



A Mental Models Approach to Biosecurity Risk Communication



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<https://better-biosecurity.eu/> www.cost.eu



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The psychology of risk perception (Bruine de Bruin, 2019)

I. Why is it important for people to understand risks?

➤ To make informed decisions

(about products to purchase, mitigation strategies to implement, policies to support or resist, etc.)

2

Risk assessment vs. risk perception

Society for Risk Analysis (2015) - Risk Glossary

- **There are differences between how experts and laypeople achieve an understanding of risks...**

Risk assessment

Systematic process to comprehend the nature of risk, express and evaluate risk, with the available knowledge.

Experts

≠

Risk perception

A person's subjective judgement or appraisal of risk.

Laypeople

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Psychometric paradigm

(e.g. Fischhoff et al. 1978; Slovic et al. 1980; Slovic, 1997)

Subjective = flawed, incorrect, prone to error, ...?

or are evaluations **based on different criteria from experts?**

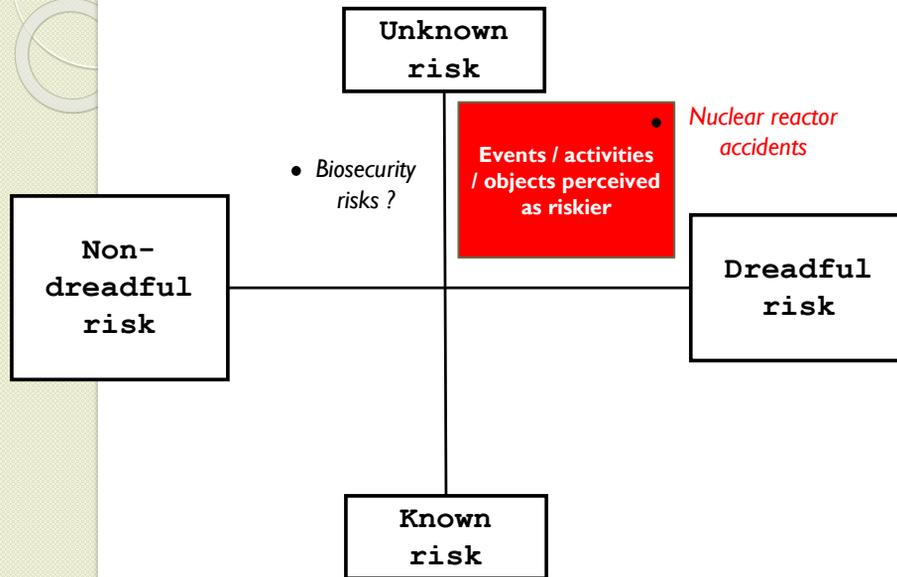
Psychometric paradigm - Measurable indicators:

- (1) **Voluntariness of risk**
- (2) **Immediacy of effect**
- (3) **Knowledge about risk to those exposed**
- (4) **Science knowledge of the risk**
- (5) **Control over risk**
- (6) **Novelty**
- (7) **Chronic vs. Catastrophic**
- (8) **Common vs. Dread**
- (9) **Severity of consequences**

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Where do laypeople place biosecurity related risks?

2 factor space
(Bruine de Bruin, 2019)



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The psychology of risk perception (Bruine de Bruin, 2019)

1. It is important for people to understand risks, to make informed decisions
 2. But why is it important for us to understand how people view risks (or 'their psychology')?
 - To communicate better about risks (related to products, mitigation strategies, policies, etc)...
- ... to promote informed decision making.

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Risk communication

Exchange or sharing of risk-related data, information and knowledge between and among different target groups (such as regulators, stakeholders, consumers, media, general public). *Society for Risk Analysis (2015) - Risk Glossary*

Effective communication >>> **reduces** the **gap** between experts and laypeople

Risk assessment

- Experts
 - Objective risk
- (Natural sciences, engineering, ...)



