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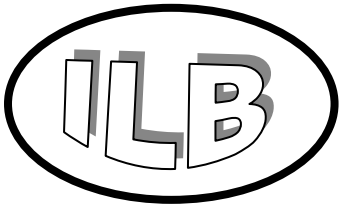

How to Improve Risk Perception Evaluation in Food Safety: A Psychometric Approach

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1. Introduction

Food consumers often query or ignore the risk assessments of scientists, the food industry and public bodies. This is widely acknowledged. It has been suggested that this 'expert-lay discrepancy' is a relatively straightforward upshot of the fact that lay people lack the knowledge and technical understanding of experts. However, much published research on risk in psychology and sociology runs counter to this 'knowledge deficit' model (Hansen *et al.*, 2003). In many cases, at least, lay risk assessments are not well explained as the product of ignorance, because they are in fact complex, situational sensitive expressions of a person's value system.
There is obviously a pressing need today to understand expert-lay discrepancies in the assessment of food risks. We need to know how consumers perceive and assess risks; why they respond to communication and advice relating to those risks in the way they do; what factors affect their willingness to trust public institutions responsible for regulating the food industry and issuing guidance on food matters; and what determines their handling of specific food hazards.
Psychometric and psychological studies of risk perception offer an invaluable corrective to excessive and simplistic reliance on the deficit model (Fife *et al.*, 2000; Hansen *et al.*, 2003). By emphasising the multi-dimensionality of lay risk perception, they have improved the understanding of expert-lay discrepancy. More generally, the demonstration that risks and benefits are not perceived independently of each other is a crucial finding of psychological research, and we now know that risk-benefit analyses that treat risk and benefits as independent factors should be handled with caution by those aiming to interpret or influence popular opinion.
Our paper is an attempt to analyse consumers' behaviour when facing a potential risky action such as consuming GM food. The hypothesis tested states that consumers take into account both costs (accident) and benefits (rewards) of uncertain outcomes and then minimize risk instead of trying to totally avoid it.
A sample of 338 students, interviewed in year 2000 (188) and in year 2008 (150), enrolled in different Italian colleges was directly interviewed on an hypothetical genetically modified tomato market. A mixture distributions was used first for inferring on what variables influence the decision to take part on the "new market" proposed and, second, to estimate the Willingness To Pay (WTP) distribution for those willing to buy the GM product proposed.

2. A Framework for Analyzing GMOs Risk Perception

In the traditional approach, often called in the literature as "technical approach", (Lind, 1987; Kasperson *et al.*, 1989) risk tends to be seen as an objective property of an event or activity and measured as the probability of well-defined adverse affects, the policy implications are obvious: order risks according to objective measures of probability and magnitude of harm, and allocate resources to reduce the greatest risks.

If, on the other hand, risk is seen as a cultural or social construction, risk management activities would be set according to different criteria, and priorities should reflect social values and life-style preferences.
The substantial difference between the two approaches has a notable influence on the type of approach to use regarding risk considerations. When 'uncertainty' prevails the objective assessments lose meaning and therefore the "technical" approach cannot be used. However, empirical evidence shows that also in situations with uncertain outcomes the individuals formulate in any case a synthetic evaluation of the associated risks. The case of transgenic food may be seen to have these characteristics. Above all in European countries one can observe that the consumer is apparently exposed to a bulk of information that has its origins in public institutions and in the scientific world, blown-up by the mass media. Nevertheless, there is no certain data and the same primary sources of information do not agree with the evaluation regarding potential effects. All this makes the consumption of transgenic food a choice with a "high rate of uncertainty".
In these cases the "technical" approach is little informative while the "balanced behaviour model" developed in the psychology field seems to work much better (Renn *et al.*, 1984).

