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Smart and Flexible Energy Systems: Impact of Individual, Social and Culture Environment

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Context

- ✓ Society spends more and more money and time to make life **safer** and **healthier**
- ✓ The public becomes increasingly concerned about risks
- ✓ Firms and scientists criticize the public for its “irrational” fears
- ✓ Many of our decisions and behaviors are based **in beliefs** concerning the likelihood of uncertain events …

- ✓ ***Real risk*** is the absolute risk adjusted by the effect of safety controls and measures

- ✓ Risk is the potential to lose something of value, which could be **physical** (such as mobility from broken bones), **mental** (such as psychological stability), **social** (such as confidence through embarrassment or disgrace), or **financial** (such as loss of or damage to possessions).

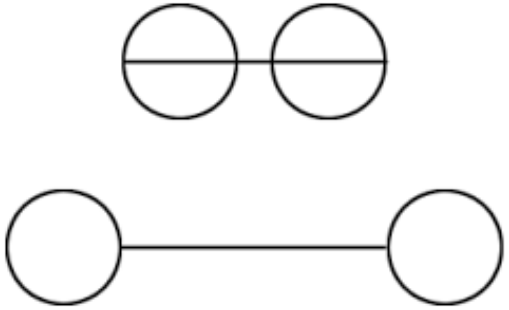
- ✓ Objective risk as used in engineering approaches (frequencies, consequences, prediction of the future, risk modeling, …)

- ✓ But risk is **not only a physical thing !**
  - Risk concerns thoughts, beliefs, and mental representation …
  - … and determines our confidence, trust, acceptance and behaviors

The subjective assessment of probability resembles the subjective assessment of physical quantities

e.g., the relationships between the size and the distance of an object

e.g., optical illusions and visual phenomena



Risk perception is the **subjective judgment** that people make about the characteristics and severity of a risk

Perceived risk is the individual's subjective assessment of the risk present.

This perceived risk varies between individuals undertaking the same activity, and may be much lower or higher than the real risk.

A mismatch between risk and perceived risk

- ✓ **Trust** is of crucial importance for the understanding of risk perception

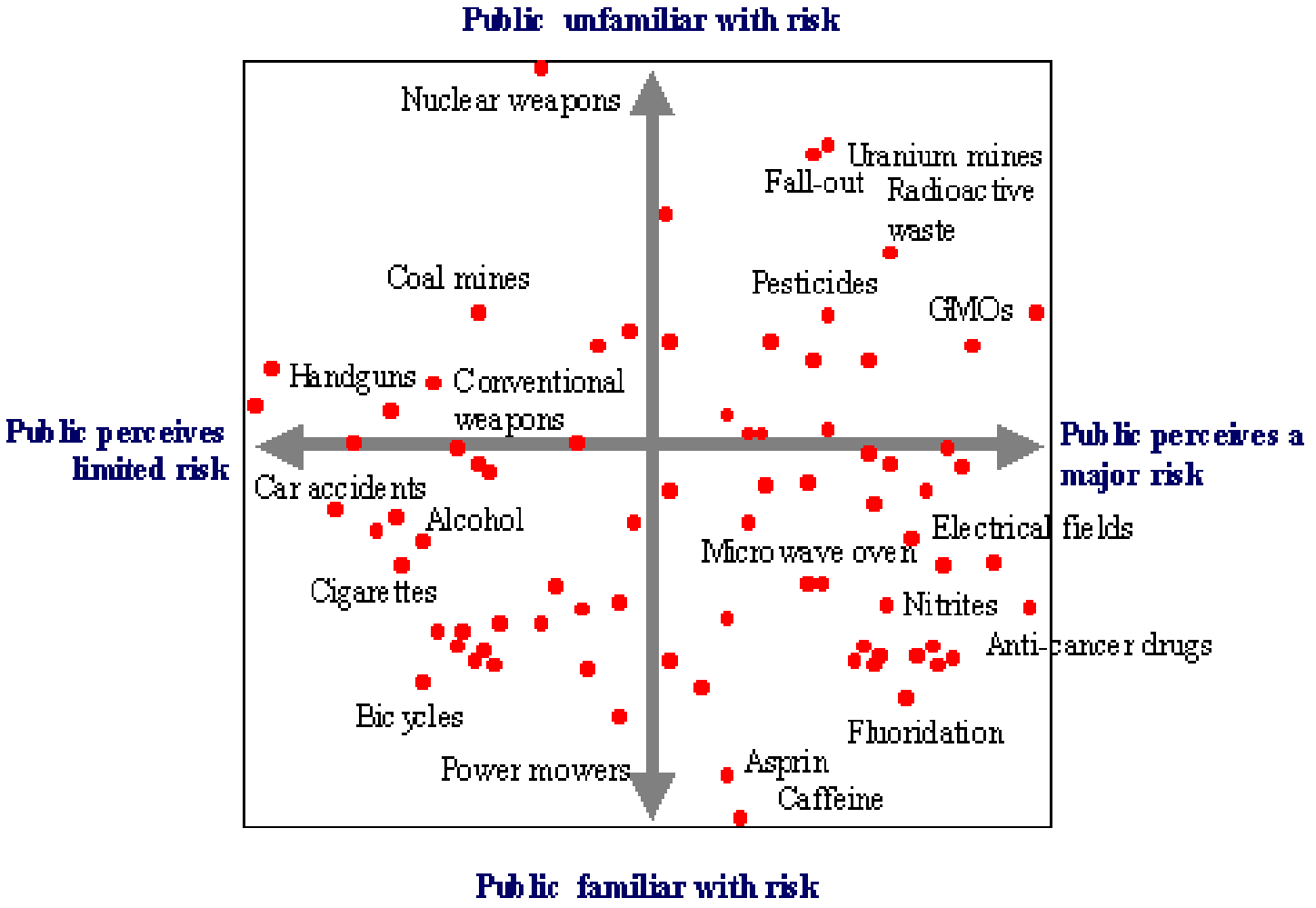
- ✓ Trust is especially important
  - When individuals have **low level of knowledge** about an object
  - When individuals have **very few personal control** over the risk
  - For **highly complex/technical risks** (*e.g*. robot, automotive car, smart grids)

- ✓ Building public trust can be difficult and, one lost, **difficult to regain**