Risk perception

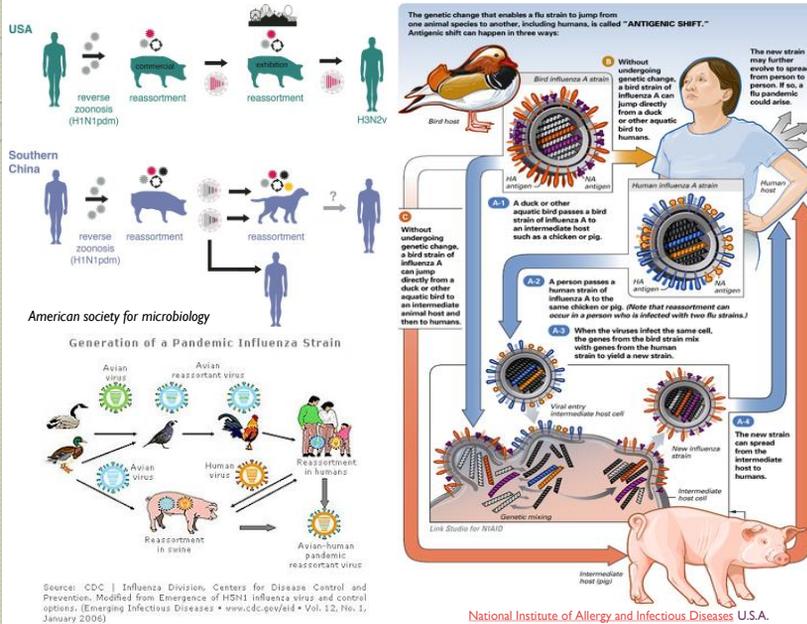
- Laypeople/non experts
 - Subjective risk
- (Social sciences)



Ineffective communication >>> **increases** the **gap** (e.g. use of scientific jargon)

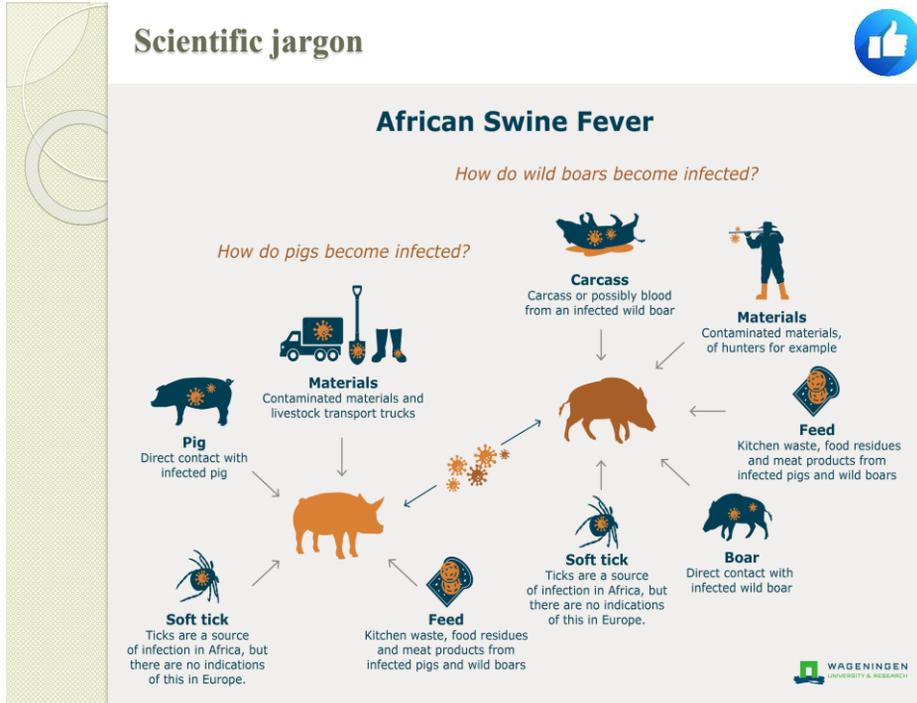
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Scientific jargon



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Scientific jargon



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The need for effective information communication

“In practice, publishing technical information on a website that its intended audience will find **difficult to understand**, or **not broadly informing relevant audiences**, does not live up to the principles of sound risk communications.”



