Consumers psychological reactions during a food safety incident and WTP for nanosensors in meat products

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Outline

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- Background
- Research questions and objective
- Methodology
- Results
- Conclusions

Background (1/3)

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Food containing hazardous agents, or contaminants, that can make people sick e.g. zoonotic diseases, microbial pathogens, parasites, micotoxins, antibiotic drug residues, pesticides residues and GMFs.

Common mycotoxins contaminating foods [a]

Mycotoxin	Commodity	Associated fungi
Aflatoxins	Peanuts, pistachios and other nuts, corn, cottonseed, cereals	*Aspergillus flavus* *A. parasiticus*
Fumonisins	Corn, other cereals	*Fusarium verticillioides* *F. proliferatum*
Ochratoxin	Legumes, cereals, coffee beans	*Aspergillus ochraceus* *Penicillium verrucosum*
Patulin	Apples, grapes, other fruits	*Penicillium expansum* *Aspergillus giganteus* other *Penicillium* and *Aspergillus* spp.
Trichothecenes	Wheat, corn	*Fusarium tricinctum* *F. poae*, and other *Fusaria* and several other species

[a] Only common mycotoxins and representative fungi and com.s

Background (2/3)

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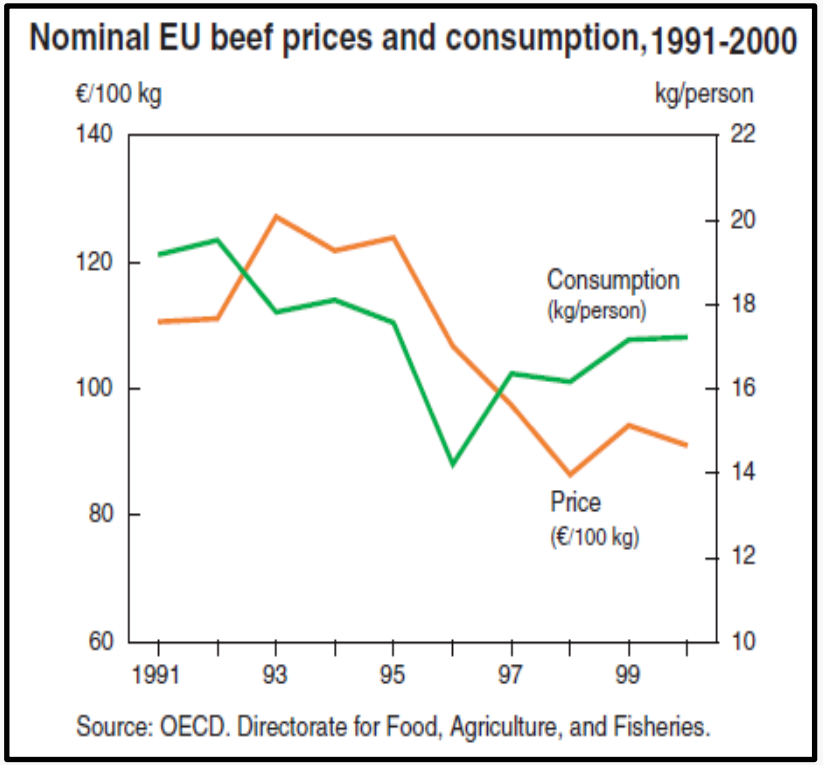
What are the economic consequences of food borne diseases and scares?

- Costs for national health services? (£5.8 billion)
- Demand for indicted products?
- Demand for surrogates of indicted products?
- Reputation of firms involved?



And what about consumer's perceived risk?

Objectives

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1. To evaluate consumers' psychological reactions under different risk situations caused by a food safety incident .
2. To estimate the willingness-to-pay for nano-sensor in meat products with and without a food safety incident.
3. To explore how SDE characteristics and psychological reactions of consumers influence purchasing behaviour.

Methodology (1/12)

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- Qualitative research (focus groups)
- Quantitative research (questionnaire):
  - Shopping habits
  - Psychological reactions
  - CV market scenarios
  - SED characteristics

Different risk information administered in three different versions of the questionnaire: BAU, LR and HR.