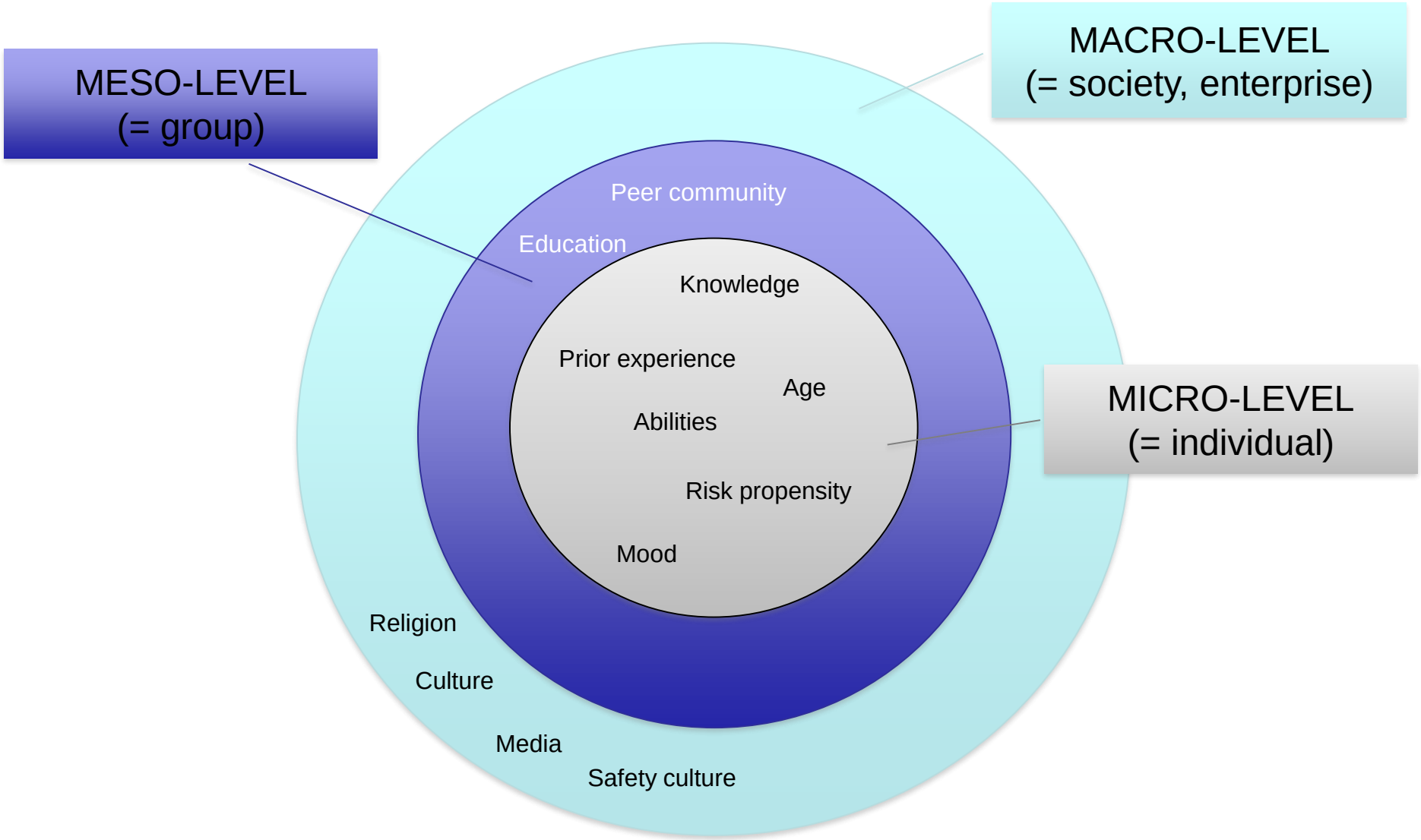
- ✓ Trust is "**asymmetric**": it is far easier to destroy trust than to create it !

- ✓ **Risk** is easier to demonstrate than absence of risk

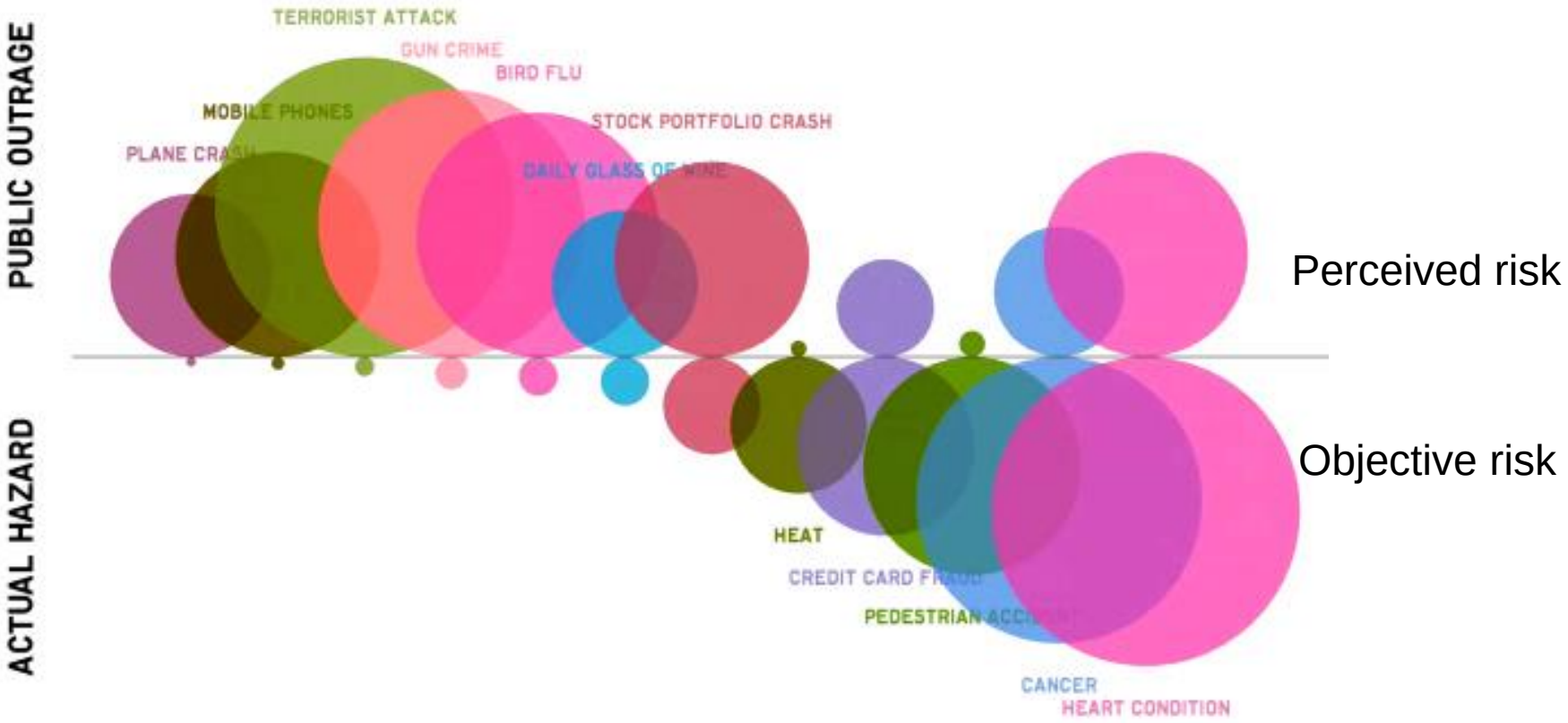
The public capacity to assess risk is not good …



Factors affecting risk perception : Examples



Visualization of the mismatch between our risk perception and the effective risk = *cf*. the *Reality Checking Device* (Hertrich, S. 2012)



Human beings use **heuristics** and **cognitive biases** to make decision

(Tvserky & Kahneman, (1974). Judgment under Uncertainty: Heuristics and Biases . *Science, New Series, 185(4157)*, 1124-1131)

… shortcut to rapidly make a decision

… a fallacious belief

	Procedure	**Advantages**	**Disadvantages**	**Examples**
Algorithm	Exhaustive, systematic, a set of rules	Solution is guaranteed	Can be very inefficient, effortful, time-consuming	Computer chess programs
Heuristics	Strategies, rules-of-thumb that have worked in the past	Efficient, saves effort and time	Solution is not guaranteed	Our daily life !

Examples of human heuristics we use everyday :

(1) **The representativeness heuristic** : is usually employed when people are asked to judge the probability that an object or event belongs to a class / processes by its similarity

e.g., the Gambler's fallacy: if something happens less frequently than normal during some period, it will happen more frequently in the future (presumably as a means of *balancing* nature)

(2) **The availability heuristic :** a mental shortcut that relies on immediate examples that come to a given person's mind when evaluating a specific topic, concept, method or decision

e.g., after seeing news stories about child abductions, people may judge that the likelihood of this event is greater

(3) **The anchoring and adjustment heuristic** : when people will often start with one piece of known information and the adjust it to create an estimate of an unknown risk

e.g., The conjunction fallacy is a formal fallacy that occurs when it is assumed that specific conditions are more probable than single general one

The SWOT analysis applied to the smart-grids

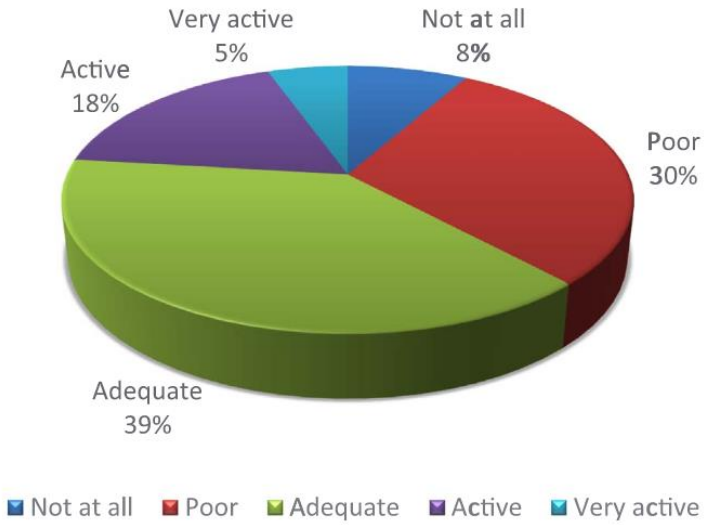


Fig. 1. Respondents effort rate to reduce energy consumption.

