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# **RISK PERCEPTION OF NANOTECHNOLOGY: IMPLICATIONS FOR RISK ASSESSMENT AND COMMUNICATION**

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# Summary

- Risk perception and society
  - Views on risk perception: the psychometric view
  - The nano risk perception problem
  - Our study (preliminary results)
  - Risk perception and communication
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# Risk Perception

- Risk averse society
  - The lower the real risk the higher the societal risk perception “sindrome”
  - Political and scientific decisions heavily influenced by risk perception
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# Risk Perception

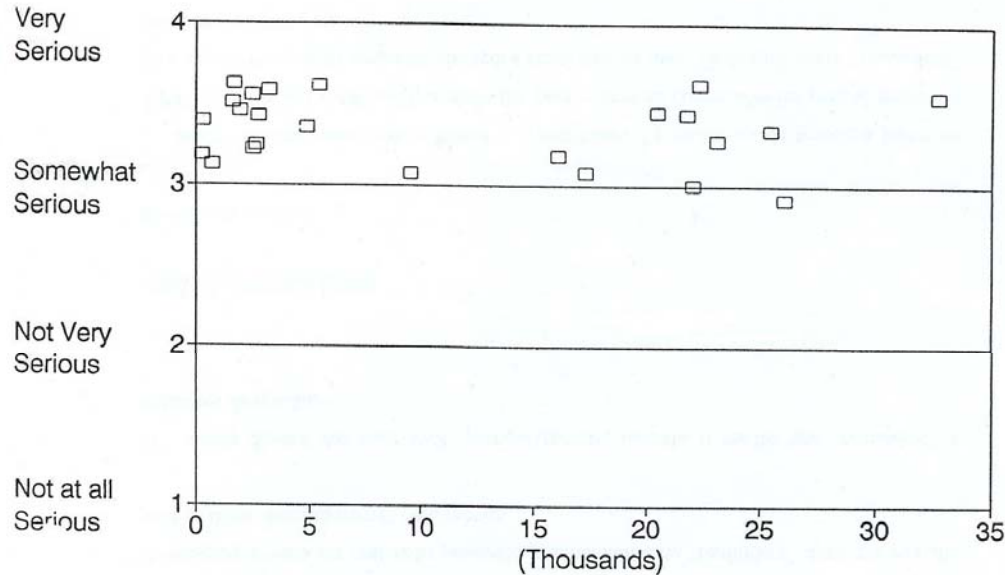
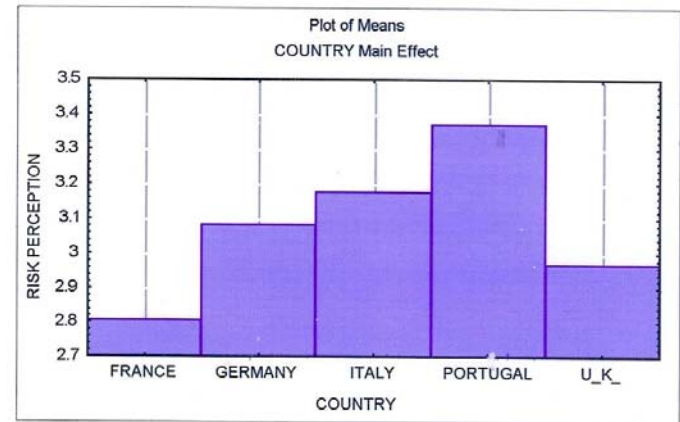


Figure 1. Perceived Seriousness of Environmental Issues in Nation By Per Capita GNP (1990 US Dollars)



Comparação entre a percepção de risco de cinco países europeus, tendo como amostras técnicos da IBM e professores do secundário Portugal é significamente diferente dos outros ( $F(4,732)=38.59, p<.01$ ).