Methodology (2/12)

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High Risk information

Imagine that yesterday a food safety incident caused by an outbreak of E.coli occurred in the UK and media report the following information:

E.coli are bacteria that live in the guts of animals and people and many strains of this bacteria are harmless to human beings. However, the E. coli strain O157:H7 can cause severe problems affecting the blood and kidney in a small number of people who get sick and may have serious health problems. These problems include anaemia, the formation of small blood clots, and kidney (renal) failure.
Possible sources of the E. coli infection include high-risk foods such as uncooked meat (especially chicken), unpasteurized milk or juices, restaurants where people infected with E.coli have eaten, exposure to live animals and recreational water such as swimming pools and lakes.

…

In the days following the scare more information is available from mass media. They report that following this outbreak 100 people in the UK had been admitted to hospital and 10 people had died after having consumed food which was probably contaminated. Media also report that there will be a 50% chance that the number of contaminated chicken in your supermarket will be 20 out of 100. However, consumers should not worry about consuming food and should apply the norms proposed by the World Health Organisation as shown in this picture below.

Methodology (3/12)

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Market scenario introducing nanotechnology

Nanotechnology is a new technology which uses very small particles. These nanoparticles are a thousand times smaller than the size of a particle of sand. One of the potential applications of the nanotechnology in the food sector is in the development of new packaging materials such as nanosensors which can increase the safety of the food that we consume.

Nowadays even food that you buy in supermarkets is generally safe, packaging containing nanosensors is capable to communicate consumers whether a bacterial infection develops in the food that they have purchased. Essentially these nanosensors are stickers which change colour or flash a light when pathogens develop in the food that you store at home. The picture below shows how these nanosensors can communicate consumers the presence of E.coli in food products.

An example of nanosensor indicating the presence of bacterial contamination

When the meat is contaminated by bacteria like *E. coli*, the nanosensor shows a gray color.

Methodology (4/12)