European Food Safety Authority (2017). *When Food Is Cooking Up a Storm – Proven Recipes for Risk Communications*. Parma, Italy: EFSA.

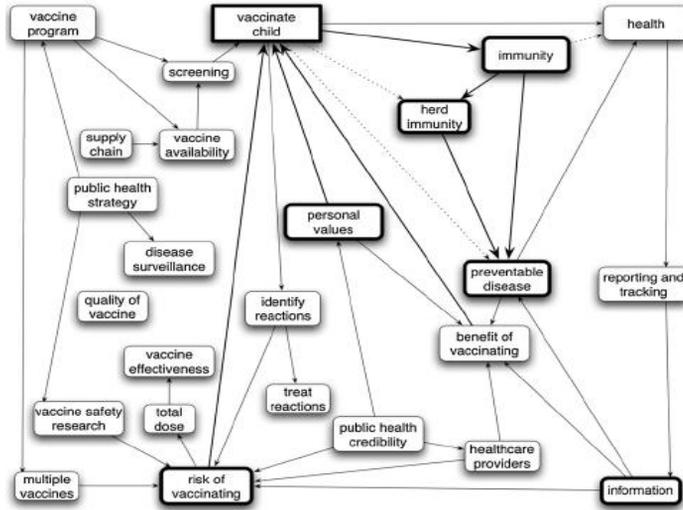
➤ To communicate effectively, we need to **understand how people view risks** (‘their psychology’) and **reduce the gap** between experts and laypeople

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Mental models approach (Bruine de Bruin, & Bostrom, 2013; Downs, Bruine de Bruin, & Fischhoff, 2008)

Expert decision model

Experts from the National Immunization Program at the Centers for Disease Control and Prevention.

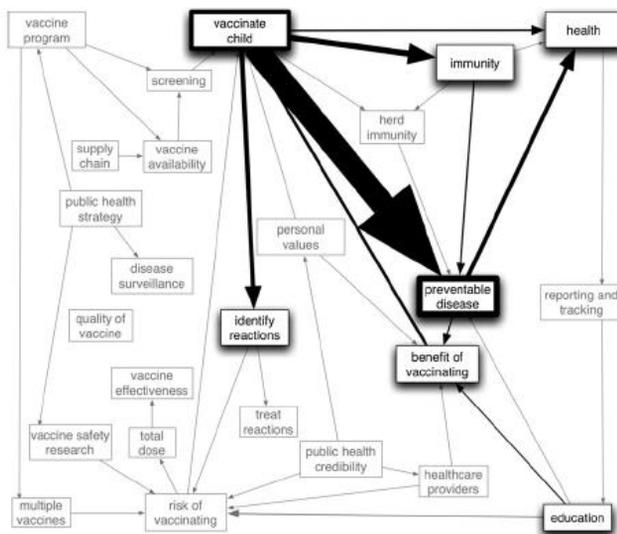


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Mental models approach (Downs, Bruine de Bruin, & Fischhoff, 2008)

Lay decision model

Parents of young children



Note: The thickness of each arrow corresponds to how frequently that link was mentioned; grey arrows indicate links that were not mentioned in response to the question about how vaccines work.

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A Mental Models Approach to Biosecurity Risk Communication – An example

Attitudes and Beliefs of Producers and Veterinarians Regarding the Implementation of Biosecurity Measures on Cattle Farms

(Mateus, Nunes, & Gaspar, 2018)

Biosecurity practices: Individual and collective actions taken at international, national, local and farm level, to reduce the risk of introducing and spreading infectious diseases among individuals, populations, farms, or ecosystems (Jia, St-Hilaire, Singh, & Gardner, 2017).