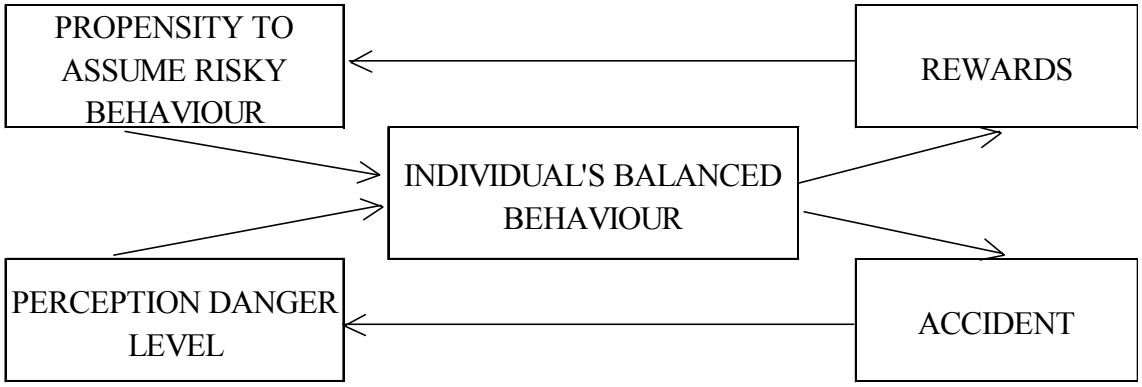

Figure 1. Risk Compensation model

The "balanced behaviour model" assumes that risk is subjectively defined by individuals who can be influenced in their evaluations by psychological, social institutional and cultural factors. In Figure 1 we show a simple risk compensation model which illustrates the circularity of relationships which limit the development and objective measurement of risk.
This model was originally derived from Gerald Wilde (Krimsky *et al.*, 1992) later modified by Adams (1996). The arrows indicate the direction of the different influences and their sequences. The propensity to assume risky behaviour and the perception level of the danger all result in the individual's behaviour. In subsequent experiments this showed adverse and/or resulting rewards from the behaviour chosen.
Accumulated experience modifies both the propensity to take on risks as well as the perception of danger and as a result later behaviour will be influenced. One of the starting points in the psychometric approach is to note the individual's will to take on risks because any risky action is related to some rewards (Lopes, 1983; Wildavsky *et al*., 1990). This is also the distinguishing principle in relation to a large part of literature concerning risk. Standard literature regarding security management very often ignores the role of rewards, and potential losses of reward, as a result of a much too guarded behaviour. As a result, the scope of security management is to eliminate all potential disputes. Alternatively, the risk compensation model just illustrated could be used to describe the behaviour of an individual who knowingly places him/herself at risk. In favour of this model here are several consideration to take into account.

First, the evaluation of consequences differs considerably among groups when the undesired effects include the breach of ethical and moral values, such as equity considerations or social outcomes. All these additional effects may or may not be more relevant than just physical harm and/or environmental damages, but they are surely and strongly connected to an individual's order of preferences. When such aspects are taken into account, technical approach is not any longer suitable (Hansen *et al.*, 2003; Faass and Lahr 2007).
Secondly, the risk compensation model assumes that individual behaviour can change over time according to rewards and accidents experimented in everyday life. This last aspect could be very important in GM food case. As a matter of a fact, during last years, media attention on GMOs progressively decreased in Italy and no scares grew up among lay people. On the other side, any new evidence about potential adverse effects on human health has been hypothesized by scientists. So, it can be presumed that lay people familiarity with GMOs is increased and, as argued by psychologists and stressed in psychometric approaches, risk perception is strongly affected by familiarity (Fife-Schaw and Rowe, 2000).
On the other hand the "balanced behaviour model" may be difficult to make operational. It is often presented (Adams, 1996) as a conceptual model non-operationalisable because of the frame contents which is not always objectively measured.
In this paper we make the point that in the case of transgenic products a balanced behaviour, as the one in figure 1, can be measured by the propensity to consume transgenic products and by the price level being paid for these products. Such behaviour is determined by the propensity to take on risks and by perceiving danger. In the case of GMOs these two factors cannot be directly linked to consumers' previous experience. Danger perception could be placed in relation to the degree of knowledge and personal ability to newly elaborate information. Furthermore, the propensity to risk (which in the frame is determined by previously experienced reward) the consumption of the transgenic product's could be considered in relation to the general attitude of the individual regarding measurable risk, pointing out the behaviour concerning an ample set of actions with uncertain results. Perceived danger can therefore be above all determined by the level of personal knowledge and experience about GMOs and the ability to elaborate additional information. It should be also stressed that perceived danger is directly affected by experimented accident and more generally by public scares and disagreement in scientific community. Finally it is hypothesized that there is a general bias, based on both innate predispositions and experience, to give greater weight to negative outcomes (Rozin and Royzman, 2002). Bearing all these points in mind, we hypothesize that the more an individual is informed on transgenic products the higher the probability that consumption of transgenic products will be accepted. A good level of knowledge increases the feeling of control and the level of familiarity therefore it has the tendency to reduce perceived danger.