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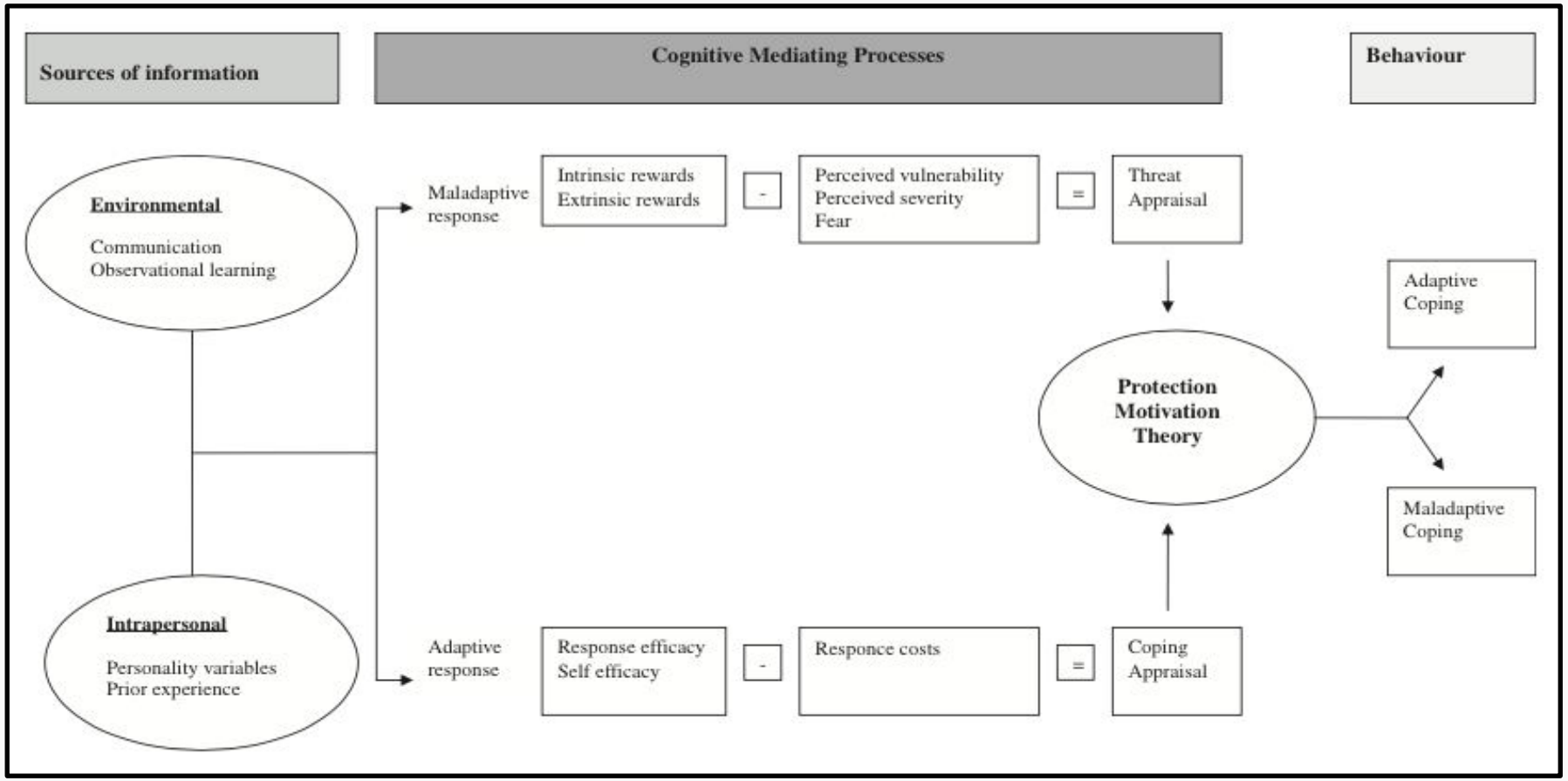
How were psychological reactions captured?

The conceptual framework (Protection Motivation Theory - Roger, 1985)



Methodology (5/12)

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Possible outcomes of consumer purchasing behaviors in relation to combinations of PMT elements (Witte,1992)

		Perceived Threat	
		Low Threat	**High Threat**
Perceived Efficacy	**Low Efficacy**	*No Response* (ignore the message and zero WTP for nanosensors)	*Fear control* (WTP for Nanosensors is lower than danger control)
	High Efficacy	*Low Response* (WTP lower than Danger control)	*Danger control* (Highest WTP for Nanosensors)

Methodology (6/12)

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Selected examples of how the PMT elements of the cognitive mediating process were measured.

Perceived severity

Health problems caused consuming meat contaminated by *E. coli* can reduce life expectancy.

Completely disagree	Disagree	Neither disagree nor agree	Agree	Completely agree
☐	☐	☐	☐	☐

Perceived vulnerability

How likely or unlikely is that if I eat meat contaminated by E. coli I will die.

Extremely unlikely	Unlikely	Neither unlikely nor likely	Likely	Extremely Likely
☐	☐	☐	☐	☐

Methodology (7/12)

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Perceived self-efficacy

I am capable of finding supermarkets selling meat products containing nanosensors in the packaging.

Completely disagree	Disagree	Neither disagree nor agree	Agree	Completely agree
☐	☐	☐	☐	☐

Perceived response efficacy

I believe that food products containing nanosensors can remove the risk of eating meat products contaminated by E.coli.

Completely disagree	Disagree	Neither disagree nor agree	Agree	Completely agree
☐	☐	☐	☐	☐

Methodology (9/12)

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Market scenario for nanosensors' WTP

WTP elicitation method (payment card)

Imagine that you are buying 1 kg of your usual meat on sale at the price £6.00. Please look at the monetary values in £ shown in the table below and indicate the **maximum amount of extra-money** that you are willing to pay for having the same meat packaged with nanosensors. Before answering, remember that your budget is limited and so spending more for meat packaged with nanosensors you will have less money to buy other goods.