# Psychometric Paradigm

Slovic, Fischhoff, and Lichtenstein

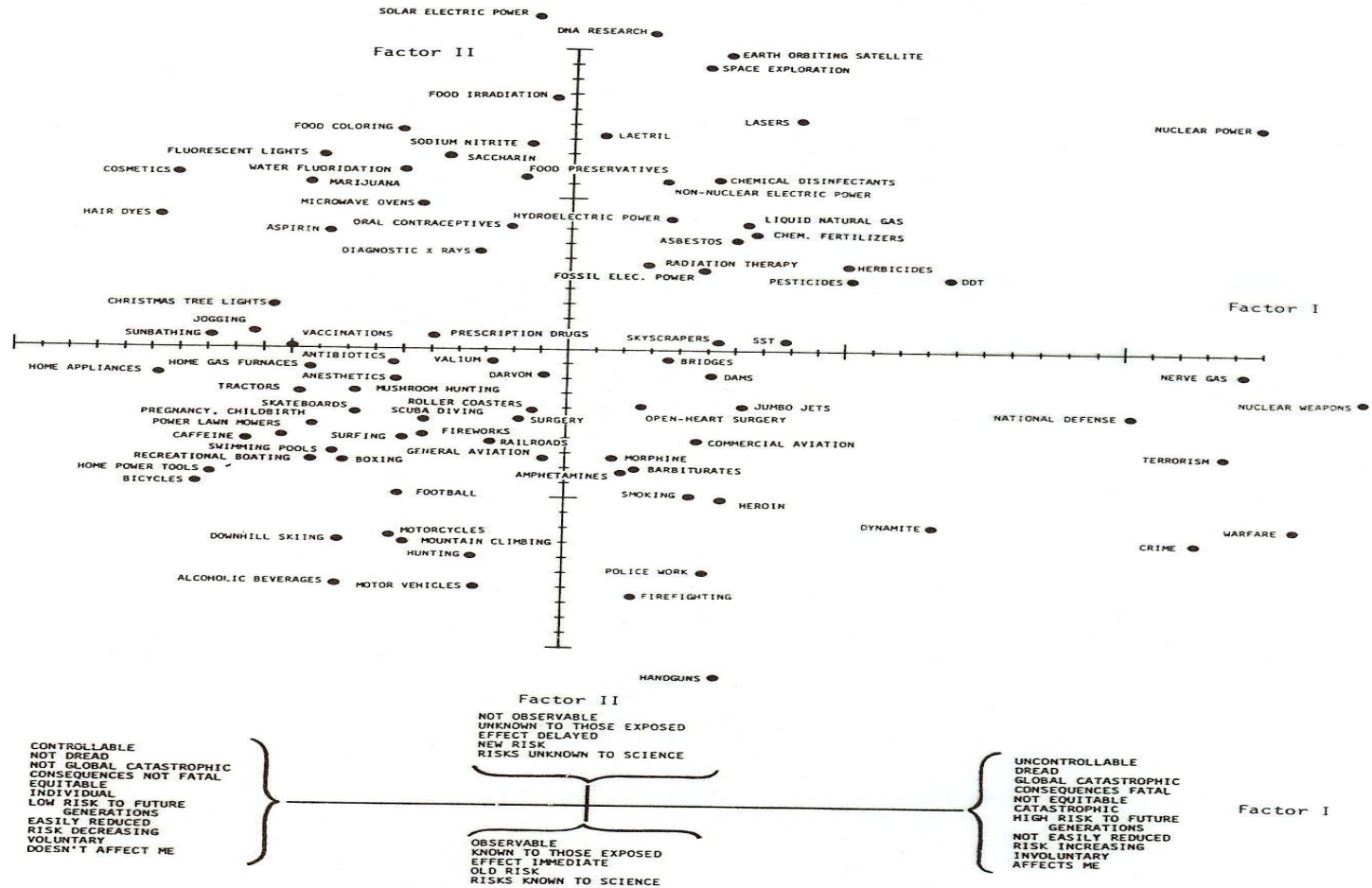
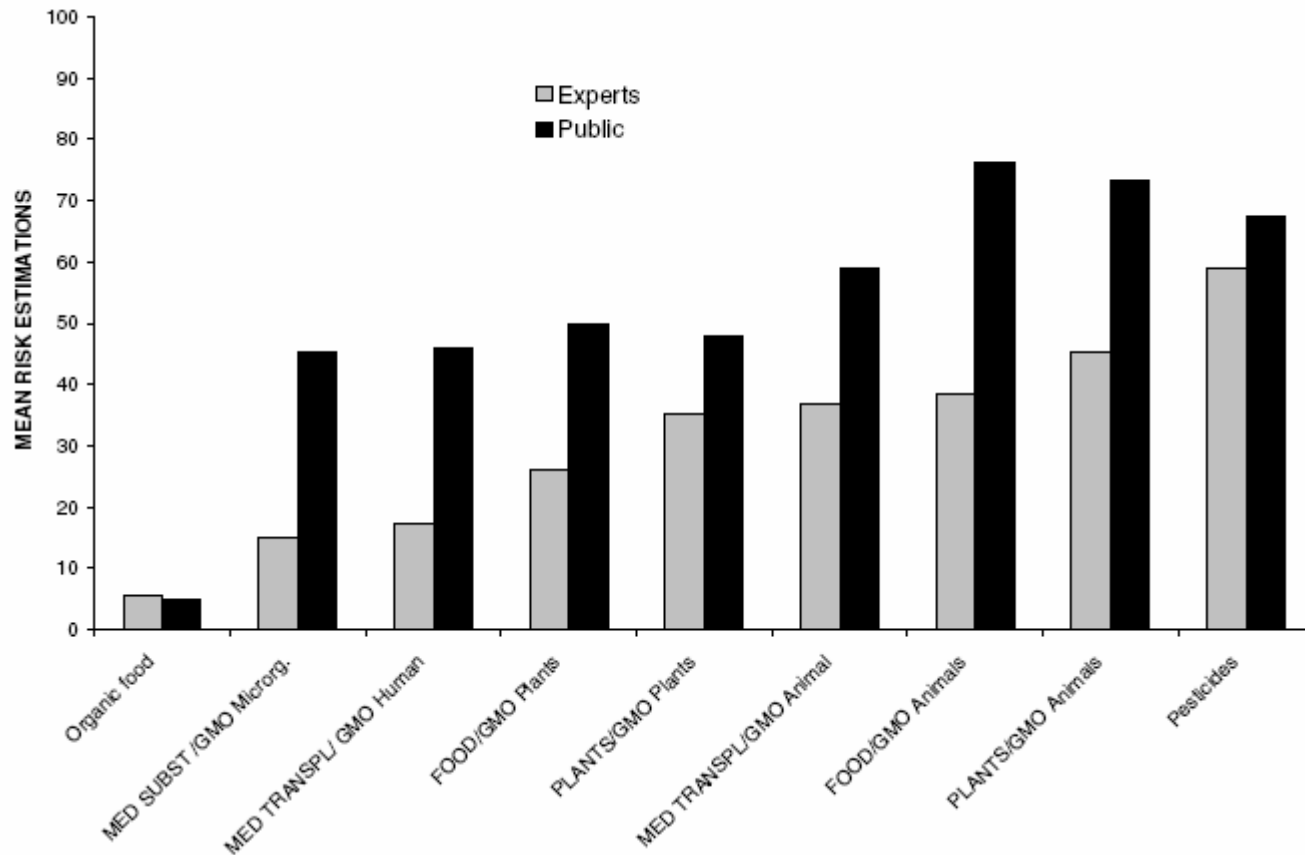
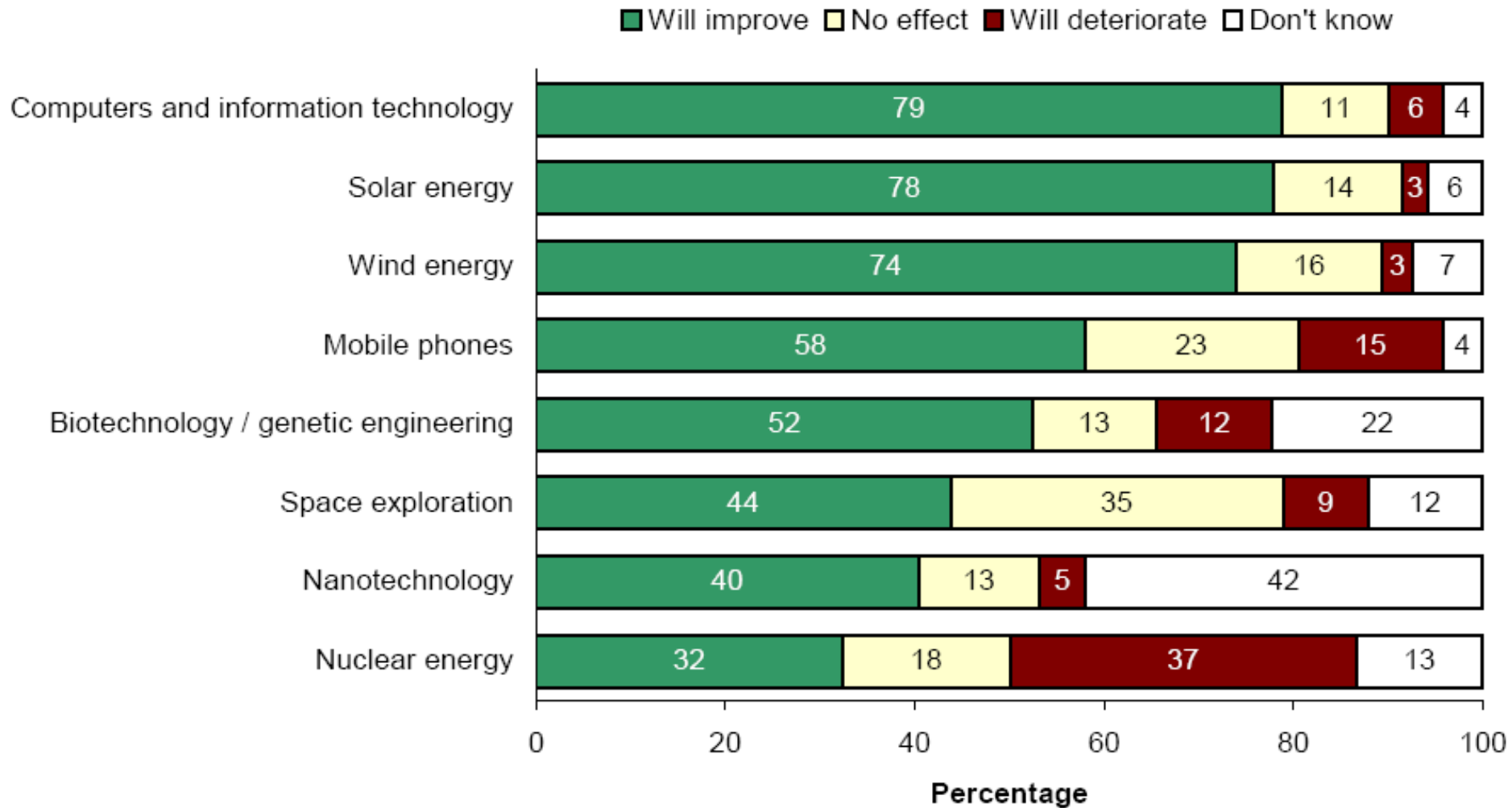


Fig. 1. Hazard locations on Factors 1 and 2 of the three-dimensional structure derived from the interrelationships among 18 risk characteristics. Factor 3 (not shown) reflects the number of people exposed to the hazard and the degree of one's personal exposure. The diagram beneath the figure illustrates the characteristics that comprise the two factors. Source: reference 12.