3. Operationalising a "balanced behaviour model" for GMOs

The "balanced behaviour model" for GMOs was made operational by collecting information on an hypothetical GM tomato market, through a questionnaire submitted to 188 undergraduate students during winter 2000 and to 150 students in winter 2008. The sample was randomly selected from the population of the third or forth year undergraduate students enrolled at the University of Naples, College of Agricultural Science (168 students sampled) and Social Science (170 students sampled).

This choice was suggested by several considerations:

- - undergraduate students population allows to stress the role that knowledge about transgenic issue and personal attitude to take risk can play in making decision on whether entering or not this peculiar market;

- - university students from third and forth year are supposed to have a medium/high cultural level, and a certain degree of attention about current social issues like GM food;
- - Agricultural Science students attended at least one class in genetics, and they are believed to posses a high level of technical knowledge even regarding aspects related to transgenic issues. This allowed to implement an index of knowledge about transgenic more complete than "Do you know what a transgenic product is?" or "Among the following definitions could you check the correct one for transgenic?" would be;
- - at that age (21-25 years) students are exposed daily to many risky situations, at least in the typical Italian social contest. Moreover, in this age range people are less likely to forego risky actions on the basis of altruistic reasons, as they normally do not have dependents or responsibilities for others (few have family and children). This allowed to build an accurate index for personal risk attitude.

Each student in the sample was administered a questionnaire to collect the information useful to fill the frames in figure 1. We assumed that the student's population could be split in two parts, one willing and one unwilling to participate to the GM tomato market.
The GM tomato used in the hypothetical market scenario contains some genes coming from a fungus which allowed tomato to synthesize an enzyme *chitinasi* that gives to plants a greater resistance against some pathogens, reducing the amount of pesticide use. It was asked if and how the student would be willing to buy such a tomato, and if yes, how much he would be willing to pay assuming that the conventional one had a price of 0,75 € in 2000 and 1 € in 2008.
We have hypothesized that the decision to participate or not to the GM tomato market will come from a "balanced choice". According to figure 1 the individual balanced behaviour will come from:

- the perception of danger level. We assumed this perception to be linked to the knowledge on GMOs issue. This frame was filled with an index ranging from 0 to 5 according to the answers to 5 question related to GMOs: 1) correct definition of a GMO, 2) mandatory regulation on labelling when a GMO is contained in a products; 3) presence\absence of DNA in daily diets; 4) correct definition of genetic pollution; 5) possibility of interaction between the DNA of ingested vegetable and human DNA.
- the propensity to assume risky behaviour. This frame was filled by an index ranging from 0 to 7 according to the answers to 7 question related to risky behaviour: 1) smoking cigarettes, 2)driving a motorbike without helmet, 3) consuming cow meat after the BSE scandal in Europe, 4) driving a car with set-belt unfastened, 5) respecting speed limits while driving a car, 6)using condom in occasional sex affair, 7) consuming light drugs.
- the possible rewards was given by the opportunity to buy a tomato that requires less input of agrochemicals at the desired price.
- the perception of the possible accident flowing from the consumption of the GM tomato, because it has never been experienced by the consumer, is supposed to be linked to the knowledge on the GMOs issue: the more an individual is informed on transgenic products higher is the probability that the consumption of transgenic products will be accepted. This is, of course, a hypothesis to be tested.