○ £0.05	○ £0.55	○ £1.05	○ £1.55	○ £2.05	○ £2.55
○ £0.10	○ £0.60	○ £1.10	○ £1.60	○ £2.10	○ £2.60
○ £0.15	○ £0.65	○ £1.15	○ £1.65	○ £2.15	○ £2.65
○ £0.20	○ £0.70	○ £1.20	○ £1.70	○ £2.20	○ £2.70
○ £0.25	○ £0.75	○ £1.25	○ £1.75	○ £2.25	○ £2.75
○ £0.30	○ £0.80	○ £1.30	○ £1.80	○ £2.30	○ £2.80
○ £0.35	○ £0.85	○ £1.35	○ £1.85	○ £2.35	○ £2.85
○ £0.40	○ £0.90	○ £1.40	○ £1.90	○ £2.40	○ £2.90
○ £0.45	○ £0.95	○ £1.45	○ £1.95	○ £2.45	○ £2.95
○ £0.50	○ £1.00	○ £1.50	○ £2.00	○ £2.50	○ £3.00

○ More than £3.00 Please specify: £ _____

Methodology (10/12)

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Data analysis (1/2)

Multivariate statistical analysis

- To identify the underlying dimensions of PMT with and without food safety incident via factor analysis
- For each factor identified, the scores were calculated through the following general form equation: $PMT_i = \beta_{1i}X_{1i} + \beta_2X_{2i} + .. + \beta_nX_{ni}$
- The identified underlying dimensions used in econometric analysis to see how they affect WTP for nanosensors

Methodology (11/12)

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Data analysis (2/2)

Econometric analysis

- Tobit regression appropriate for analysing dependent variables that cannot take values below or above a particular analysis
- WTP for nanosensors shows a censored distribution with a large proportion of zero values as the lowest value
  - *Among consumers with zero WTP, varying values of the independent variables imply different probabilities of experiencing a protest*
  - *For consumers who are WTP for nanosensors, varying values of the independent variables imply variation in the magnitude of the WTP*
- $$\begin{cases} if\ X\beta + e > 0, then\ y = X\beta + e \\ if X\beta + e \leq 0, then\ y = 0 \end{cases}$$

Methodology (12/12)

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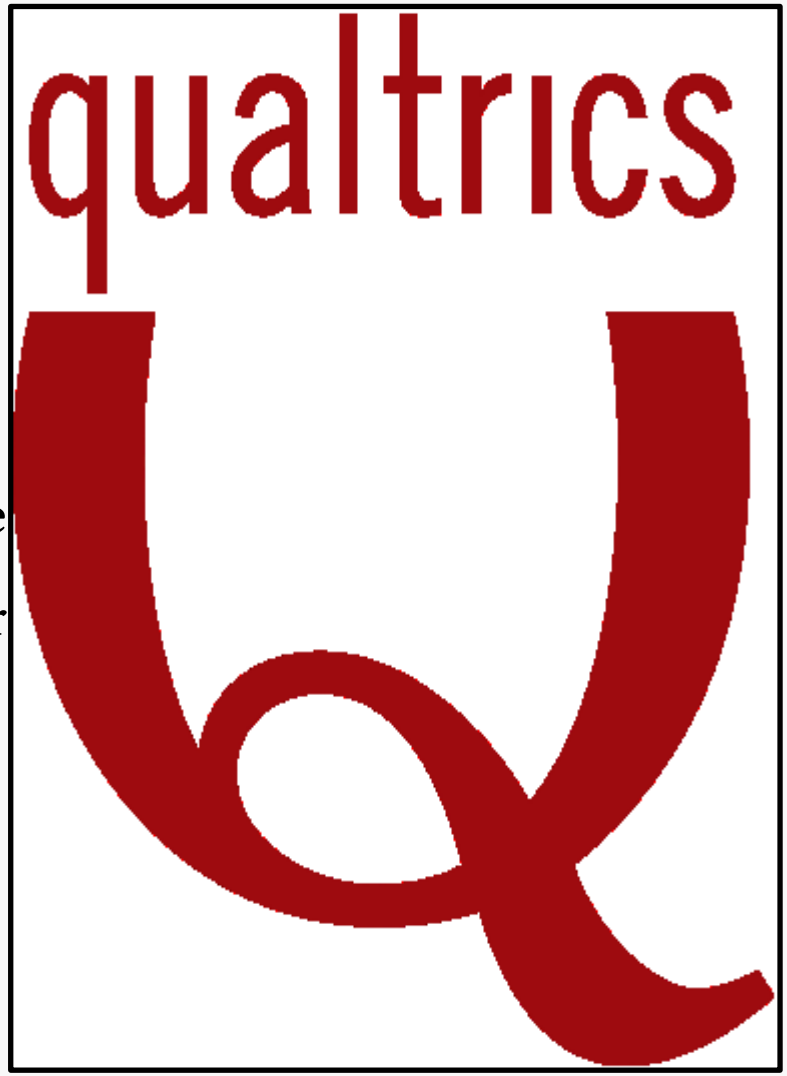
Data collection