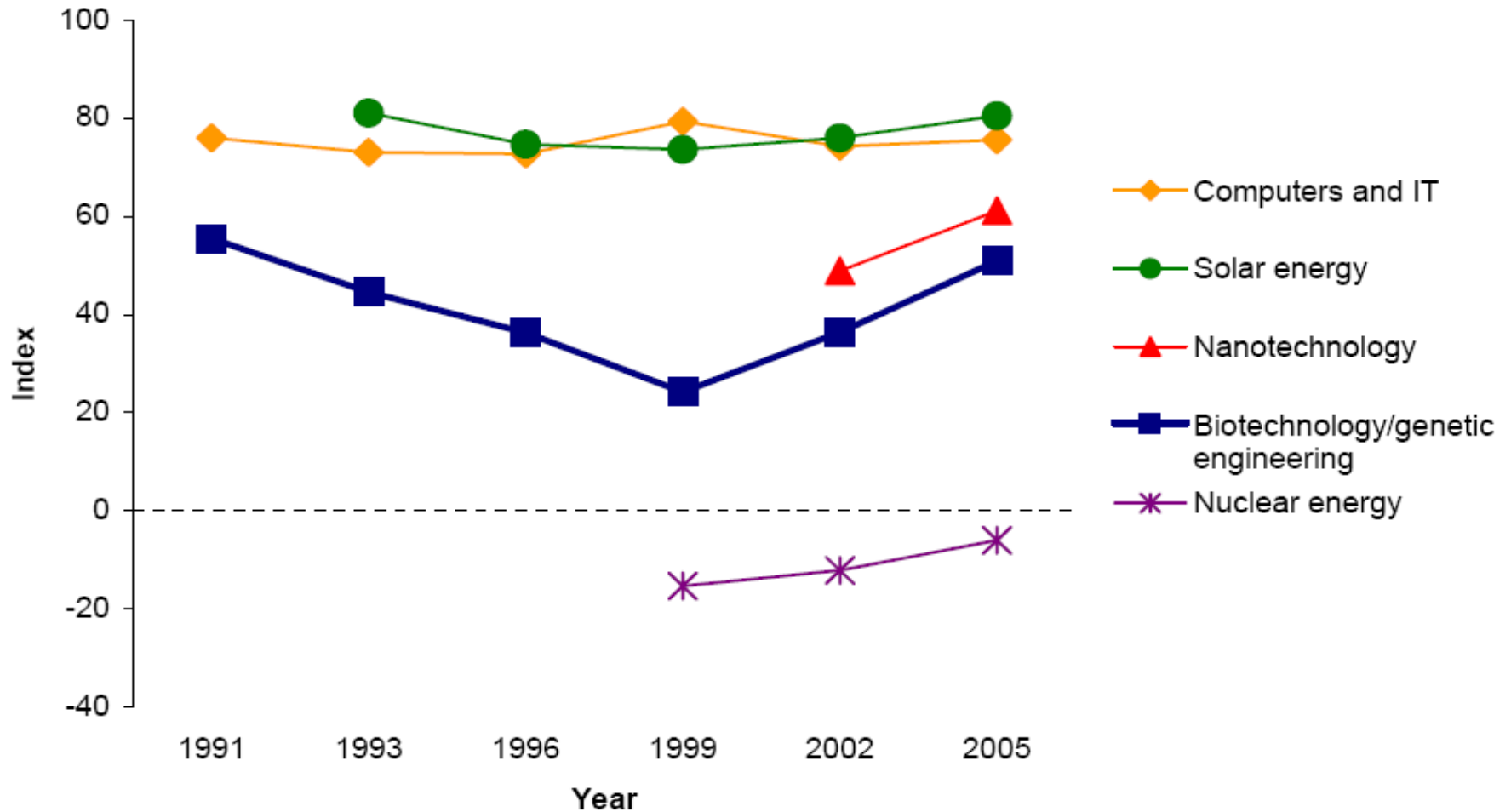
# Psychometric Paradigm



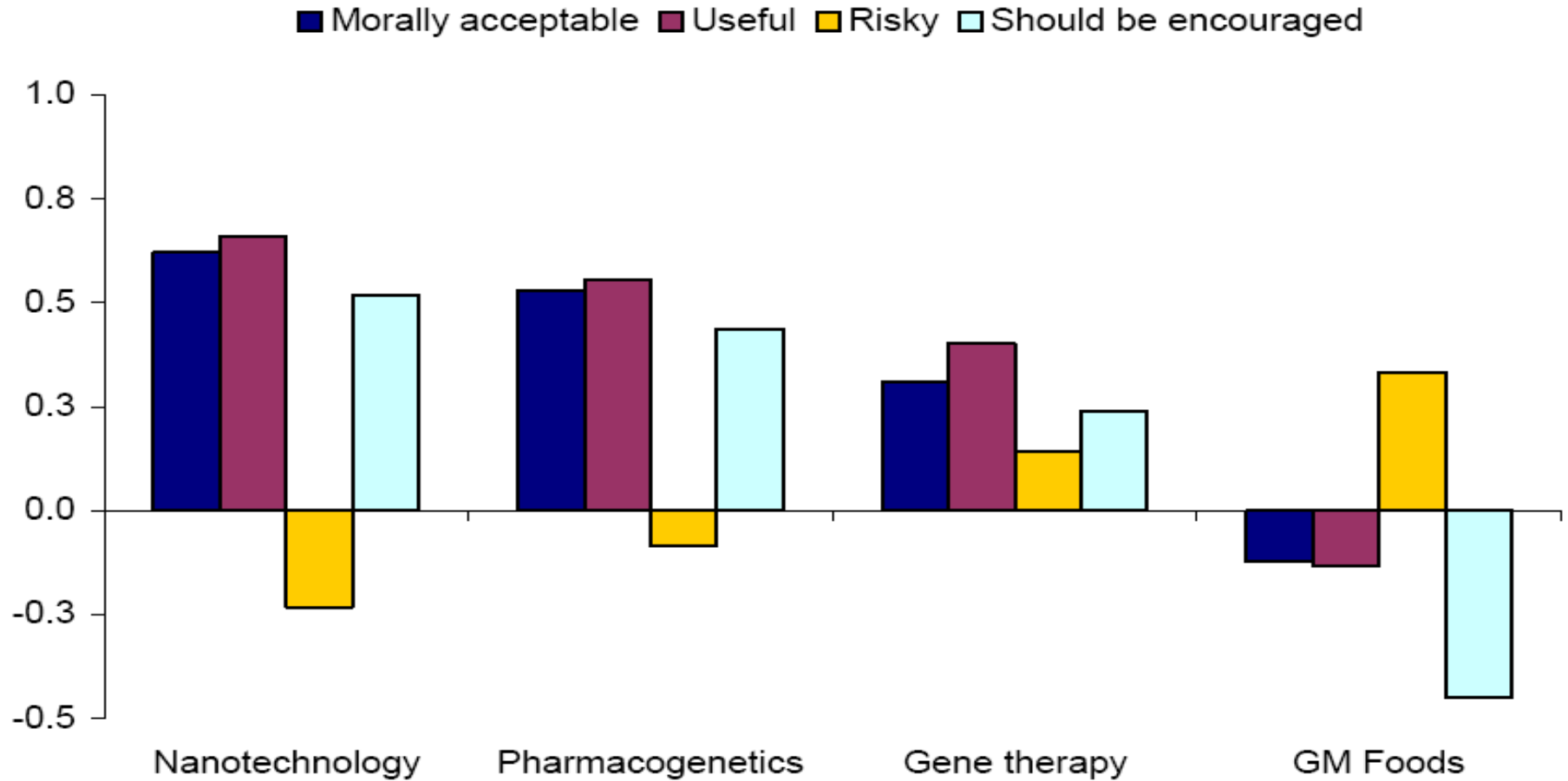
# Nano Risk Perception



# Nano Risk Perception



# Nano Risk Perception



# Nano Risk Perception

Rating Scale	Dread Risk	Distrust	Ethically Justified
Probability of health damage (1 = very improbable)	<b>0.99</b>	-0.01	0.02
Worries about risks (1 = not worried)	<b>0.98</b>	-0.12	-0.01
Voluntariness of risk (1 = voluntary)	<b>0.88</b>	0.40	0.04
Knowledge of risk to exposed people (1 = known precisely)	-0.24	-0.02	<b>-0.89</b>
Adverse health effects (1 = not at all)	<b>0.96</b>	0.03	0.21
Control over risk (1 = controllable)	0.35	<b>0.84</b>	0.08
Trust in governmental agencies (1 = no trust)	0.47	<b>-0.69</b>	0.12
Ethically justifiable (1 = not justifiable)	<b>-0.63</b>	-0.05	<b>0.64</b>

*Note:* Loadings exceeding 0.5 are in boldface.