4. The statistical model

Having assumed that the student's population can be split in two parts, one willing and one unwilling to participate to the GM tomato market we used a mixture distribution to estimate the variables influencing the decision to get or not into the GM tomato market, and also the WTP distribution for the students willing to ay for the transgenic tomato[1].
Let *g* be the probability that a student chosen from the population is not interested at all in bu-

ying the proposed transgenic tomato (WTP = 0), and F(w) the continuous cumulative distribution for the student sub-population which is willing to pay for the transgenic tomato. Where w is the open-ended response. Then the range of the WTP domain can be defined according to the following mixture distribution:

$$\Pr ob(WTP < w) = \begin{cases} 0 & ,w < 0 \\ \gamma & ,w = 0 \\ \gamma + (1-\gamma)F(w) & ,w > 0 \end{cases}$$

In our case study, we have assumed F is a lognormal distribution that is defined only on positive values of w, and g depends on unknown parameters to be estimated. Consequently, the likelihood function can be written as proportional to:

$$\prod_{i=1}^{n} \gamma_i^{\delta_i} \left[(1-\gamma_i) f(w_i)\right]^{1-\delta} \qquad [1]$$

Where d_i is a vector that assumes value 1 if the student is willing to buy the transgenic tomato, zero otherwise, f is the derivative of F and depends on unknown parameters to be estimated. The likelihood function [1] can be rewritten as:

$$\prod_{i=1}^{n} \gamma_i^{\delta_i} (1-\gamma_i)^{1-\delta} \prod_{w_i>0} f(w_i) \qquad [2]$$

Assuming the effect of the covariate information on f is independent of its effect on g, the likelihood function can be split in two separate parts that can be maximized separately.
If we assume

$$\gamma_i = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Z_i} e^{\frac{s^2}{2}}\, ds$$

where s is a standardized normal distribution, $Z_i = \beta X_i$, with X_i the vector of covariates from which g_i depends, and b is the vector of parameters to be estimated, it follows that g_i is a conventional *Probit* where the dependent variable takes value 1 if the student is unwilling to buy the transgenic tomato, and zero otherwise (Reiser and Schechter, 1999).
Assuming F is distributed as a lognormal, from the maximization of the second part of the likelihood function in [2], we get the usual lognormal model giving the maximum likelihood estimators of the parameters of the WTP distribution.

1. Detailed description of the model is in Reiser and Schechter (1999) that first suggested this approach to address Contingent Valuation with zero values. Application of this model is also in Cembalo, Cicia and Verneau (2001), Marta-Pedroso et al. (2007).

5. The empirical model

As specified in the previous chapter, two econometric models were estimated in year 2000 and two in year 2008. The first represents individual choice to take part of the market hypothesized in the scenario proposed; the second, concerning only those individuals who declared a positive WTP, investigates the variables that explain differences in willingness to pay.
The first relation was estimated by means of a binary model (Probit). The dependent variable is the event that a consumer is not interested at all in buying and consuming the GM product suggested. This is placed in relation to some explanatory variables such as: GMOs technical knowledge, GM food risk perception, personal attitude to risk, and finally to some socio-economics characteristics.
In formal terms, the Probit model was defined as follow:

$g = Prob(y_i=1) = F(b'X_i) \quad i=1,2,...n$
where:

y_i is a sequence of binary and independent random variables which assumes value 1 if the i^{th} consumer interviewed is interested in buying a GM product, and 0 otherwise; X_i is a vector of explanatory variables, b' is a vector of parameters to estimate; F is a known function (Amemiya, 1985). The functional form of F chosen in this work is the normal cumulative distribution. In table 1 results γ model for data collected in year 2000 and 2008 are reported.
In the year 2000 model three explanatory variables resulted statistically significative[1]:

- *Risk attitude*: this variable concerns consumer behaviour to generic risky actions. It was developed by means of a linear index expressing the personal attitude to risk. Such index ranges from 0 to 7 depending on the amount of risky actions he/she usually undertakes. It assumes value 0 if no risky action listed is undertaken by the consumer interviewed, and value 7 in the case any of the 7 listed risky action is usually undertaken. A positive value of the estimated coefficient means that respondents with conservative attitude are less willing to get in the GM market.
- *Degree of GMOs knowledge*: this variable concerns specific technical knowledge coded to build up an "objective knowledge" index. It was based on the computation of correct answers given during the interview about technical aspects of DNA, GM products, and so on. It was, then, elaborated a linear index which ranged from 0 to 5, where 0 represents the lowest level of knowledge (no one correct answer), and 5 the highest level of knowledge (5 correct answers). A negative value of the estimated coefficient means that the higher is the level of information, the higher is the willingness to buy the GM product suggested.