- Web survey via QUALTRICS
- Quota sampling
- Piloting February 2015
- Survey February/March 2015
- Filter questions to reach the population target and to control for the quality of data



Results (1/5)

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Socio-demographic and economic (SED) characteristics

Scenarios / SED characteristics	BAU N=209	Risk N=418	Total N = 627
Gender:			
- Female	105	210	315 (50.2%)
Age:			
- Under 25 years	29	58	87 (13.9%)
- 25-44 years	88	176	264 (42.1%)
- 35-54 years	55	110	165 (26.3%)
- 65 years and above	37	74	111 (17.7%)
Education:			
- High school or less	107 (51.2%)	219 (52.4%)	326 (52%)
- University degree or post.	102 (48.8%)	199 (47.6%)	301 (48%)
Income (Household):			
- Less than £799	27 (12.9%)	47 (11.2%)	74 (11.8%)
- From £800 to £1599	56 (26.8%)	126 (30.1%)	182 (29%)
- From £1600 to 2399	47 (22.5%)	88 (21.2%)	135 (21.5%)
- From £2400 to £3199	41 (19.6%)	72 (17.2%)	113 (18%)
- From £3200 or more	38 (18.2%)	85 (20.3%)	123 (19.6%)
Occupation:			
- Employed	120 (57.4%)	251 (60.0%)	371 (59.2%)
- Unemployed	12 (5.7%)	27 (6.5%)	39 (6.2%)
- Housewife	25 (12.0%)	35 (8.5%)	60 (9.6%)
- Student	12 (5.7%)	22 (5.3%)	34 (5.4%)
- Retired	36 (17.2%)	74 (17.7%)	110 (17.5%)
Household Wellbeing:			
- Difficult or modest	141 (67.5%)	263 (62.9%)	404 (64.4%)
- Reasonably well or better	68 (32.5%)	155 (37.1%)	223 (35.6%)

Results (2/5)

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Cognitive change in two scenarios