Abdmouleh, Z., Gastli, A., & Ben-Brahim, L. (2018). Survey about public perception regarding smart grid, energy efficiency & renewable energies applications in Qatar. *Renewable and Sustainable Energy Reviews*, *82*, 168-175.

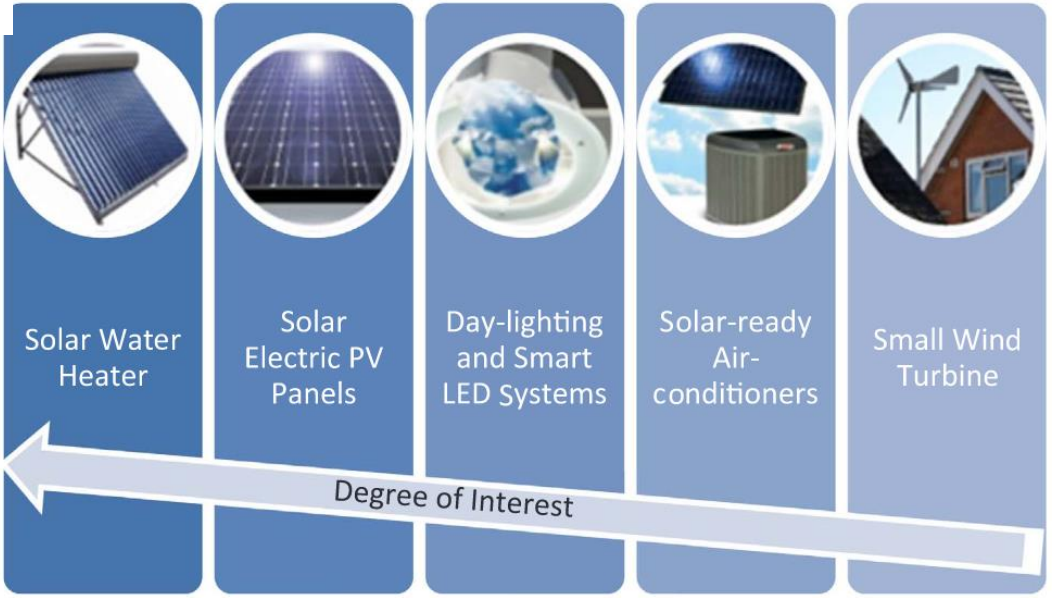


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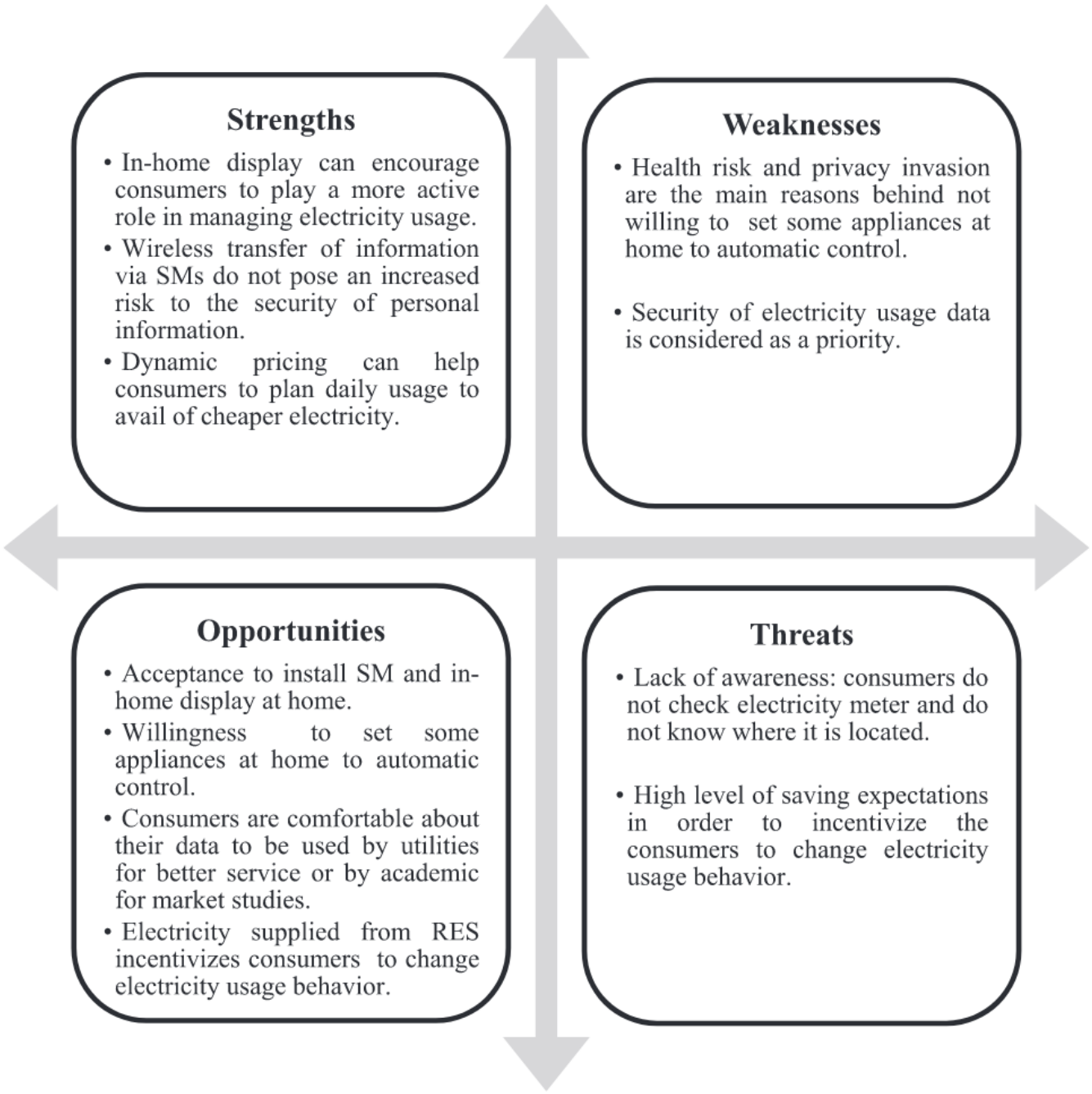
Fig


Strengths
• In-home display can encourage consumers to play a more active role in managing electricity usage.
• Wireless transfer of information via SMs do not pose an increased risk to the security of personal information.
• Dynamic pricing can help consumers to plan daily usage to avail of cheaper electricity.
Weaknesses
• Health risk and privacy invasion are the main reasons behind not willing to set some appliances at home to automatic control.
• Security of electricity usage data is considered as a priority.
Opportunities
• Acceptance to install SM and in-home display at home.
• Willingness to set some appliances at home to automatic control.
• Consumers are comfortable about their data to be used by utilities for better service or by academic for market studies.
• Electricity supplied from RES incentivizes consumers to change electricity usage behavior.
Threats
• Lack of awareness: consumers do not check electricity meter and do not know where it is located.
• High level of saving expectations in order to incentivize the consumers to change electricity usage behavior.