1. The statistical significance was assured at least at 5%.

Table 1. $\gamma = Prob(y_i=1)$ model (year 2000-2008)

Variable	Coefficient	z-statistic	p-values
year 2000			
Risk attitude	0.142	3.084	0.002
Degree of GMOs knowledge	0.332	5.076	0.000
GMOs Benefit > Costs	0.772	3.348	0.001
Obs with Dep=0	63		
Obs with Dep=1	125		
Total obs	188		
Log likelihood	-100.16		
Avg. log likelihood	-0.53		
Prediction Evaluation (cutoff = 0.5)	73.4%		
year 2008			
GMOs Benefit > Costs	1.305	3.317	0.001
Age	-0.074	-5.407	0.000
Environmentalist	-0.594	-1.641	0.100
Degree of GMOs knowledge	0.386	5.079	0.000
Obs with Dep=0	79		
Obs with Dep=1	71		
Total obs	150		
Log likelihood	-77.35		
Avg. log likelihood	-0.52		
Prediction Evaluation (cutoff = 0.5)	75%		

- *GMOs Benefit > Costs*: this variable expresses the interviewee perception of the rate of benefits/risks associated to the use of GMOs in agriculture. It assumes value of 1 if the consumer believes that benefits are greater than risks, and 0 otherwise. A positive value of the estimated coefficient means that consumer who believes that benefits associated with GMOs are smaller than risks (costs), then he/she is less willing to be part of the GM market suggested.

As for year 2008 model, four variables resulted statistically significative[1]. Two are common to the one just discussed (*GMOs Benefit > Costs, Degree of GMOs knowledge*) showing the same sign and sharing the same interpretation. The other two are:

- *Age*: representing interviewee's age. A negative value of the estimated coefficient means that the older one is, the smaller is the willingness to be part of the GM market suggested.
- *Environmentalist*: it is a dummy variable which assumes value of 1 if the interviewee declared to be associated to an environmental association (such as green peace, WWF, or others), 0 otherwise. A negative value of the estimated coefficient means that to be environmentalist lower the willingness to be part of the GM market suggested.

In both models socio-economics characteristics, as gender, family income, etc, have no influ-

1. The statistical significance was assured at least at 5% with the exception of "Environmentalist" which is at 10%.

ence on the willingness to enter in the GM market proposed.
It is also worth to underline that in the 2008 model *Risk attitude* does not result statistically significant, lining up empirical results with theoretical model.
The second model estimated concerns only those individuals that declared a positive WTP. Distribution function implemented for modelling the sub-population was a lognormal, which is defined only for non-negative values. Empirical model results that estimate the willingness to pay for the GM product suggested are reported in table 2.

Table 2. Lognormal model for WTP

Variable	Coefficient	t-ratio	P-value
	year 2000		
Constant	21.916	4.963	0.000
Moral issue	-6.229	-4.185	0.000
Intrinsic food attribute	3.328	2.464	0.014
Income	0.056	2.473	0.013
Degree of GMOs knowledge	-2.225	-2.573	0.010
GMOs Benefit ÷Costs	-5.195	-1.980	0.048
Variance for lognormal distribution			
Sigma	0.462	9.780	0.000
Log likelihood function	-38.24	Obs.	63
Mean WTP	0.75		
Reference value for WTP	0.77		
	year 2008		
Constant	1.347	6.263	0.000
Pro GM regulation	0.563	2.536	0.011
Food&Moral issues	-0.370	-1.870	0.062
Variance for lognormal distribution			
Sigma	0.459	8.447	0.000
Log likelihood function	-42.07	Obs.	71
Mean WTP	1.66		
Reference value for WTP	1.00		

Intrinsic food attribute indicates the importance assigned by consumers to the attributes that could influence the food choice process (such as brand, price, etc.); *Moral issue* indicates the loss of ethical and moral values and represents the issue considered by interviewees as the most relevant among those listed in the *questionnaire* submitted; *Income* is the family income; *Degree of GMOs knowledge* is an index of objective knowledge about GMOs; *GMOs Benefit/Costs* represents the respondent's judgment in terms of the rate benefits/costs associated to GM products; *Pro GM regulation* is a dummy variables that assumes value 1 if interviewee declared to be in favour of a GMO public regulation, 0 otherwise; *Food&Moral issues* indicates that interviewees considered food and the loss of ethical and moral issue the most relevant issue among those listed in the *questionnaire* submitted.
Empirical results for year 2000 allow to conclude that the WTP for the GM product proposed: is inversely proportional to the importance that consumer gives to the information related to pro-

duct intrinsic attributes. In other terms, when consumer makes his/her choice looking only at price and brand, it is as if he/she would delegate the quality verification to others. When, on the other hand, he/she shows greater interest for product intrinsic attributes, consumer exhibits a lower WTP;