Rotated component matrix of PMT items

PMT Items	BAU Scenario				PMT Items	Risk Scenario			
	CA	FEAR	SEV	VULN		FEAR	CA	SEV	VULN
RESP_2	.825	.004	.128	.058	Fear_EAT	.939	.078	.084	.051
SELF_3	.687	.023	.227	-.294	Fear_COOK	.918	.058	.125	.066
SELF_2	.660	.009	-.120	.151	Fear_BUY	.900	.081	.129	.062
RESP_3	.654	.132	-.042	.208	RESP_2	.217	.709	.025	.110
RESP_1	.612	-.034	.047	.020	RESP_3	.220	.703	-.111	.214
SELF_1	.551	.016	.380	-.400	SELF_3	-.081	.667	.366	-.124
Fear_EAT	.040	.950	.075	.120	RESP_1	-.046	.667	-.106	-.059
Fear_COOK	-.012	.930	.054	.179	SELF_2	.040	.560	.104	.100
Fear_BUY	.089	.914	.050	.160	SELF_1	-.133	.511	.495	-.194
SEV_2	.090	.051	.850	.165	SEV_2	.166	.046	.802	.276
SEV_1	.030	.081	.787	-.046	SEV_1	.190	.005	.742	-.063
SEV_3	.039	.018	.691	.385	SEV_3	.076	.009	.604	.543
VULN_3	.117	.109	.209	.849	VULN_3	.157	.091	.094	.878
VULN_2	.262	.191	.274	.721	VULN_2	.234	.173	.211	.765
VULN_1	-.063	.161	-.011	.288	VULN_1	-.072	-.026	-.048	.317
% Var.	25.20	17.61	12.25	8,78	*% Var.*	26.45	14.88	11.92	9.18
Cr. Alpha	0.78	0.77	0.76	0.75	*Cr. Alpha*	0.77	0.78	0.76	0.75

Results (3/5)

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WTP for nanosensors in meat products

WTP for nanosensors for BAU and Risk scenarios

	BAU (n=209)	Risk (n=418)
WTP for nanosensors > £0.00	174 (83.3%)	353 (84.4%)
WTP=0 (cannot afford, already safety, believe cooking)	16 (7.7%)	23 (5.5%)
WTP=0 (not enough information, lack of trust it)	19 (9.1%)	42 (10%)
Mean	£0.69	£0.76

Results (4/5)

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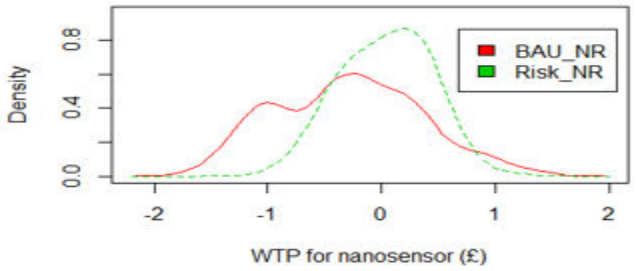
WTP for nanosensors in four outcomes of PMT

No Response

BAU: N= 77 (36.8%) WTP= - £0.29 (0.62)*

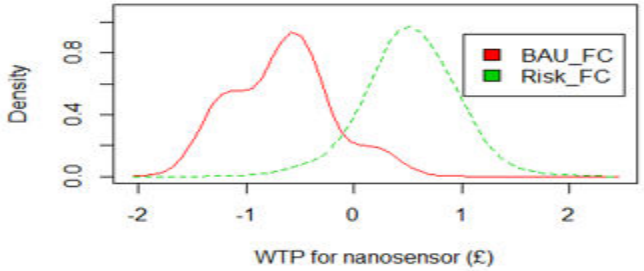
RISK: N=127 (30.4%) WTP= £0.04 (0.38)



Fear control

BAU: N= 10 (4.8%) WTP= - £0.66 (0.45)

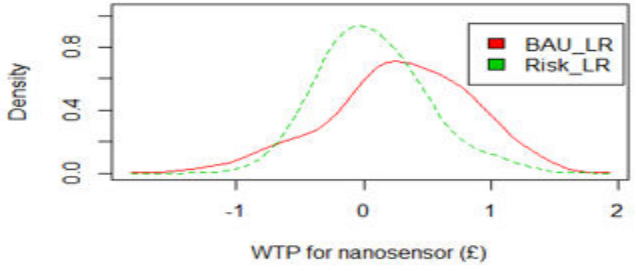
RISK: N=101 (24.2%) WTP= £0.52 (0.38)



Low Response

BAU: N= 67 (32.1%) WTP= £0.28 (0.55)

