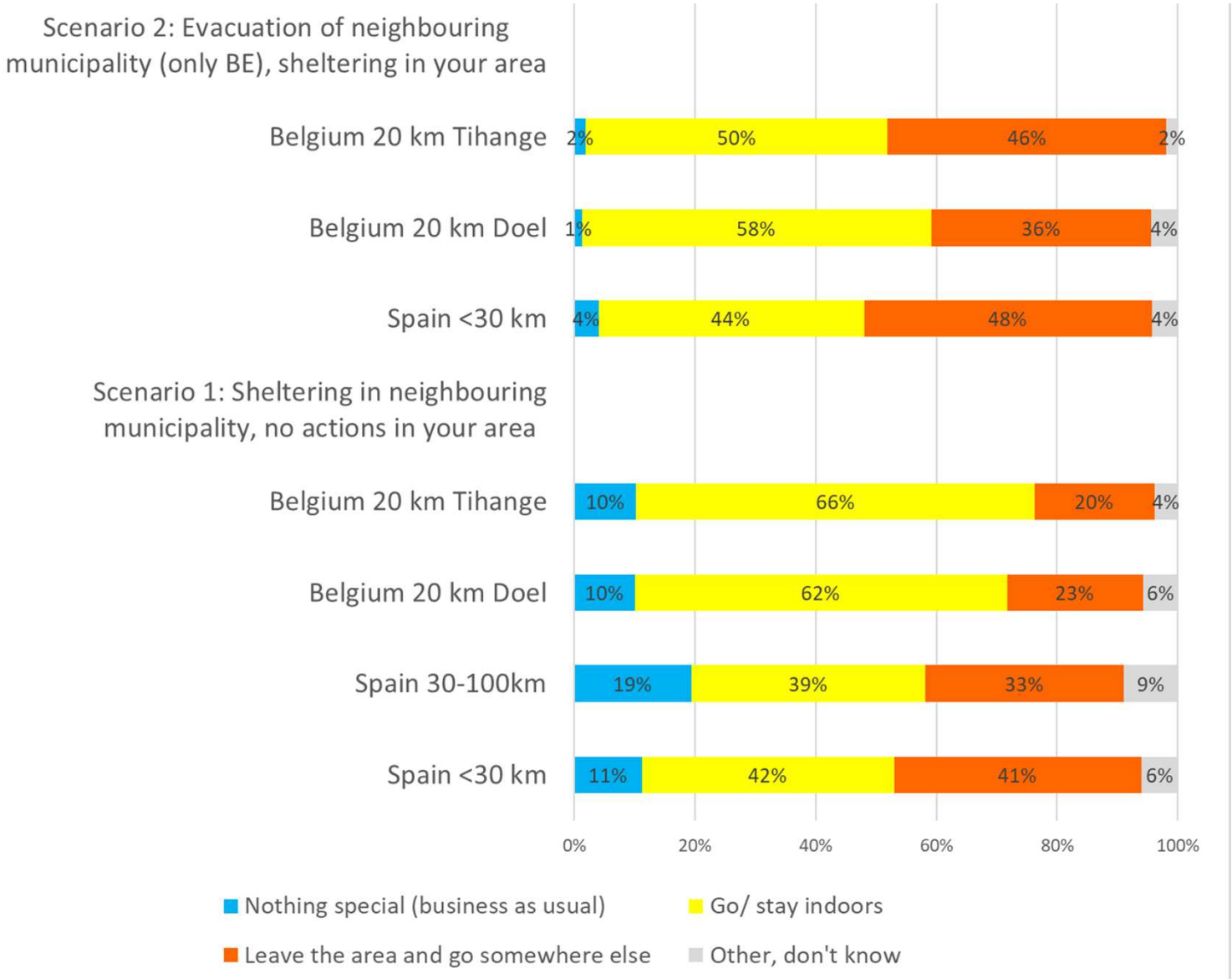

Sheltering vs. evacuation

No action vs. sheltering

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Factors associated with expected compliance with protective actions