- is inversely proportional to consumer sensitivity related to ethical and moral issues. When consumer has high sensitiveness to ethical and moral issues, he/she shows a lower WTP;
- is directly proportional to family income. As expected, family income positively influences WTP. Notice, however, that it was not significant in the first model. This suggests that family income does not influence the decision to take part in this peculiar market (ethical and moral issues are considered more relevant), but once one decides to be in the market, then family income influences his/her own WTP;
- is inversely proportional the degree of knowledge related to GMs. A possible explanation resides in the fact that the students interviewed, with a higher degree of technical information, is able to link this technical innovation to some benefits due to a costs saving technology;
- is inversely proportional to the perception of the specific risks: if the respondent believes that the benefits associated with GMs are smaller than the costs, then he/she has a lower WTP.

Empirical results for year 2008 WTP is influenced by two variables. The first, *Pro GM regulation* and *Food&Moral issues*. Sign show that in 2008 moral believes are still crucial in explaining the probability of higher WTP for GM products. Moreover, more regulation need seems to be claimed by those willing to buy a GM products.
Average WTP in 2008 shows that interviewees are willing to pay a premium price for positive attributes associated to the GM tomato proposed in the scenario submitted (WTP:€1,66 *vs* ref. price €1), while in year 2000 interviewees claimed for a discount (WTP:€0.75 *vs* ref. price €0.77).

6. Concluding remarks

In order to analyse risk perception of a sample of consumers, when facing a decision about GM products, a psychometric approach was used. It allowed to emphasize some interesting aspects. A first relevant conclusion regards the theoretical approach implemented. In fact, psychological studies have successfully investigated individual behaviour, building many interpretative models. However, such models are usually seen as merely conceptual because of their complexity and strong underling hypothesis. The first need was, therefore, to empirically test the "risk compensation model" applied to individuals that face potentially risky situation. On the subject, a mixture model was chosen. It confirmed the hypothesis formulated: when consumers manage risky actions they do not tend to totally reset risk but they aim to minimize it up to when they feel convenient the risk/benefit rate associated to a certain action with uncertain outcome.
A second conclusion that may be drawn regards another specific aspect of the results obtained. The Wilde and Adams model implemented underlines the relation between knowledge and risk perception.
In year 2000 risk perception was, on its hand, a key variable in determining either the willingness to take part of a GM market and to be willing to buy a product containing GMOs. In a situation of substantial uncertainty and scarce knowledge, like that which characterized GM market in Europe at that time, information could be exploited to influence consumer choices. If information were complete and costless, then private firm objectives (profit maximization) and policy makers' objectives (welfare maximization), would coincide. Unfortunately, reality seems quite different. Ability to elaborate available information appeared, in fact, narrow and limited. The bulk of information did not seem to be sufficient to make consumers able to make

a fully conscious choice. In a scenario where information is asymmetric and incomplete it is likely that private enterprises try to use educational and informational means to highlight the GM products esteems, keeping silent or minimizing the potential risks associated with them. Policy makers appear to be unable to successfully regulate the GM production, as well as their introduction in the market (Bradbury, 1989). However, its role is crucial in the attempt to regulate and control information available

Year 2008 results show a higher share of consumers willing to participate to the proposed GM market; participants to GM market show, in 2008, a willingness to pay a premium price for positive attributes associated to the GM tomato proposed in the scenario submitted, while in year 2000 interviewees claimed for a discount.

Results are coherent with "risk compensation model" invoked. "Degree of knowledge" and "familiarity" seem to be grown over the observation period of time; during last years, media attention on GMOs progressively decreased and no scares grew up among lay people; no new evidence about potential adverse effects on human health has been hypothesized by scientists. As a consequence, heuristic variables, such as risk attitude, have lost their crucial role in explaining adverse consumer's attitude on GMOs. On the other hand, moral believes and environmental sensitiveness still play a relevant role.