From the TAM and DOI to an unified theory (Carter and Belanger, 2005)

DOI =
Rogers' (1995)
Diffusion of Innovation theory
The rate of diffusion is affected by
- the innovation's relative advantage,
- complexity,
- compatibility,
- trialability
- and observability

TAM =
Davis' (1989)
Technology Acceptance Model

= « The perception of confidence in the electronic marketer's reliability and integrity »

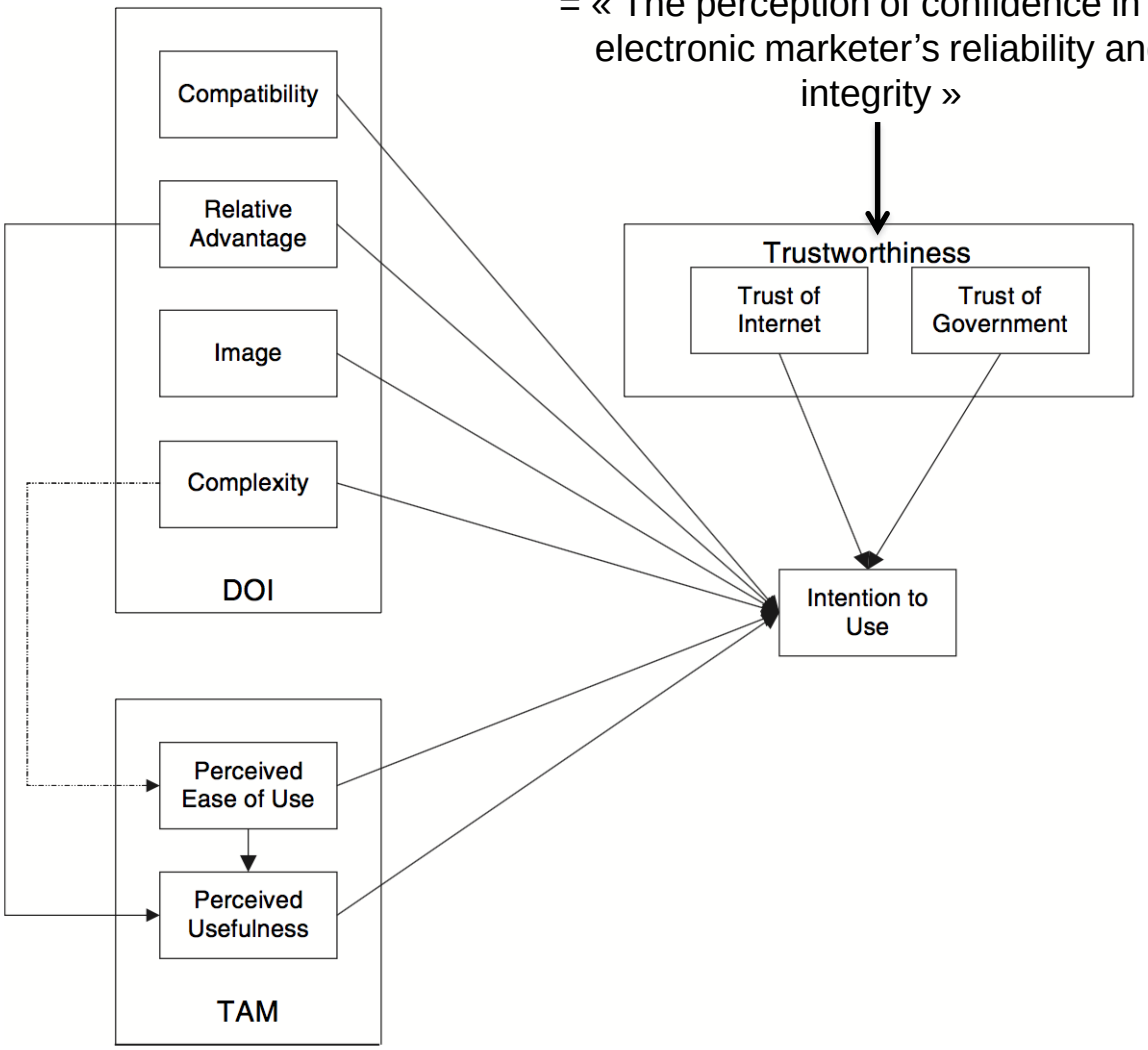


Figure 2. Adoption research.

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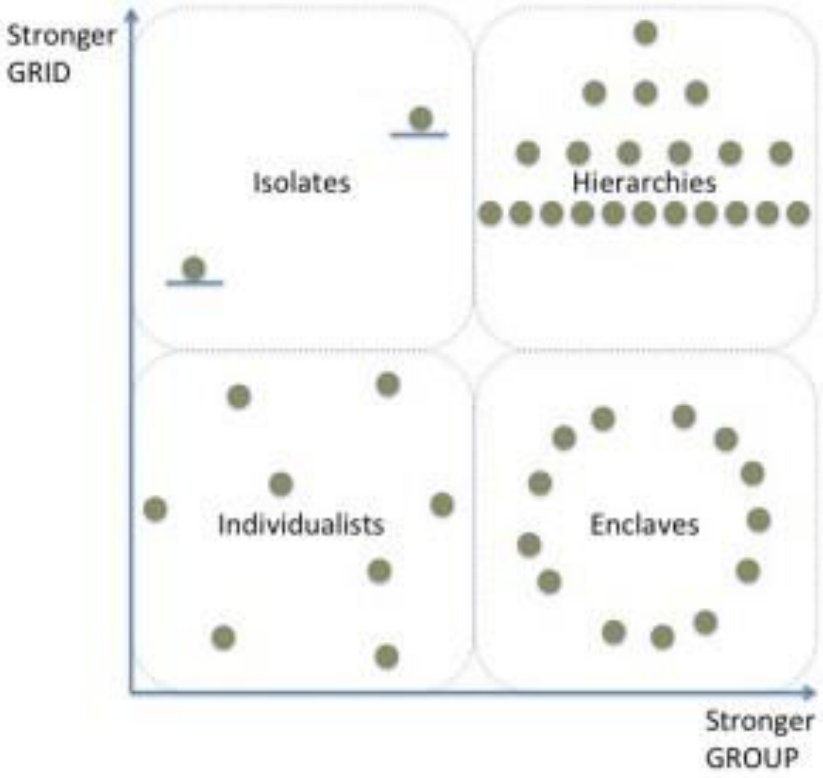
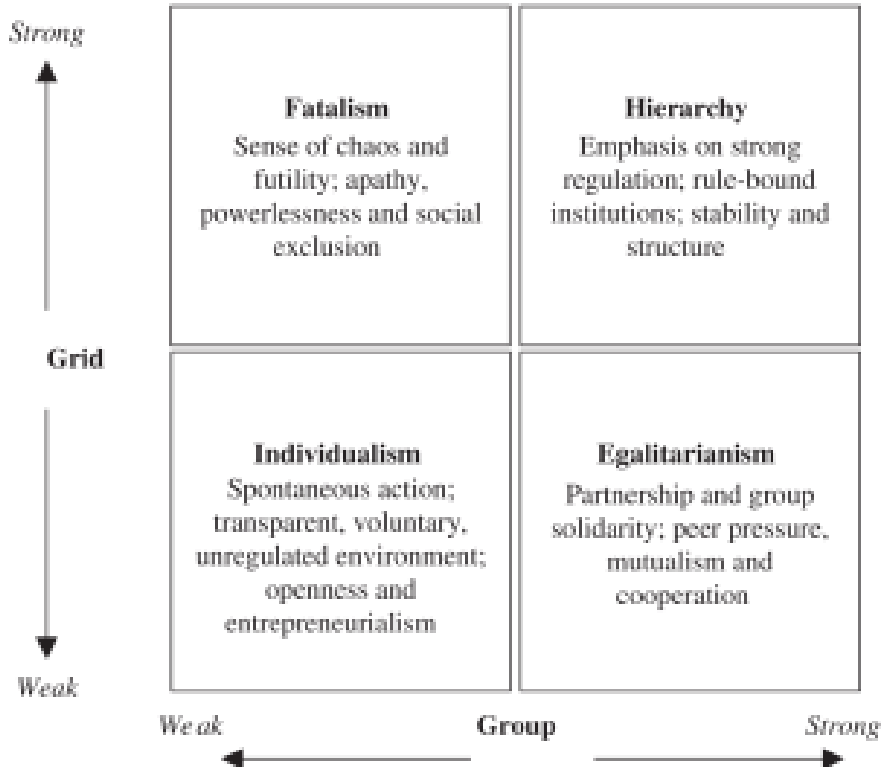
The Cultural Theory of Risk (Douglas and Wildavsky, 1982)