Siegrist, et al. (2007)

# Nano Risk Perception



**Fig. 1.** Location of the nanotechnology hazards within the two-component space for the layperson sample.

# Biotech Risk Perception

	Factor 1: Harmful and Dread Application (31.4% Var.)	Factor 2: Useful Application (21.2% Var.)	Factor 3: Science Knowledge (10.2% Var.)	Factor 4: New Application (9.1% Var.)
Personal exposure	<b>0.865</b>	-0.074	-0.161	-0.007
Harmful to environment	<b>0.800</b>	-0.385	-0.104	0.137
Collective exposure	<b>0.793</b>	-0.128	-0.039	-0.105
Harmful to humans	<b>0.780</b>	-0.327	-0.145	0.262
Risky for future generations	<b>0.775</b>	-0.205	-0.039	0.320
Severe negative consequences	<b>0.682</b>	-0.362	-0.255	0.175
Dread	<b>0.670</b>	-0.376	-0.143	0.327
Voluntary exposure	<b>-0.540</b>	0.221	0.321	-0.150
Acceptable risk	-0.221	<b>0.839</b>	0.101	-0.008
Benefits for humans	-0.309	<b>0.790</b>	0.153	-0.170
Personal benefits	-0.252	<b>0.774</b>	0.203	-0.250
Benefits for the environment	-0.424	<b>0.704</b>	0.086	0.031
Precise personal knowledge	0.059	<b>0.470</b>	0.199	-0.462
Observable damage	-0.098	0.108	<b>0.838</b>	-0.296
Precise scientific knowledge	-0.306	0.290	<b>0.740</b>	0.168
New risk	0.320	-0.090	-0.053	<b>0.824</b>

Salvadori, et al. (2004)

# Our study

- 188 subjects
- Age: AVA 24.45 (18 to 57)
- 48 Males (27.9%) and 124 Females (72.1%)
- 68.6% high school, 19.7% Grad , 2.3% Master
- Lisbon area
- Study of nano general, five applications (clothing, food, telecommu, medicine/pharma, mili). Risk dimensions. Specific applications.

# Results

2 Factors ( 55.4% variance Varimax).

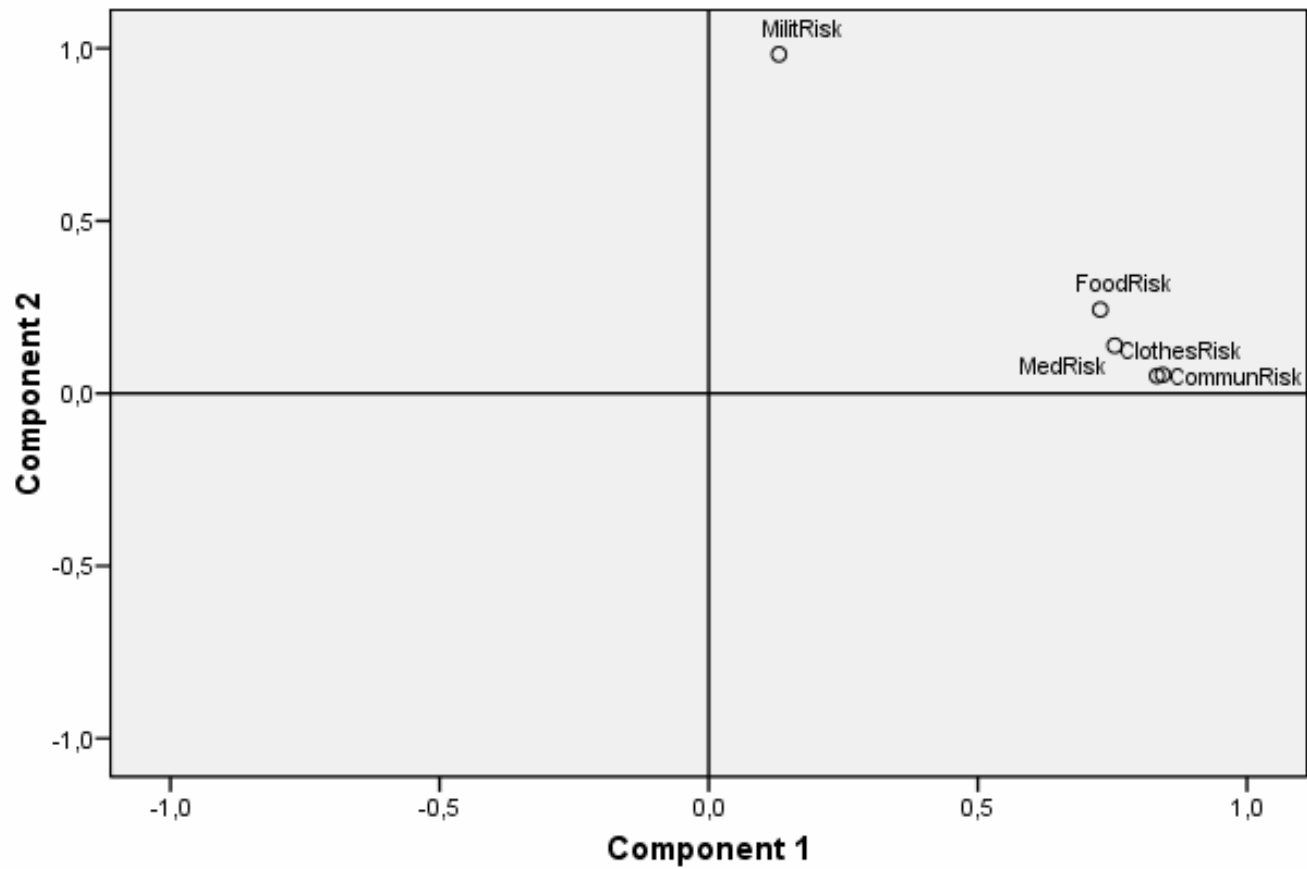
Factor 1: Health damage; Worries; Effects strength; Uncontrollable; Lack of trust; Ethically unjustifiable

Factor 2: Involuntary; Lack of knowledge.