References

Adams J. (1996). *Risk*, UCL Press Limited, University College, UK: London.

Amemiya, T. (1985). *Advanced Econometrics*, Blackwell, CH: Basil.

Bradbury, J. A. (1989). The Policy Implications of Differing Concepts of Ris*k*, *Science technology and human values* 14: 380-399.

Cembalo L., Cicia G. and Verneau F. (2001). *Prodotti transgenici e consumatore: il ruolo della conoscenza e dell'attitudine al rischio*, in Carrà G. (a cura di) "Servizi in agricoltura", Atti del XXXVIII Convegno di studi della SIDEA, Milano, Società Editrice il Mulino.

Eiser, R.J., Miles, S., Frewer, L.J. (2002), "Trust, perceived risk, and attitudes toward food technologies", *Journal of Applied Social Psychology*, Vol. 32 No.11, pp.2423-33.

Faass J., Lahr M. (2007) Towards a More Holistic Understanding of American support for genetically Modified Crops: An examination of influential factors using a binomial dependent variable, MPRA paper No. 6124.

Fife-Schaw, C., Rowe, G. (2000), Extending the application of the psychometric approach for assessing public perceptions of food risk: some methodological considerations, *Journal of Risk Research*, Vol. 3 No.2, pp.167-79.

Frewer, L.J., Salter, B. (2003), The changing governance of biotechnology: the politics of public trust in the agri-food sector, *Applied Biotechnology*, Food Science and Policy, Vol. 1 No.4, pp.1-8.

Hansen J., Holm L., Frewer L., Lynn J., Robinson P., Sandoe P., (2003) Beyond the knowledge deficit: recent research into lay and expert attitudes to food risks, *Appetite*, Vol. 41, pp. 111-121.

Joffe H. (1999). *Risk and the Other*, Cambridge University Press, UK: Cambridge.

Kasperson, R.E., Renn O., Slovic P., Kasperson J. X., and Emani S. (1989). The Social Amplification of Risk: A conceptual Framework. *Risk Analysis* 8: 177-187.

Krimsky, S. and Golding, D. (1992). *Social theories of risk*, Praeger Publisher.

Lind, N. C. (1987). Is Risk Analysis an Emerging Profession? *Risk Abstracts* 4: 167-169.

Lopes, L. (1983). Some Thoughts on the Psychological Concept of Risk. *Journal of Experimental Psychology: Human Perception and Performance* 9: 137-144.

Marta-Pedroso C., Freitas H. and Domingos T. (2007). Testing for the survey mode effect on contingent valuation data quality: A case study of web based versus in-person interviews,

Ecological Economics, 62: 388 – 398.
Miles, S., Brennan, M., Kuznesof, S., Ness, M., Ritson, C., Frewer, L.J. (2004), "Public worry about specific food safety issues", *British Food Journal*, Vol. 106 No.1, pp.9-22.
Reiser, B. and Schechter, M. (1999). Incorporating zero values in the economic valuation of environmental program benefits*, Environmetrics,* vol 10: 87-101.
Renn, O., and Swaton E. (1984). Psychological and Sociological Approach to Study Risk perception. *Environment International* 10 : 557-575.
Rozin P. (2005) The meaning of natural. Process More important than Content, *Psycological science*, Vol 16, pp. 652-658
Rozin P., Royzman E.B. (2002) Negativity Bias, Negativity Dominance, and Contagion, *Personality and Social Psychology Review*, Vol. 5, n. 4, pp. 296-320.
Siegrist M., Keller C., Kiers H.A. (2005) A new look at the psychometric paradigm of perception of hazard, *Risk Analysis*, Vol. 25, n. 1, pp.211-222.
Sjoberg L. (2000a) Factors in risk perception, *Risk Analysis*, Vol.20, n.1, pp. 1-10.
Sjöberg, L. (2000b) Specifying factors in radiation risk perception. *Scandinavian Journal of Psychology*, n.41, pp.169-174.
Wildavsky, A., and Dake K. (1990). Theories of Risk Perception: Who Fears What and Why? *Dedalus* 6: 41-60.