- ✓ Theory elaborated by two anthropologists
- ✓ Risk is defined as « *a joint product about knowledge of the future and consent about the desired prospects* »
- ✓ Risk perception must be analyzed **in the social context**

- ✓ Hypothesis = Two dimensions of social order have a large impact on our worldviews :
  - **Group** → whether an individual is member of bonded social units and how absorbing the group's activities are on the individual
  - **Grid** → degree to which a social context is regulated and restrictive in regard to individuals' behaviors
- ✓ **Social trust** → the process by which individuals assign to other persons, groups, agencies, and institutions the responsibility to work on certain tasks





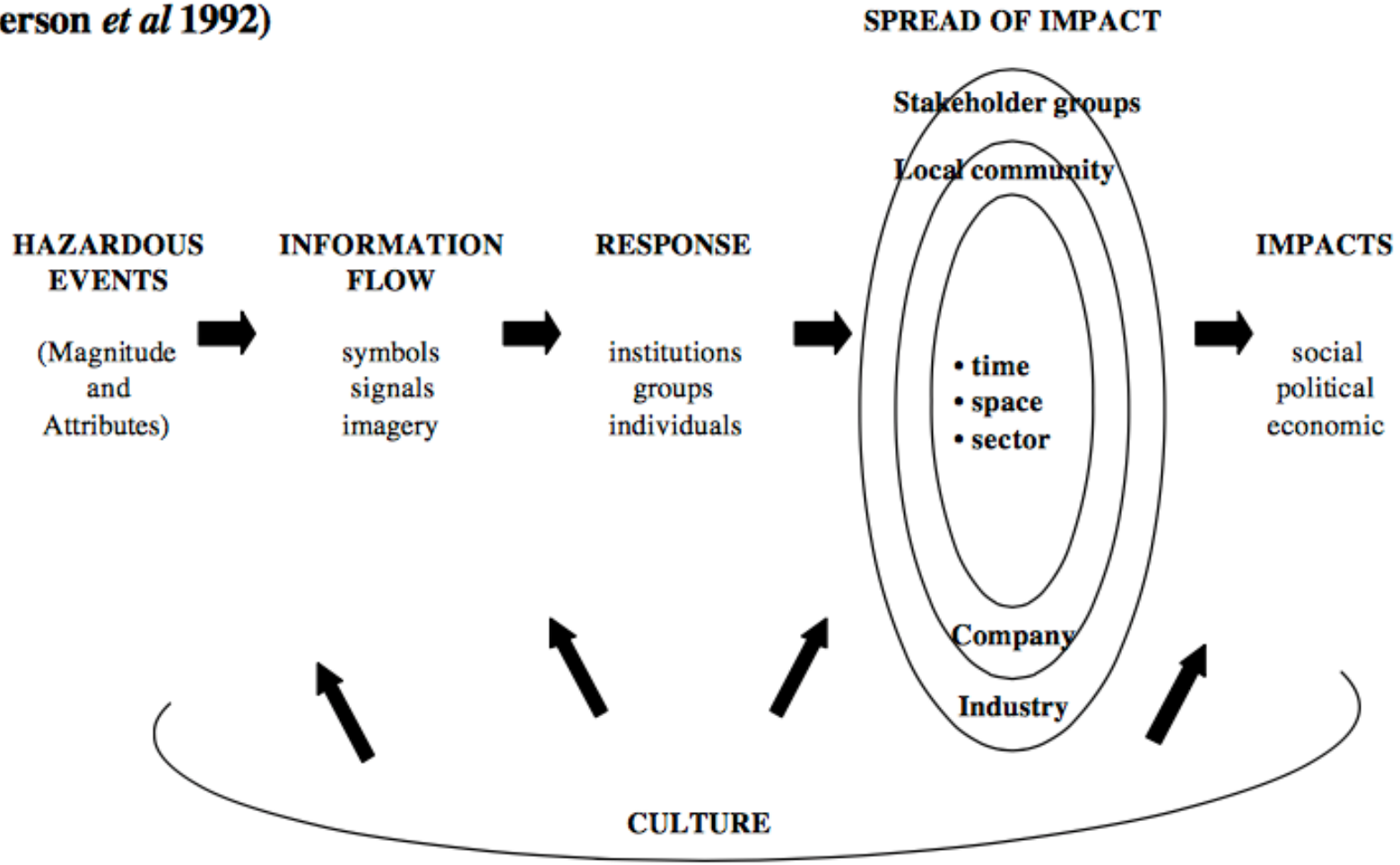
Grid-group cultural model		Group: Weak bonds between people	Group: Strong bonds between people
Grid	Many and varied interpersonal differences	**Fatalism**	**Collectivism**
	Significant similarity between people	**Individualism**	**Egalitarianism**

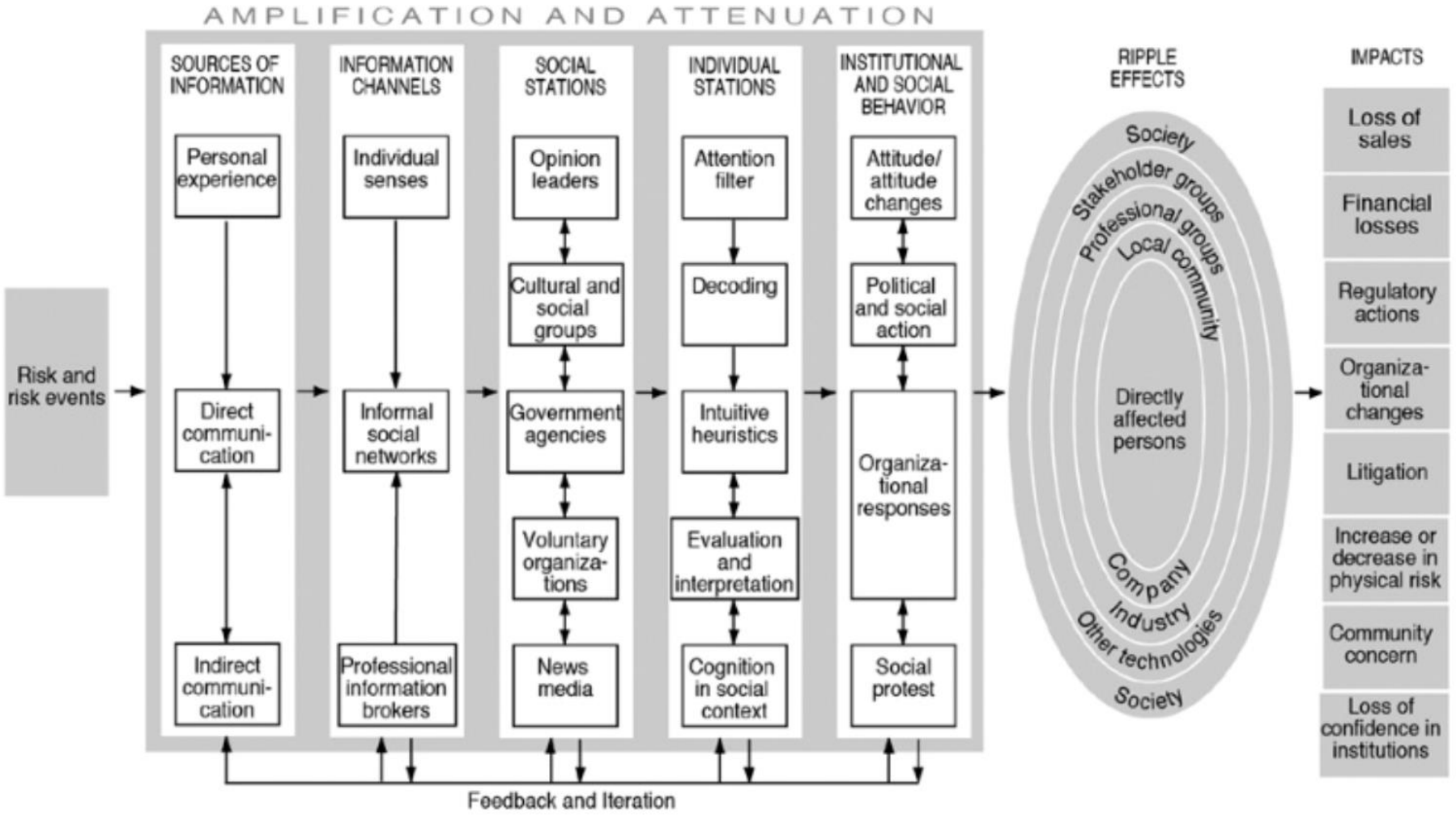
The Social Amplification of Risk (Kasperson *et al*., 1992, 2012)