	Component	
	1	2
Health damage	,824	,117
Worries	,739	,031
Involuntary	,226	,722
Lack of knowledge	-,049	,850
Effects strength	,796	,224
Uncontrollable	,567	,152
Lack of trust	,492	,417
Ethically unjustifiable	,668	,017

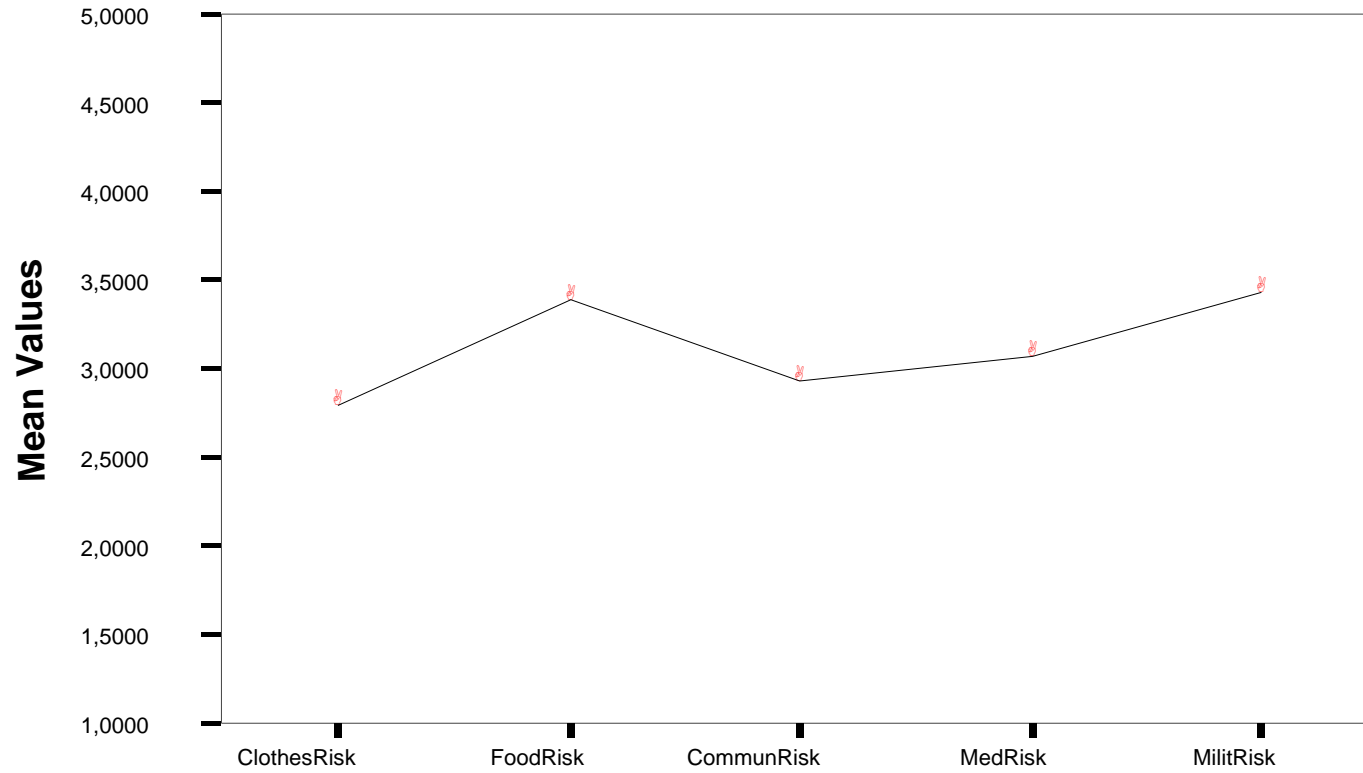
Extraction Method: Principal Component Analysis.  
Rotation Method: Varimax with Kaiser Normalization.  
a. Rotation converged in 3 iterations.