- Such measures seem particularly difficult to implement through laws... **Why?**
- Results usually **benefit society more than the producer** (Eristensen & Jakobsen, 2011).
- Depends on **economic factors**, the **viability** of these measures, the **understanding** of biosecurity principles by producers and veterinarians, their **attitude and motivation/commitment** and the **social network** or community structure to which they belong to (Brennan & Christley, 2013).

Mateus, M. P., Nunes, T. P. & Gaspar, R. (2018, October). Attitudes and Beliefs of Producers and Veterinarians Regarding the Implementation of Biosecurity Measures on Cattle Farms. Presented at the *International Conference on Mediterranean Diet and Gastronomy*, Universidade de Évora, Évora, Portugal.

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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

Step I. Identify what people need to know to make more informed decisions (*expert decision model*):

I.1 Literature search (grey and white literature).

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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

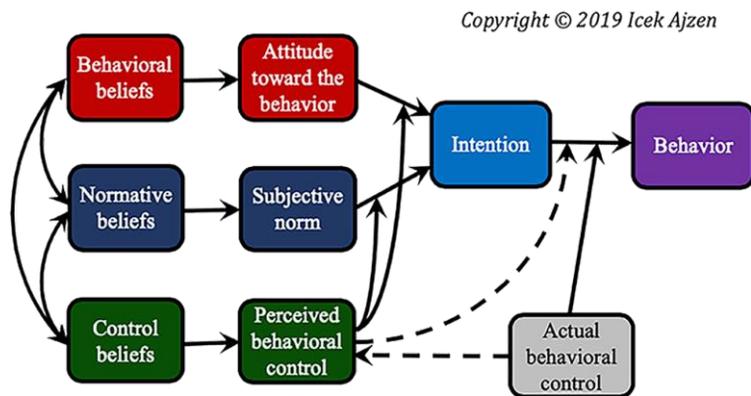
Autor e Ano de Publicação	Tema	População	Modelo Utilizado
Cattaneo et al. 2009	Resistência a antibióticos	Médicos veterinários de bovinos de leite	Teoria do comportamento planeado
Higgins, Huxley, Wapenaar e Green 2014	Controlo de doenças	Médicos veterinários de bovinos de carne	Teorema de Bayes
Brennan et al. 2016	Medidas de prevenção e controlo de doenças	Produtores de bovinos de leite	Teoria do comportamento planeado
O'Hagan, Matthews, Laird e McDowell 2016	Controlo de tuberculose bovina	Produtores de bovinos de carne	Teoria do comportamento planeado
Vergne et al. 2014	Comunicação de peste suína africana	Produtores de porcos e caçadores de javalis	Teoria do comportamento planeado
O'Kane, Ferguson, Kaler e Green 2017	Barreiras à adoção das melhores práticas	Produtores de ovelhas	Teoria do comportamento planeado; questionário de percepção de doença - revisto; cinco grandes domínios de personalidade

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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

E.g. Theory of Planned Behaviour (Ajzen, 2001)



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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

Summary results (interviews)

- **Experts** emphasized the **factors that determine/must determine producers' decisions**, i.e. antecedents of decisions.
- **Experts** emphasized measures that producers can implement to **prevent diseases**.