- ✓ Combines research in psychology, sociology, anthropology, and communication theory
- ✓ Hypothesis = all links in the communication chain (from the event to the individual) contain **filters** through which information is sorted and understood

- ✓ Some of the signal transformations serve to increase or decrease the amount of information about an event or hazard:
  - **Risk amplification** → some hazards that experts rank as low risk become a focus of public concern (e.g., terrorist attack, plane crash, shark attack, pedophilia in Internet)
  - **Risk attenuation** → other hazards that experts rank as more serious receive less public attention (e.g., radon exposure, smoking)

Figure 1.1 SARF
(from Kasperson *et al* 1992)





Source: *A Perspective on the Social Amplification of Risk*, R. Kasperson, The Bridge, 2012

Ellabban, O. & Abu-Rub. H. (2016) Smart grid customers' acceptance and engagement: An overview. *Renewable and Sustainable Energy Reviews*, *65*, 1285-1298

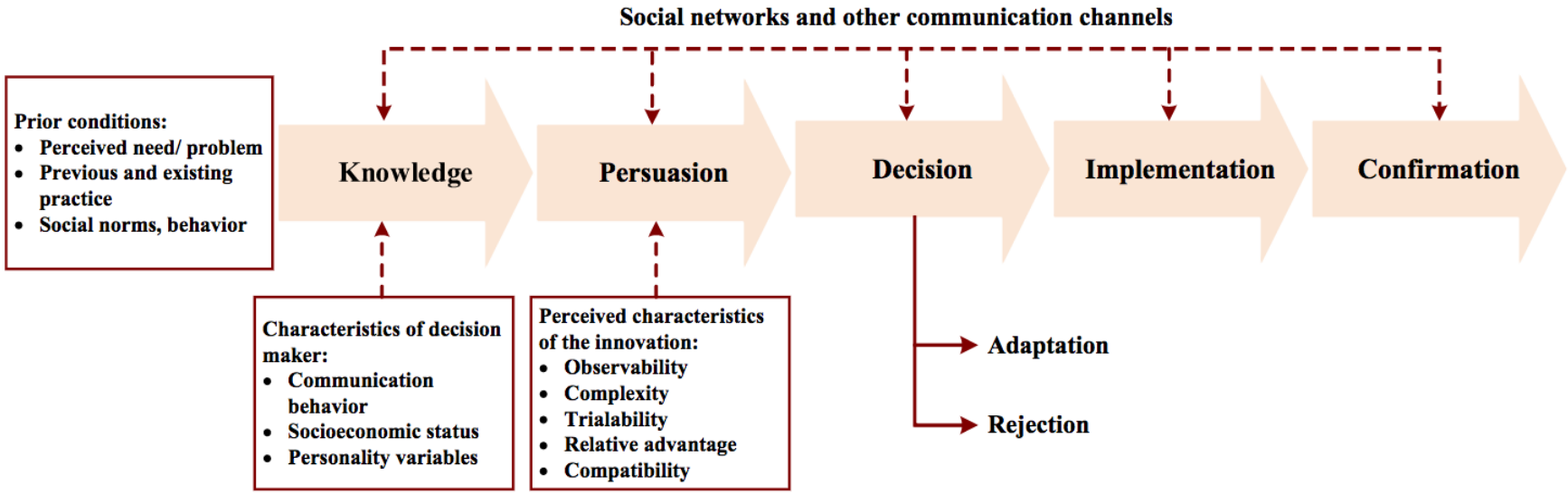


Fig. 21. The innovation decision process.

The recent introduction of the Perceived Risk (PR) in the “traditional” conceptions

➔ **But, where ????**

Im, I., Kim, T., & Han, H.-J. (2008). The effects of perceived risk and technology type on users’ acceptance of technologies. *Information & Management*, *45*, 1-9.

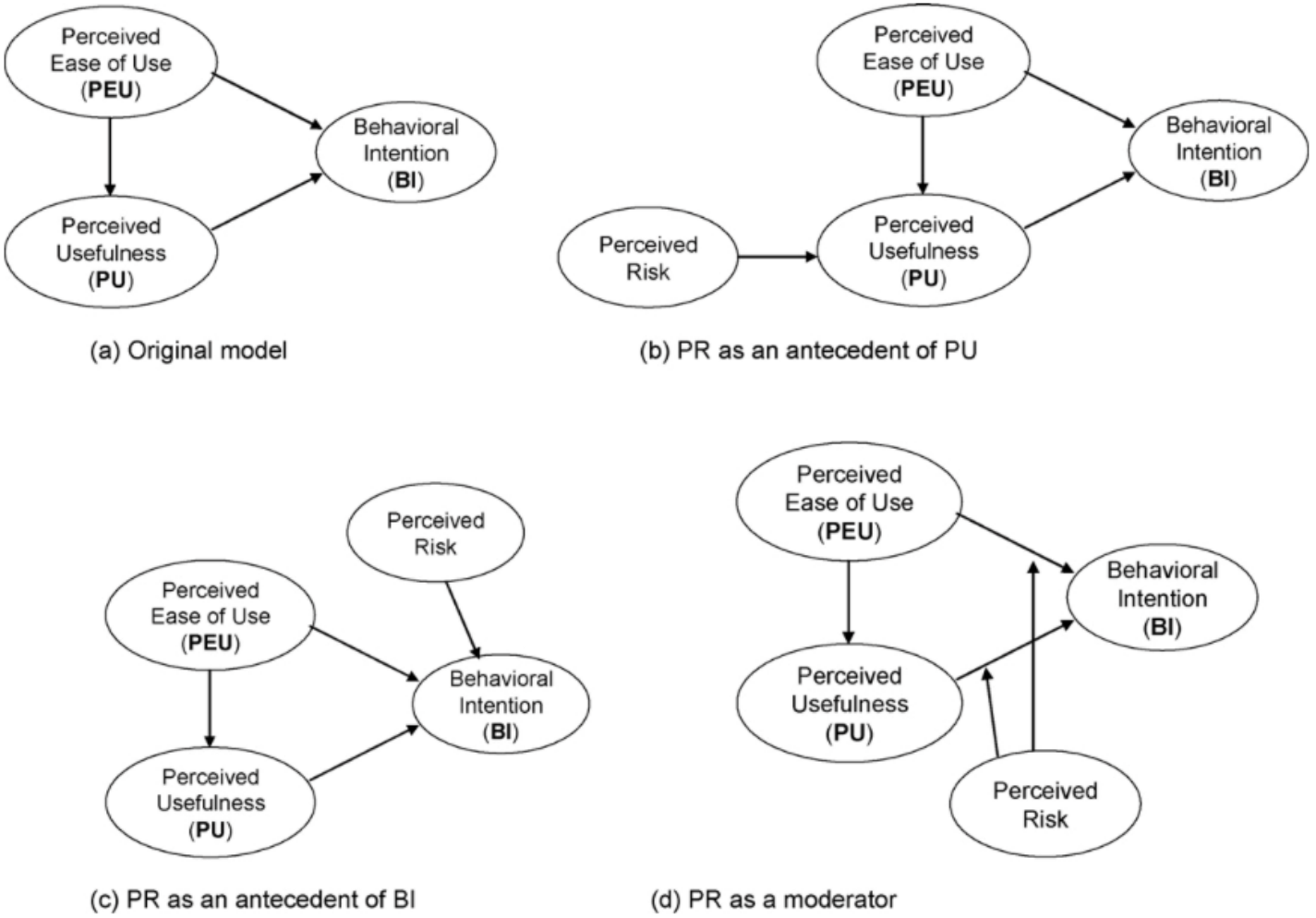


Fig. 1. Alternative conceptualizations of PR.