- **Perceived social norm**: positive correlation with compliance
  - Perception of other residents' compliance with protective actions is positively correlated with own expected compliance
- **Difficulty** to carry out the action: negative correlation with compliance
  - Particularly for leaving children at school and avoiding the use of phone (phone is also the preferred communication means)
- Perceived **effectiveness**: positive correlation with compliance
  - More research needed to understand and address concerns related to the various actions
- For leaving children in school: **trust in nuclear safety authorities**: positive correlation with compliance
- For giving stable iodine tablets to children: **taking an iodine tablet oneself**: positive correlation with compliance
- Gender, age and education: mixed evidence, in general little effect

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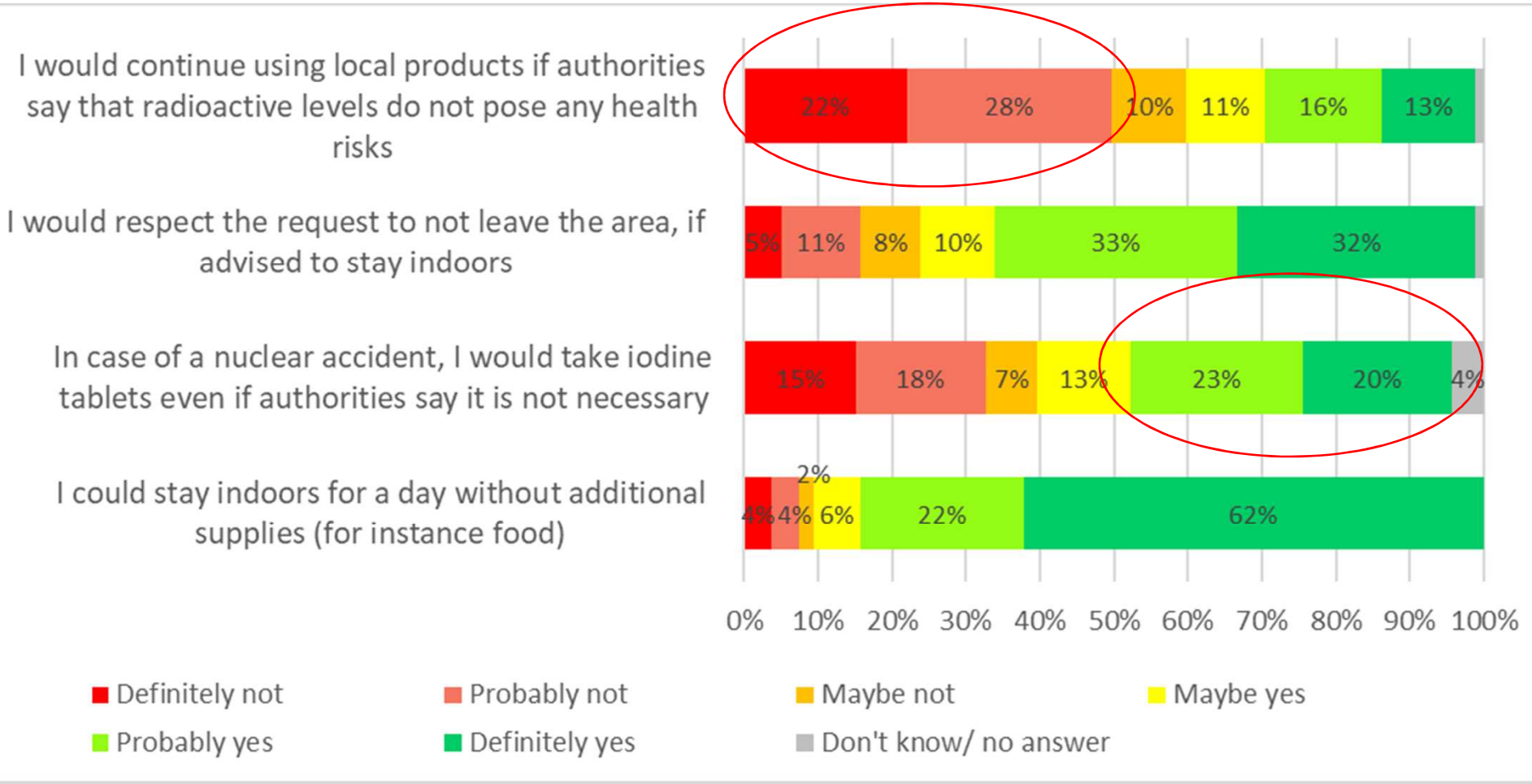
Individual protection strategies: potential for over-reaction