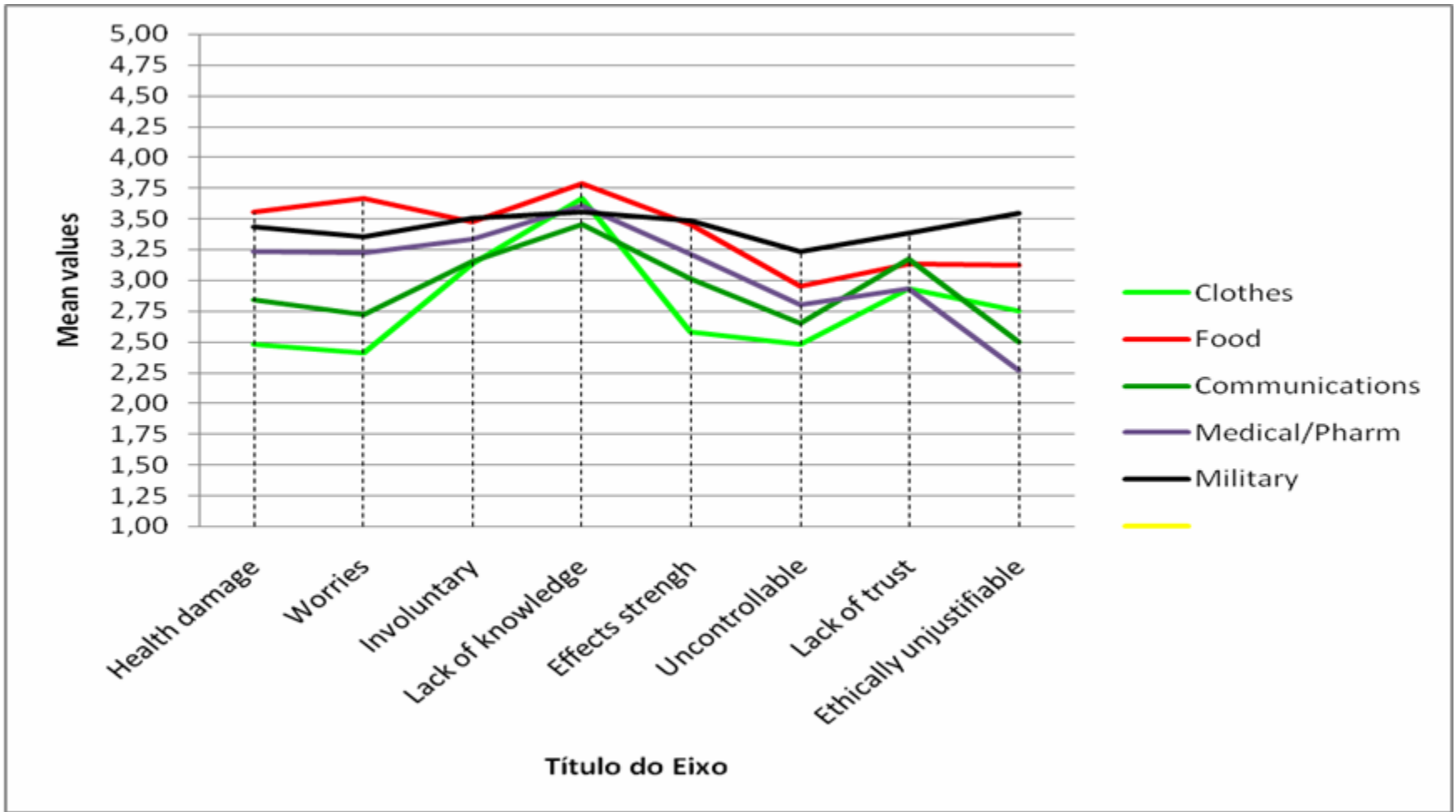
## Component Plot in Rotated Space



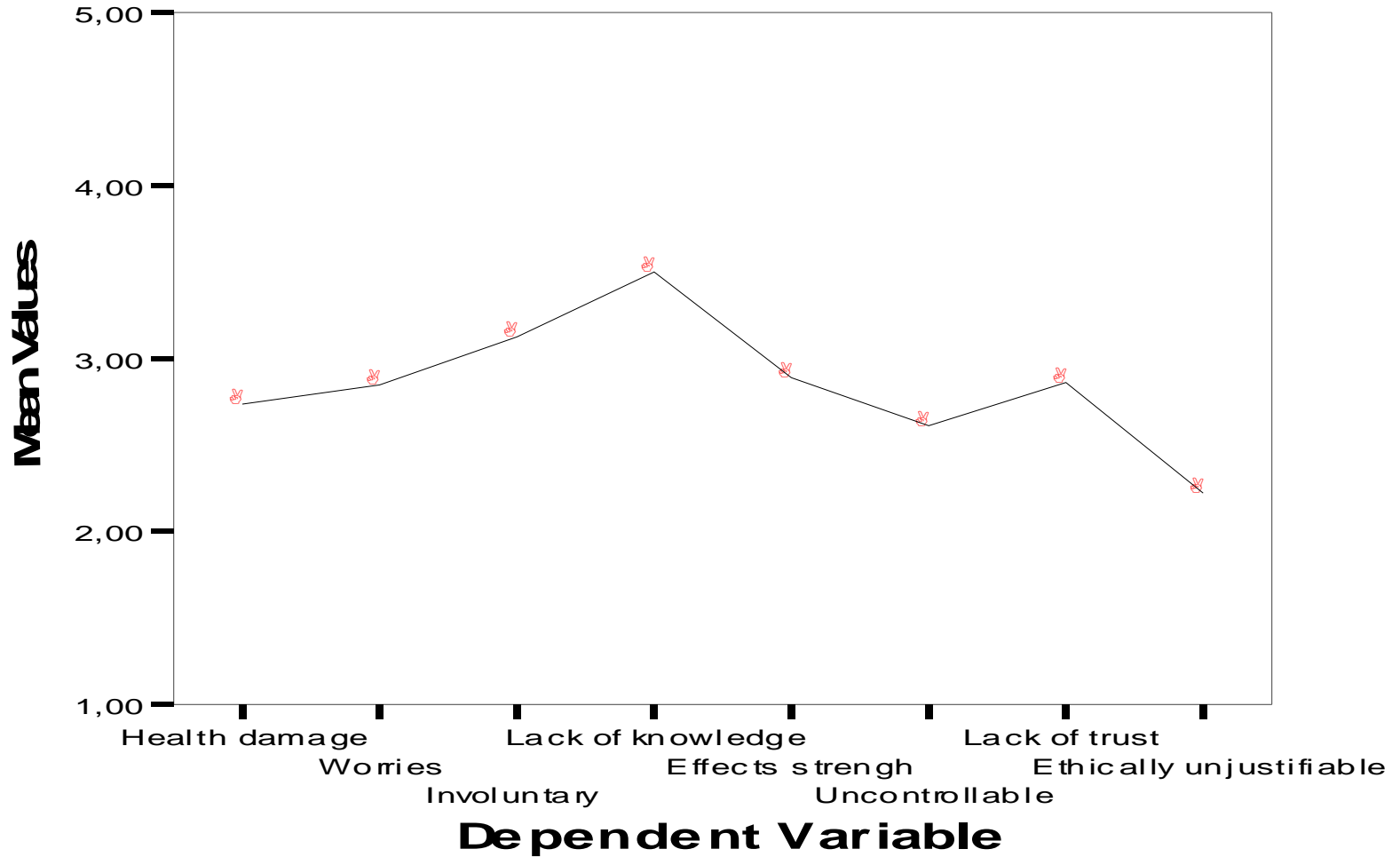
Military dif mainly 2 factor

## Perceived risk (average across factors)

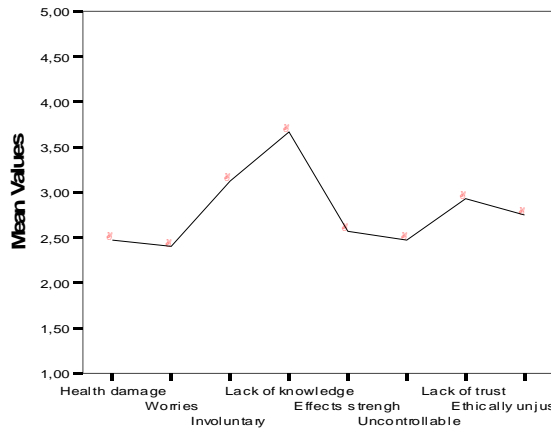




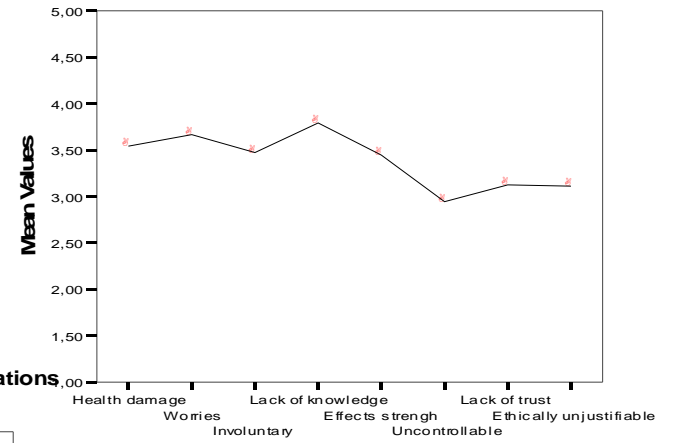
## Nanotechnologies in general



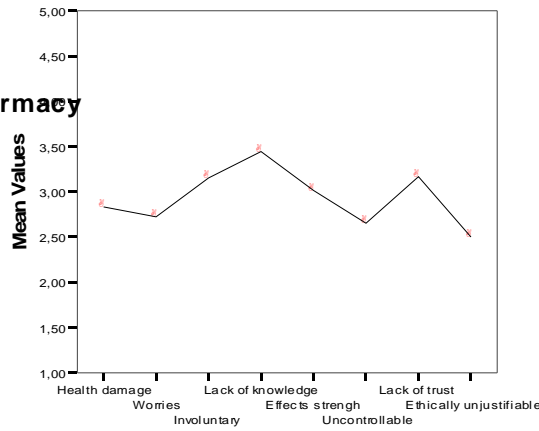
### Nanotechnologies applied to clothes



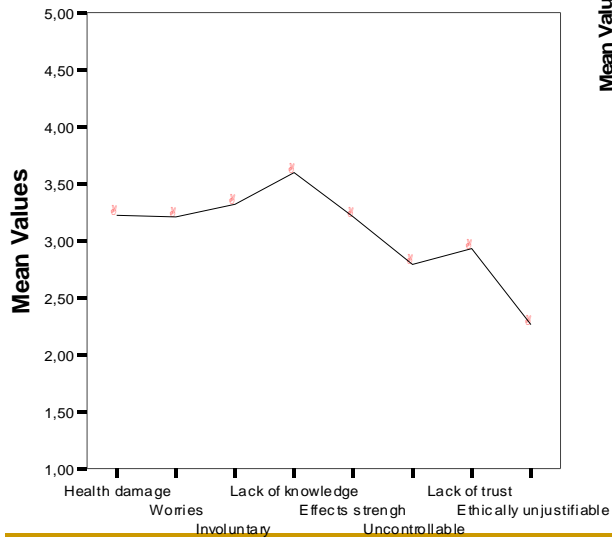
### Nanotechnology applied to food



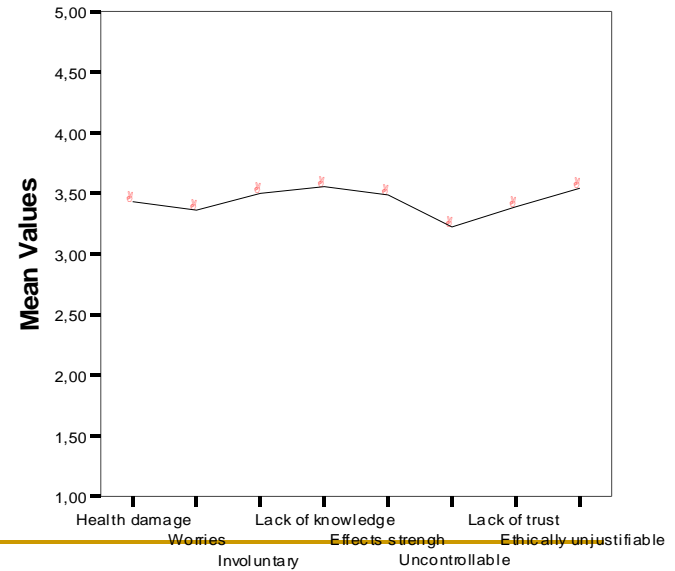
### Nanotechnology applied to communications