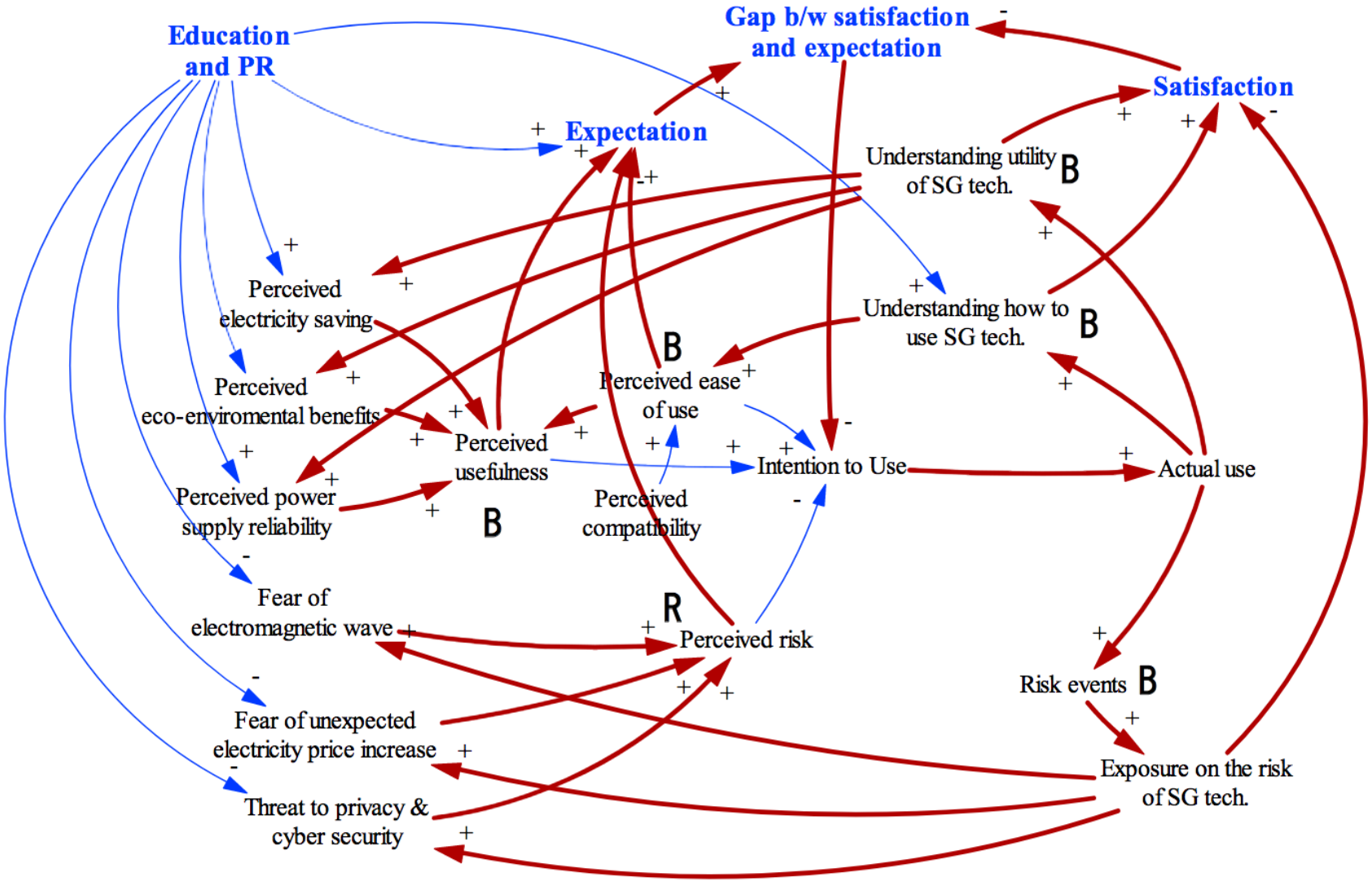
A multi-dimensional approach of the perceived risk (Featherman, M.S., & Pavlou, P.A. (2003). Predicting e-services adoption: a perceived risk facets perspective. *International Journal of Human-Computer Studies*, *59*, 451-474.)

Table 1
Description and definition of perceived risk facets

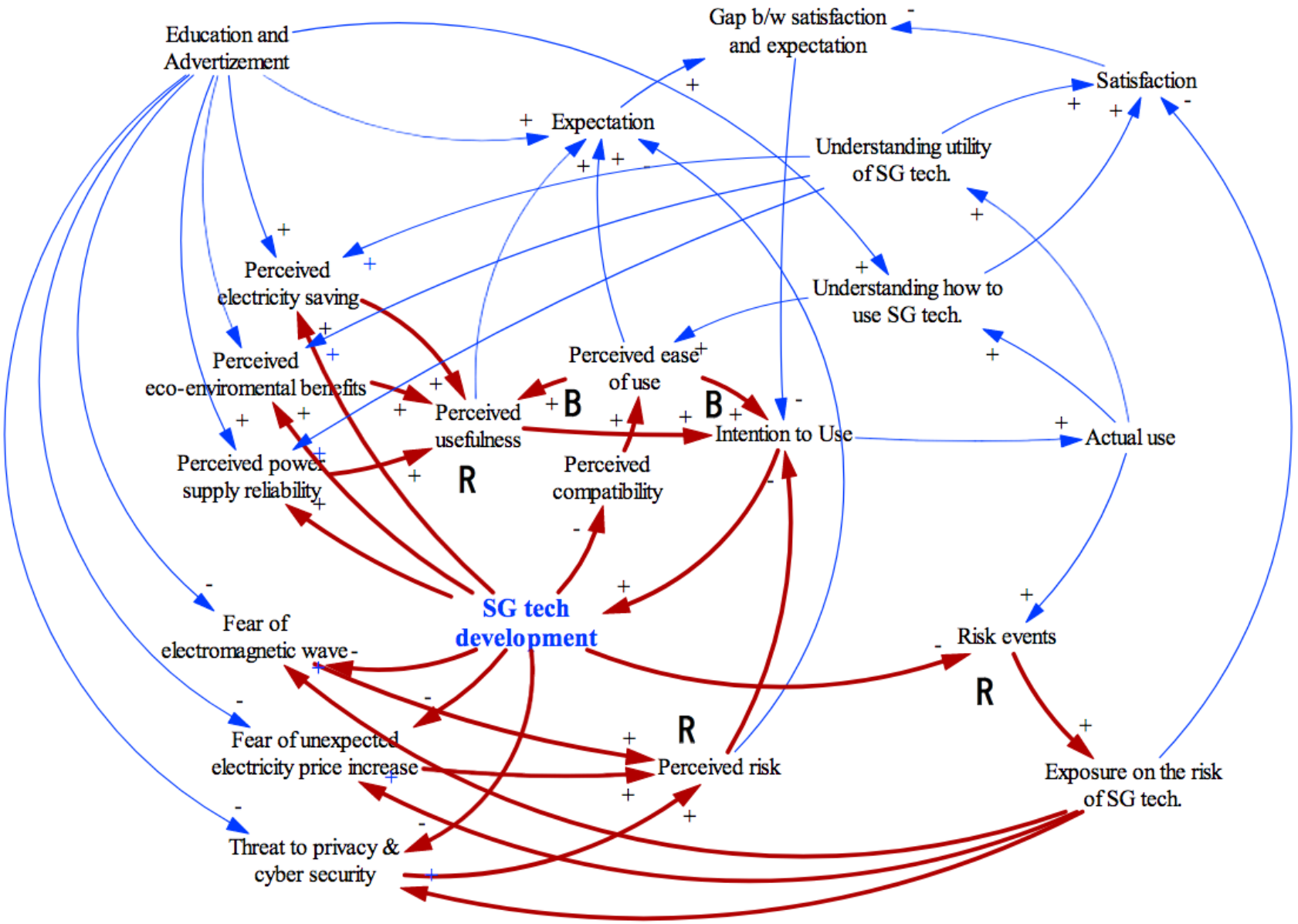
Perceived Risk Facet	Description—Definition
1. Performance risk	"The possibility of the product malfunctioning and not performing as it was designed and advertised and therefore failing to deliver the desired benefits." (Grewal et al., 1994)
2. Financial risk	"The potential monetary outlay associated with the initial purchase price as well as the subsequent maintenance cost of the product" (Grewal et al., 1994). The current financial services research context expands this facet to include the recurring potential for financial loss due to fraud.
3. Time risk	Consumers may lose time when making a bad purchasing decision by wasting time researching and making the purchase, learning how to use a product or service only to have to replace it if it does not perform to expectations.
4. Psychological risk	The risk that the selection or performance of the producer will have a negative effect on the consumer's peace of mind or self-perception (Mitchell, 1992). Potential loss of self-esteem (ego loss) from the frustration of not achieving a buying goal.
5. Social risk	Potential loss of status in one's social group as a result of adopting a product or service, looking foolish or untrendy.
6. Privacy risk	Potential loss of control over personal information, such as when information about you is used without your knowledge or permission. The extreme case is where a consumer is "spoofed" meaning a criminal uses their identity to perform fraudulent transactions.
7. Overall risk	A general measure of perceived risk when all criteria are evaluated together.