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Mental models approach (Bruine de Bruin, & Bostrom, 2013;

Morgan, Fischhoff, Bostrom, & Atman, 2002)

2. Identify what people already know and how they make their decisions (*lay decision model*)

2.1 Conduct semi-structured interviews to identify beliefs and relevant wording

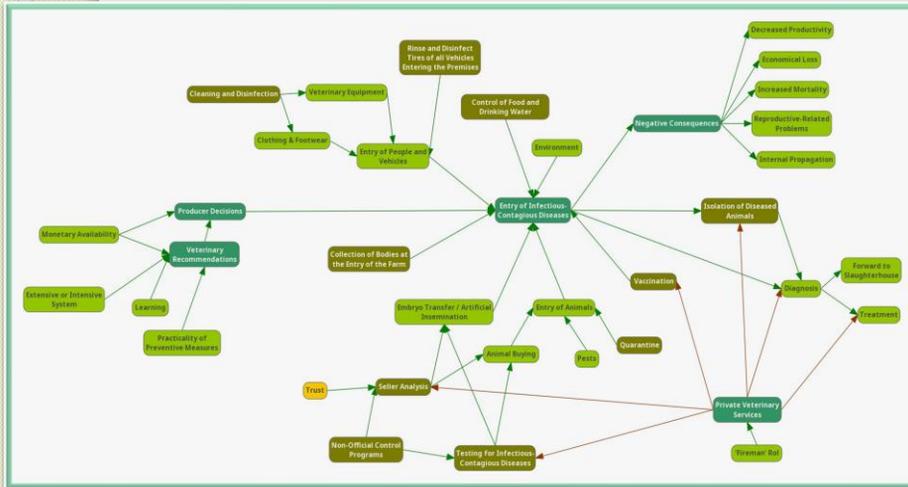
1. To characterize what the audience knows about the risk, what causes it, and what can be done about it.
2. To identify gaps and misconceptions in non-expert knowledge
 - as compared to what experts know
 - to be targeted in a risk communication
3. To identify the wording people prefer to use to describe these topics, and relevant decision contexts
 - to be used in the subsequent survey
 - to be used in the risk communication

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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

Results - Veterinarians' Mental Model



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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

Summary results (interviews)

- **Producers** focused more on the **multiple ways a disease can enter a cattle farm**, and **less on the preventive measures** they can implement to prevent it.
- **Producers** justified some of their actions and thoughts with **non-biosecurity-related measures** (e.g. new animal's adaptation period).
- **Veterinarians** emphasized the measures where they considered **themselves to have an important role**; highlighted the influence of their recommendations on producers' decisions.
- **Veterinarians** identified more preventive measures than producers.
- **Producers** and **veterinarians** emphasized more the **consequences** of a disease entering the farm.

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Mental models approach (Bruine de Bruin, & Bostrom, 2013; Morgan, Fischhoff, Bostrom, & Atman, 2002)

2. Identify what people already know and how they make their decisions (*lay decision model*)

2.1 Conduct semi-structured interviews to identify beliefs and relevant wording

2.2 Conduct follow-up surveys with larger samples to examine prevalence of interviewees' beliefs

1. To examine prevalence of beliefs
 - Which topics are commonly understood (and do not need to be repeated)?
 - Which topics are most commonly misunderstood (and in need of intervention)?
2. To examine which beliefs seem most related to behaviors

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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

Step 2: Lay decision model:

2.1 Individual Interviews to cattle producers (n = 24) and veterinarians (n = 20): indicators of attitudes and beliefs in both groups; what they knew about biosecurity risks, diseases causes & consequences, and biosecurity measures to prevent these.

2.2 Questionnaires: attitudes, knowledge and beliefs prevalence in producers and veterinarians (n = 112).

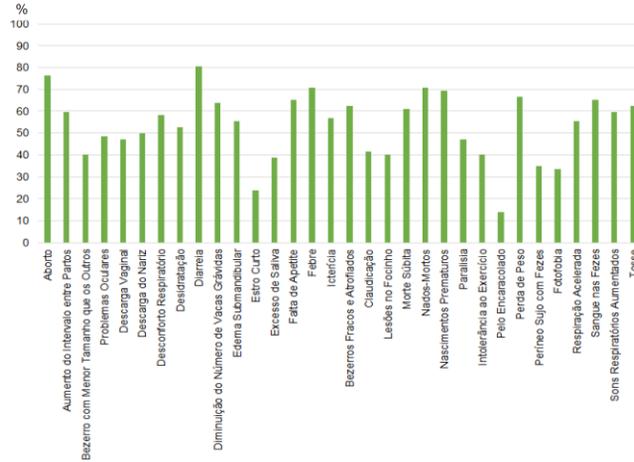
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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

Results - Knowledge

Gráfico 5. Percentagem de resposta à pergunta “Da lista que encontra abaixo, qual ou quais considera serem possíveis indicadores de que está presente uma doença numa exploração.”