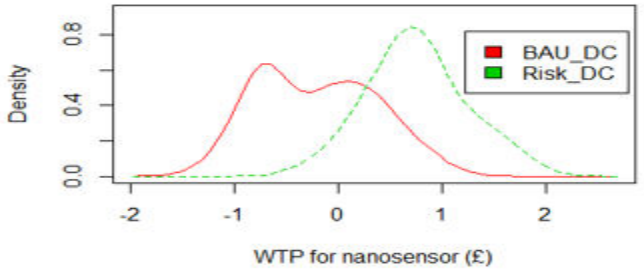
RISK: N= 52 (12.4%) WTP= 0.07 (0.39)



Danger control

BAU: N= 55 (26.3%) WTP= - £0.21 (0.56)

RISK: N=138 (33%) WTP= £0.76 (0.46)



Results (5/5)

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Determinants of WTP for nanosensors

Variables		Model 1 (Scenario of BAU)			Model 2 (Scenario of RISK)		
		Adjusted coefficient	∂P(z)/∂x (Probability of being uncensored)	∂E(0<y*)/∂x (the changes of uncensored)	Adjusted coefficient	∂P(z)/∂x (Probability of being uncensored)	∂E(0<y*)/∂x (the changes of uncensored)
SED Characters	Constant	**-2.52 (4.21)*** **	-0.413	-0.63	**-1.09 (2.82)*** **	-0.397	-0.68
	GENDER	0.16 (1.24)	-0.083	-0.13	**-0.18 (1.99)** **	-0.040	-0.08
	EDU_ Undergraduate	0.18 (1.28)	0.009	0.01	-0.07 (0.69)	0.007	0.01
	EDU_ Postgraduate	0.03 (0.13)	0.001	0.0001	0.01 (0.09)	0.046	0.09
	AGE (25 to 44)	**-0.01 (1.74)***	-0.140	-0.22	-0.01 (1.24)	-0.115	-0.23
	AGE (45 to 64)	**-0.25 (1.83)***	-0.229	-0.33	-0.12 (1.22)	-0.148	-0.30
	AGE (65 or older)	0.10 (0.59)	-0.190	-0.27	-0.10 (0.80)	-0.087	-0.18
	Household_ SIZE	0.19 (1.47)	0.007	0.01	-0.01 (0.14)	0.027	0.06
	Occupation	0.16 (0.94)	0.144	0.21	0.02 (0.20)	0.015	0.03
	Wellbeing_ Modest	-0.12 (0.66)	-0.023	-0.04	0.05 (0.43)	-0.012	-0.02
	Wellbeing _WELL	**-0.42 (2.05)** **	-0.029	-0.05	**0.22 (1.65)***	0.018	0.04
Shopping Experiences	PRICE KG	**0.09 (1.76)***	0.048	0.08	0.04 (1.25)	0.019	0.04
	EXP_TIME	-0.07 (1.12)	-0.004	-0.01	0.01 (0.14)	-0.004	-0.01
	HEARD Nano	**-0.29 (2.11)** **	-0.058	-0.09	**0.17 (1.80)***	0.015	0.03
Psychological Constructs (PMT)	Coping Appraisal	**0.11 (3.71)*** **	0.028	0.05	0.01 (0.22)	0.021	0.04
	FEAR	-0.03 (1.20)	0.014	0.02	**0.07 (4.08)*** **	0.008	0.02
	Severity	**0.18 (3.94)*** **	0.002	0.002	**-0.11 (3.44)*** **	-0.001	-0.004
	Vulnerability	**-0.29 (6.74)*** **	-0.003	-0.005	**0.19 (7.49)*** **	0.015	0.03
Model statistics							
Log likelihood function		-454.62			-653.68		
Sigma		1.189***			0.947***		
Mean of WTP		-£0.10			£0.39		

Conclusions

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- The cognitive process varies in the BAU and Risk scenarios (i.e. fear becomes the most important element of the PMT).
- The cognitive elements of the PMT have different impacts on the WTP of nanosensors in the BAU and Risk scenarios.
- The WTP of nanosensors was also affected by SED.
- The use of nanosensors could be a good strategy to mediate/reduce public concern and fear towards food safety incidents.
- More information about novel food products should be released by government institutions and medias to tackle the issue of consumers' uncertainty towards the novel product.