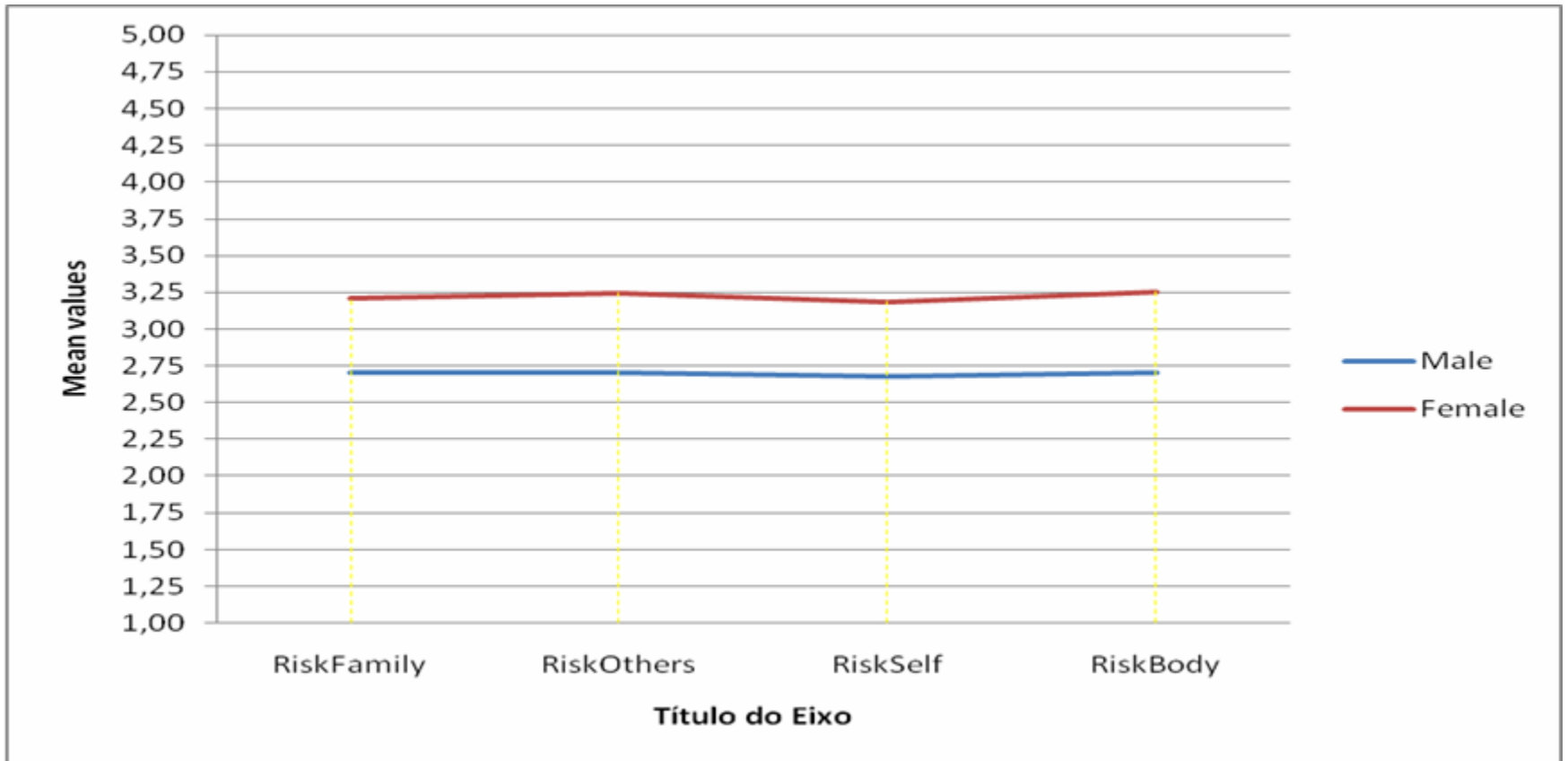


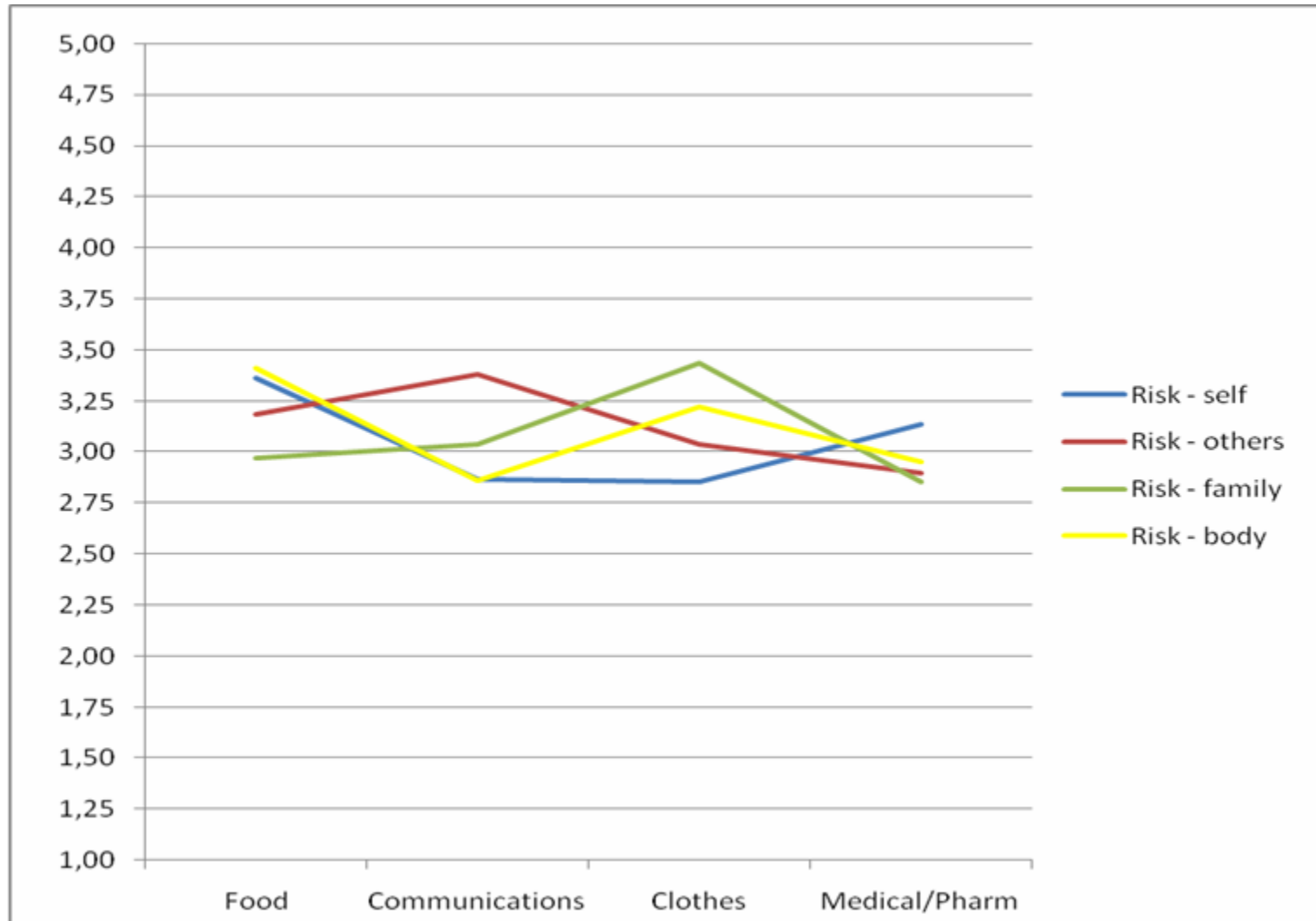
### Nanotechnology applied to medicine/pharmacy