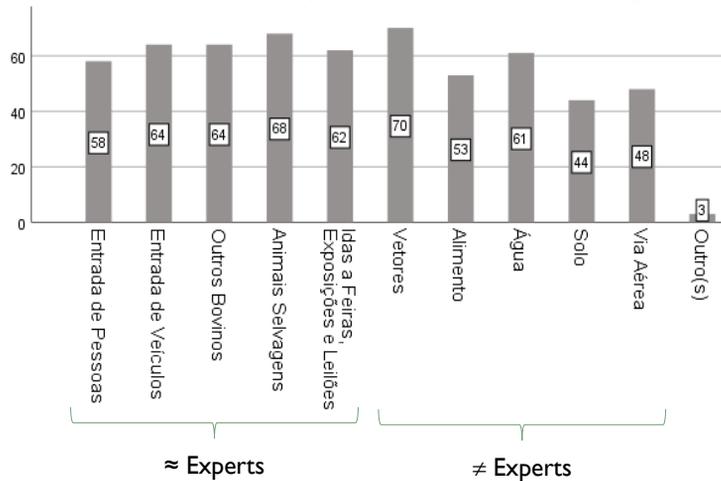
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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

Results - Knowledge

n = 72 “Infectious diseases may be introduced in a farm through...”

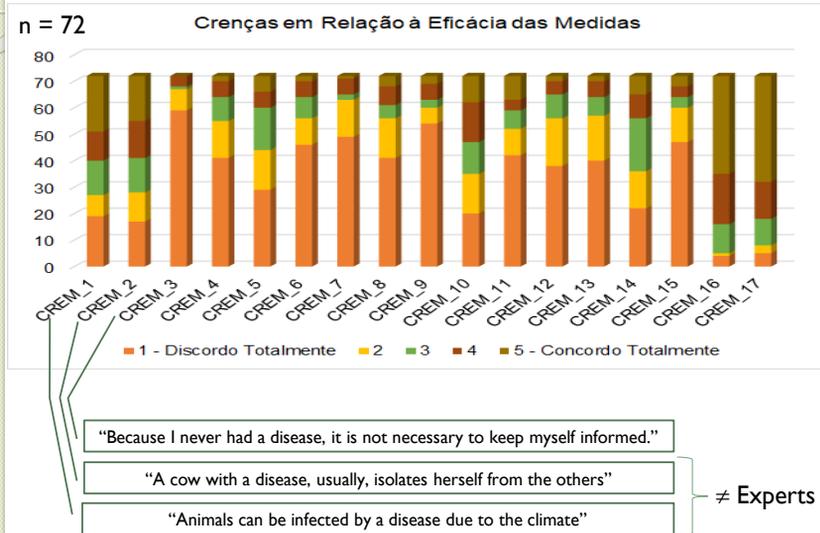


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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

Results - Beliefs



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Mental models approach (Bruine de Bruin, & Bostrom, 2013;

Morgan, Fischhoff, Bostrom, & Atman, 2002)

3. Design communication content

➤ Compare lay decision model with expert decision model

✓ Identify facts most in need of intervention:

-i.e. That most people do not know

AND/OR

- Knowing it will help them to change their decisions or behaviors (e.g., referred to as decision-relevant or behaviorally relevant)

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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

Mental models comparison – examples:

Experts	Producers	Veterinarians
Factors that determine/should determine producer's decisions		
Preventive measures to impede the disease of entering farms		Preventive veterinary medicine
Disease entrance pathways		
Measures not related to biosecurity		
Veterinarians as "Firemen"		
	Consequences of the disease entering the farm	Consequences of the disease entering the farm
Financial resources availability Vaccination		

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Mental models approach (Bruine de Bruin, & Bostrom, 2013;

Morgan, Fischhoff, Bostrom, & Atman, 2002)

3. Design communication content

- Address common gaps and misconceptions in understandable wording
- ✓ Write initial text at 6th grade level, using wording and contexts taken from interviews.
- Iteratively test communications for adequacy and understanding as well as for accuracy.
 - ✓ Comprehension (use further interviews with target audience)
 - ✓ Accuracy (check with domain experts)

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Mental models approach – An example

(Mateus, Nunes, & Gaspar, 2018)

- ✓ A small group agreed with “Given I never had a disease [in the farm], it is not necessary to keep myself informed.”
 - >>> People need to be **motivated** to act (Michie et al. 2011), i.e. to perform effective and reliable disease surveillance, and to implement biosecurity measures (Sawford 2011; Srigley et al. 2015).
- ✓ “A cow with a disease, usually, isolates herself from the others”
 - >>> Communication should target **biased beliefs** (for people to do “the right thing for the right reasons”, i.e. informed decision making).
- ✓ Veterinarians or livestock producer organizations (OPPs) were the information sources in which respondents placed more trust, valuing those who were closest to them.
 - >>> Communication of biosecurity risks and preventive measures may be **better received**, if performed by veterinarians or OPPs.

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Mental models approach (Bruine de Bruin, & Bostrom, 2013;

Morgan, Fischhoff, Bostrom, & Atman, 2002)

4. Test effectiveness of communication content

- Conduct randomized controlled trial to test effect of communication (vs. control) on recipients’:
 - ✓ Understanding
 - ✓ Decision making
 - ✓ Behaviour
 - ✓ ...

Target group	Initial assessment	Communication	Final assessment	Monitoring
Group A	Assessment A ¹	Yes	Assessment A ²	Assessment A ³
Group B	Assessment B ¹	No (control)	Assessment B ²	Assessment B ³

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Mental models approach (Bruine de Bruin, & Bostrom, 2013)

1. Identify what people need to know to make more informed decisions (*expert decision model*)

- ✓ Conduct literature review
- ✓ Convene expert panel



2. Identify what people already know and how they make their decisions (*lay decision model*)

- ✓ Conduct semi-structured interviews to identify beliefs and relevant wording
- ✓ Conduct follow-up surveys with larger samples to examine prevalence of interviewees' beliefs



3. Design communication content

- ✓ Compare lay decision model with expert decision model
- ✓ Address common gaps and misconceptions in understandable wording
- ✓ Iteratively test communications for adequacy and understanding (with members of intended audience) as well as for accuracy (with domain experts)

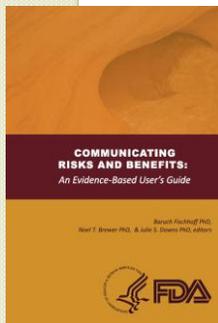


4. Test effectiveness of communication content

- ✓ Conduct randomized controlled trial to test effect of communication (vs. control) on recipients' understanding, decision making, and behaviour

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Fulfilling our duty...



Chapter 4: Duty to Inform

Baruch Fischhoff, PhD - Carnegie Mellon University

Summary

After using the best available science and their limited resources to design and evaluate communications, agencies must decide whether the result is adequate to demonstrate fulfilling their duty to inform and use their resources efficiently. **To be considered adequate, communications must pass three tests: Contain the information that users need, connect users with that information, and be understood by users.**

Published by the Food and Drug Administration (FDA),
US Department of Health and Human Services, August 2011.

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