The adoption of smart-grids:
a balance between « **expectation** » and « **satisfaction** »

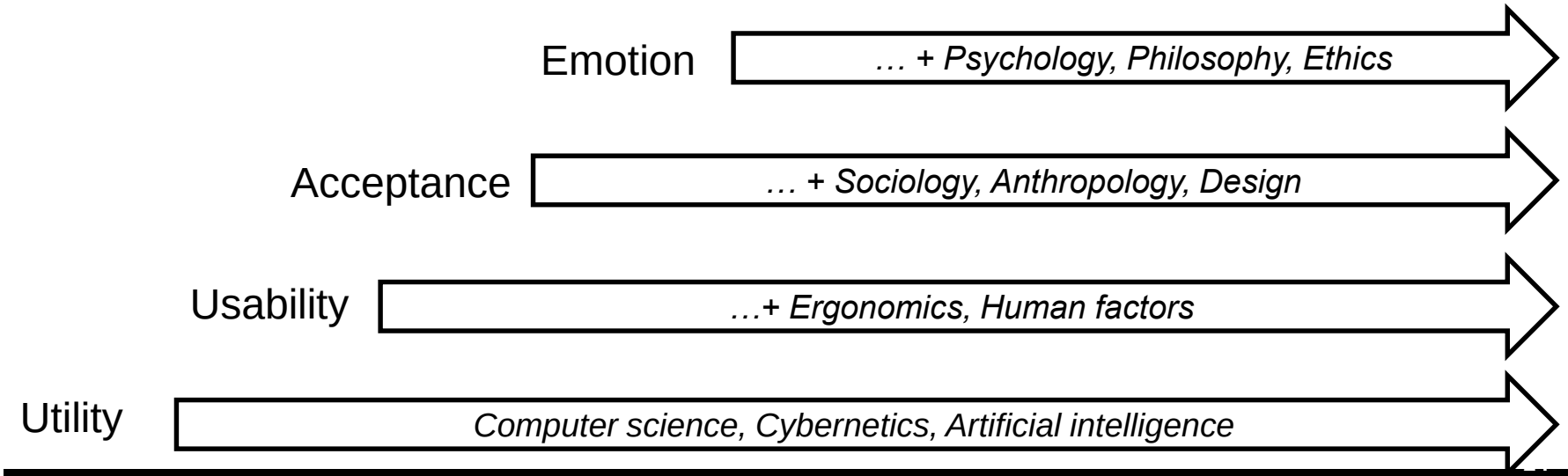
Chankook P., Hyunjae K., & Taeseok, Y. (2017). Dynamic characteristics of smart grid technology acceptance. *International Scientific Conference "Environmental and Climate Technologies",* CONECT 2017,10–12 May 2017, Riga, Latvia.



… to the recommendations **to improve the adoption**



Main questions / challenges addressed today



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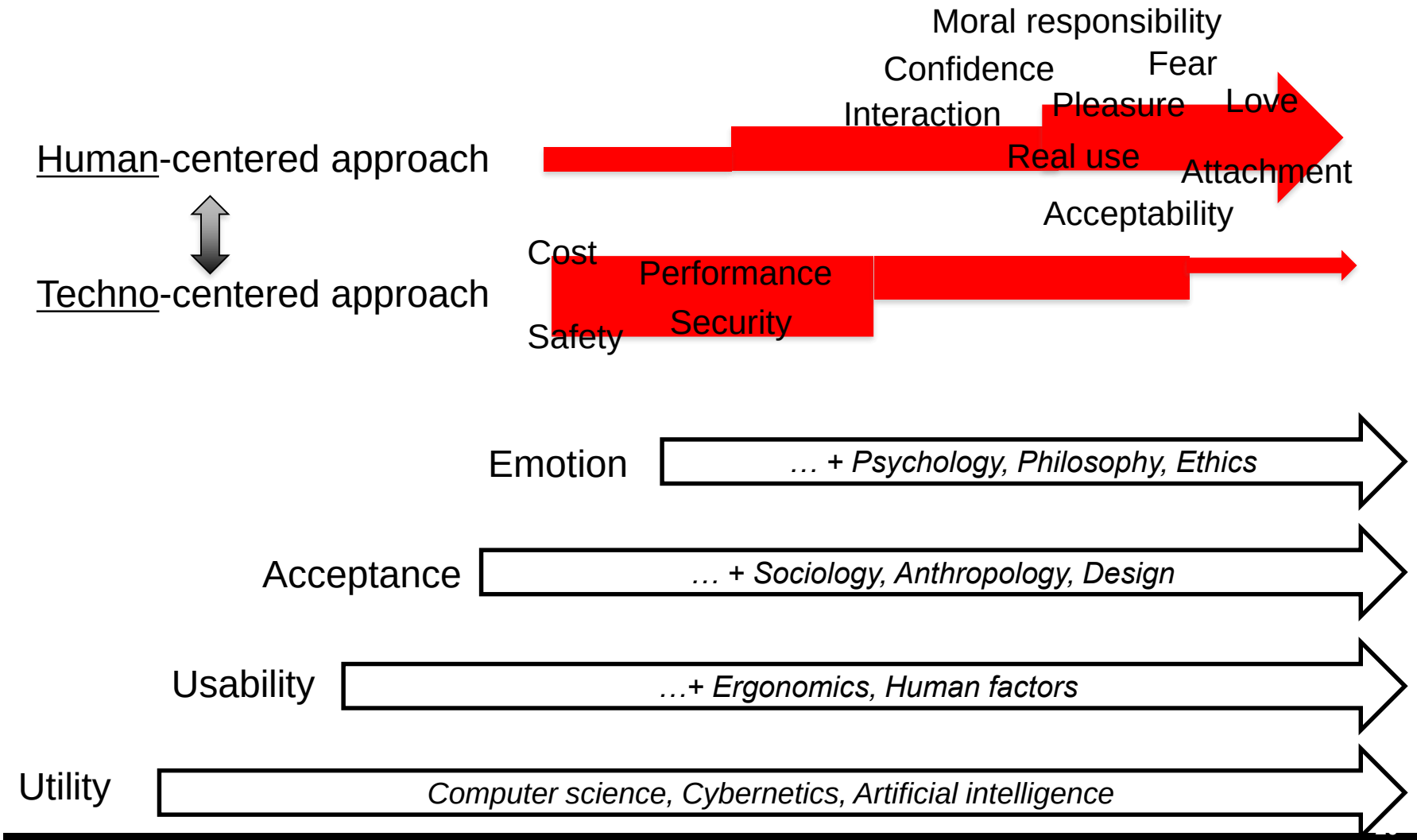

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Thank you for your attention ….

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