N=159, Doel sample, not weighed

CONFIDENCE Deliverable D9.26 Planned behaviour in nuclear emergency situations. Turcanu et al (2018)

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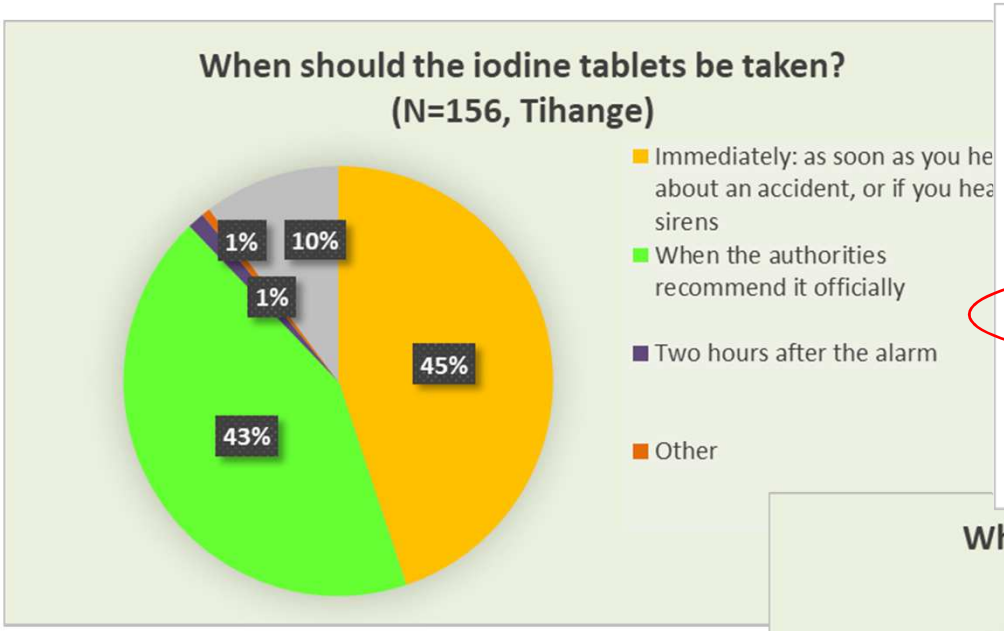
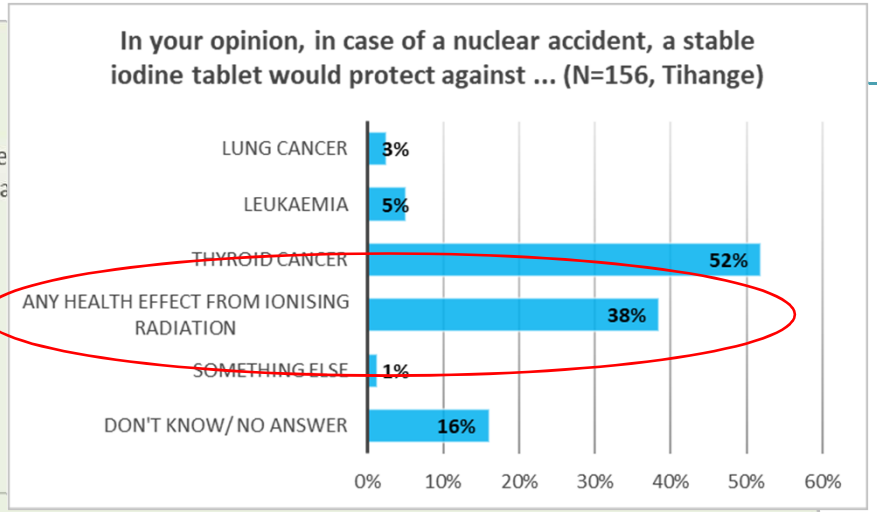
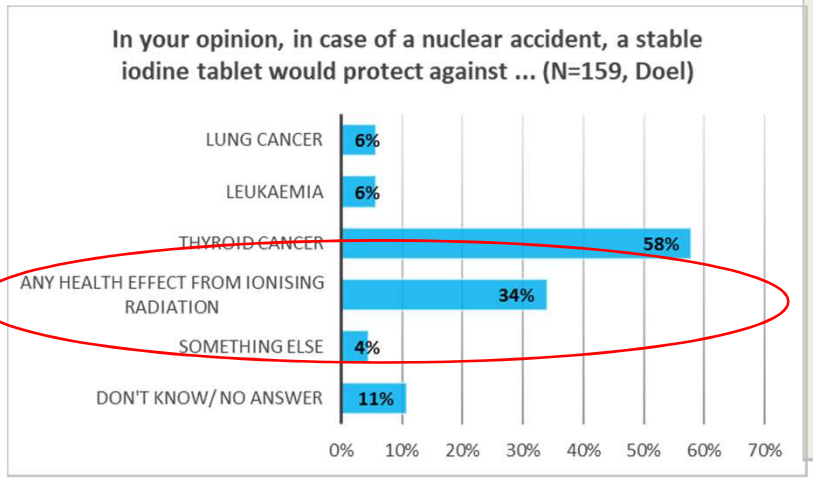
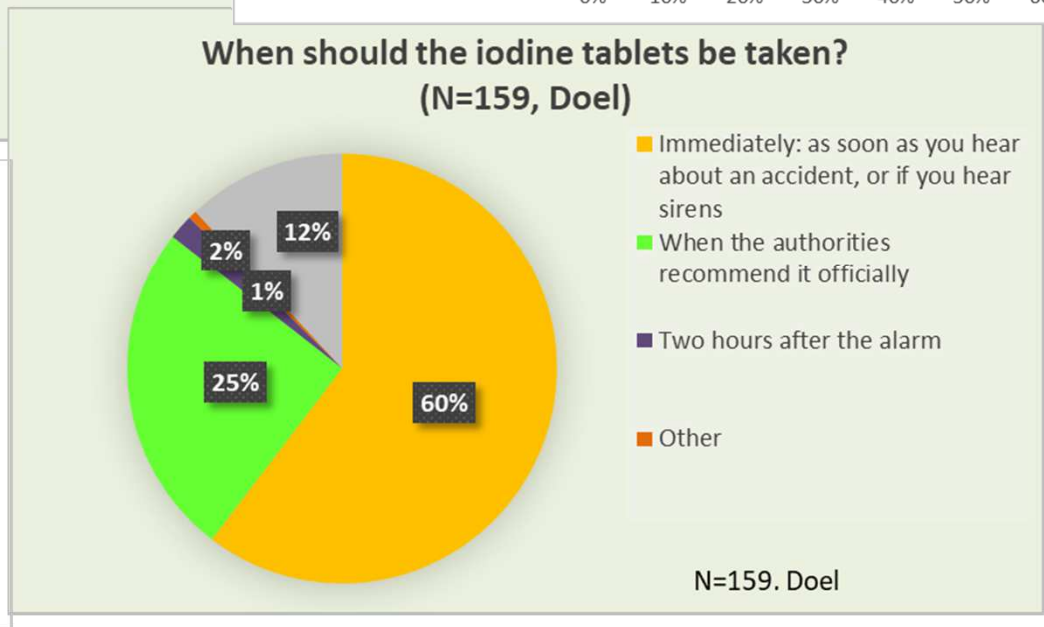
Low awareness about the role of iodine tablets









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Summary

- Social and scientific uncertainties are inter-linked
- Risk (particularly health risk) and people (particularly children and family) are the first concerns in an emergency situation
- Reactions in case of an emergency may differ between countries and areas in the same country
- Low awareness of EP&R and protective actions, lack of clarity about practical aspects
- Citizen science can help address some of the social uncertainties
- Most respondents expect to comply with emergency actions, except for leaving children at school or avoiding the use of phone
- However, large fractions of the local population may overreact by taking a more conservative course of action.
- Perception of other residents' behaviour, effectiveness and ease of carrying out protective actions positively correlated with compliance
- Trusted communicators in case of an emergency: rescue services, Crisis Centre, medical doctors, Red Cross, *nuclear safety authorities* & *scientists (more trusted by general public than residents living close to NPP's)*

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Take away messages

"Integrate radiation protection aspects into societal decisions, rather than integrating societal values into radiation protection decisions"

OECD-NEA (2018), Post-Accident Recovery Planning and Management: Stakeholder-Involvement Lessons from Fukushima

Identifying and addressing social uncertainties helps build resilience and improve emergency planning and response

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