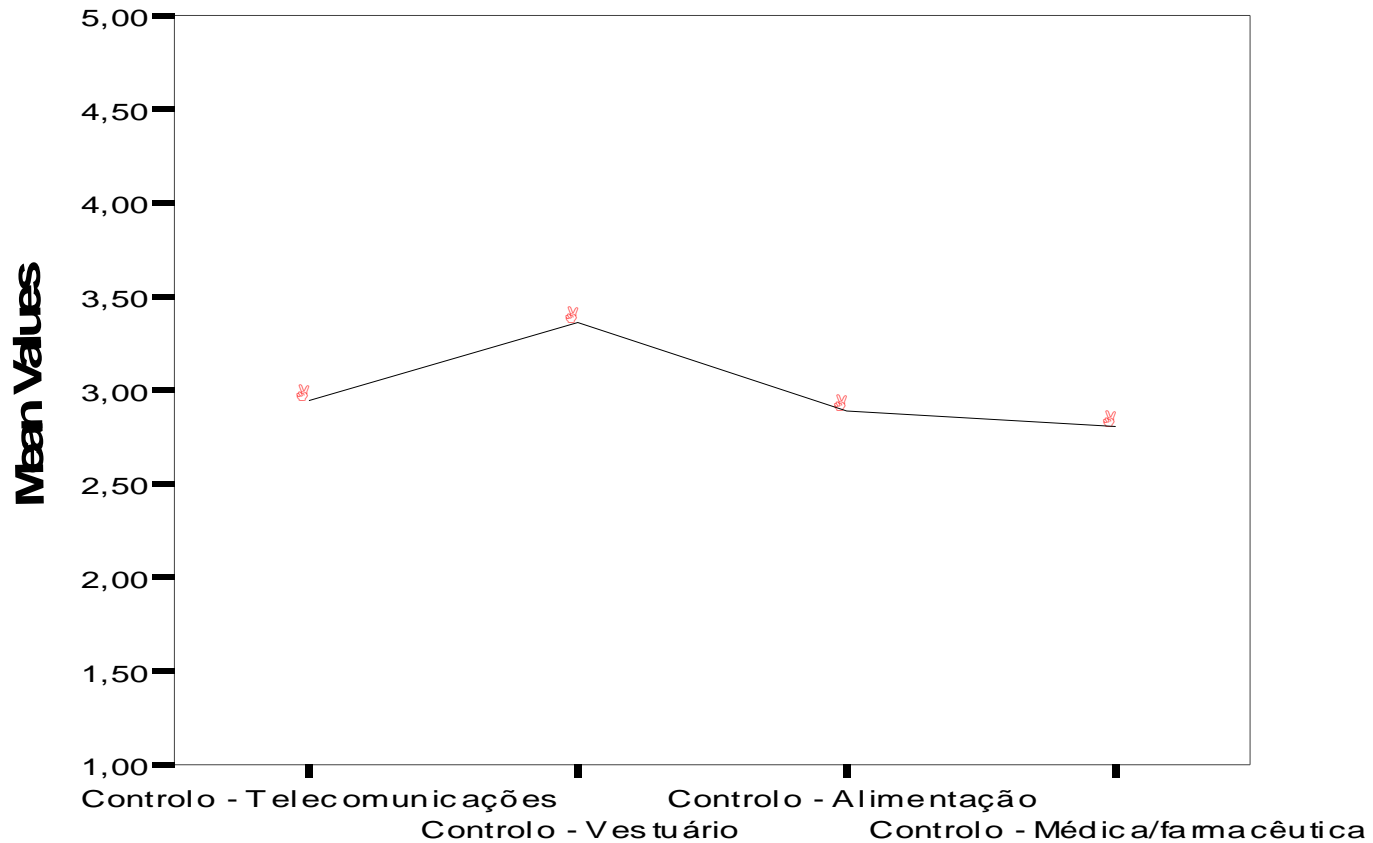
### Nanotechnology for military purposes







## Perceived control

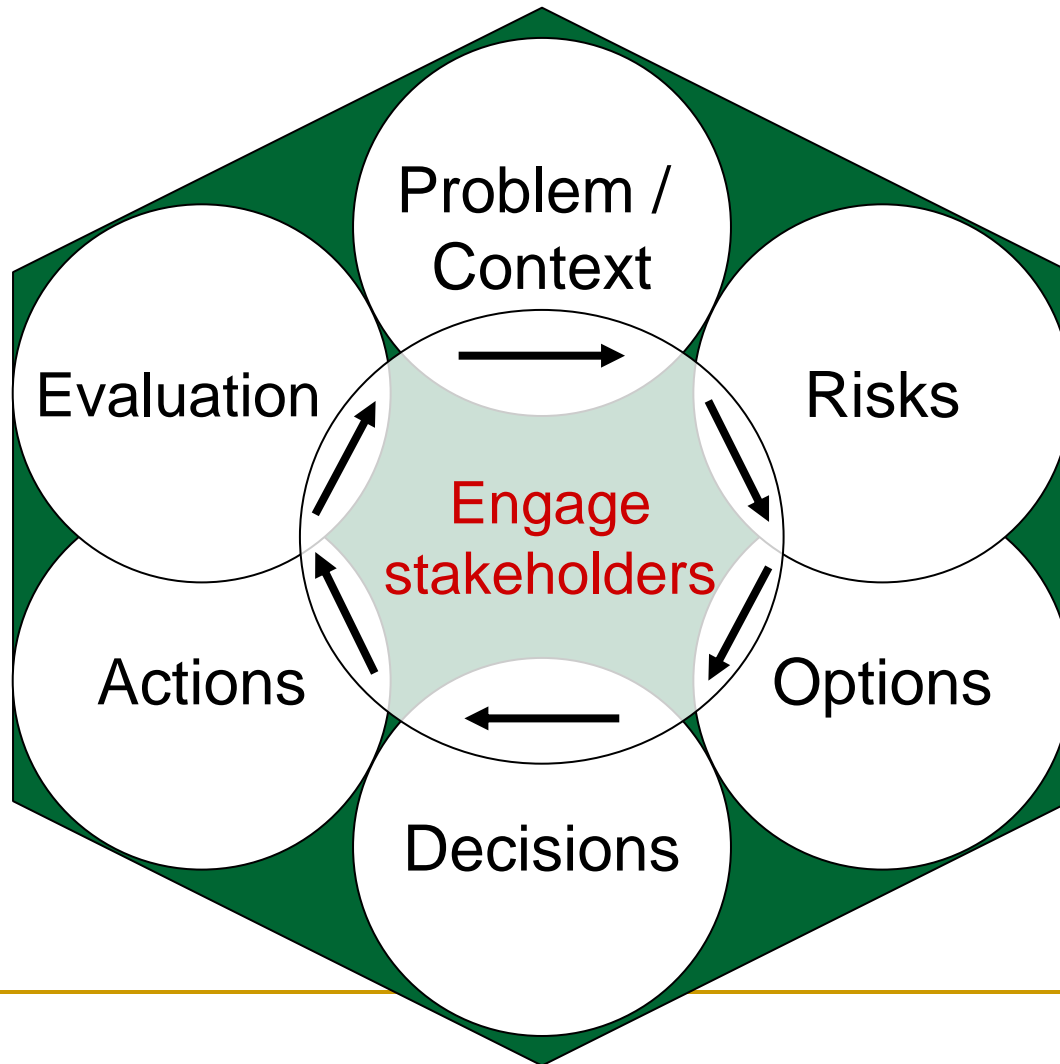


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Conclusions...

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# Environmental Risk Management Framework



# Framework for Risk Management

The Commission's Framework is designed to help all types of risk managers—government officials, private sector businesses, individual members of the public—make good risk management decisions (see “Principles for Risk Management Decision-Making” on page 4). The Framework has six stages:

Define the **problem** and put it in **context**.

Analyze the **risks** associated with the problem in context.

Examine **options** for addressing the risks.

Make **decisions** about which options to implement.

Take **actions** to implement the decisions.

Conduct an **evaluation** of the action's results.

The Framework is conducted:

- In **collaboration** with stakeholders.
- Using **iterations** if new information is developed that changes the need for or nature of risk management.

