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European Public Perceptions of Food Risk: Cross-National and Methodological Comparisons

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This article presents a comparative study of public perceptions of food risk across 25 European member states. A secondary data analysis is conducted on a Eurobarometer survey fielded to nationally representative samples in 2005. The survey included closed questions as well as free associations to map risk perceptions. Taking a quantitative approach, we find that people in a majority of European countries express similar levels of concern about food risks. However, outside this majority a North-South divide is evident, with the Northern countries worrying less than the Southern countries. Multilevel modeling shows that cross-national differences in individual respondents' level of worry are in part attributable to shared country effects and to generalized risk sensitivity about a range of personal risks. On the underlying structure of food risk concerns, factor analysis points to three dimensions described by groupings of risks related to adulteration and contamination, health effects, and production and hygiene. A qualitative analysis of respondents' free associations about problems and risks with food identifies three major themes that are consistent with the quantitative results. However, the free associations also point toward greater cross-national diversity and to striking variations in the range and importance of food risks. Overall, the picture is of a public that frames food risks in a wider context of beliefs about the links between diet and health. We conclude with some implications for research on food risk perceptions in particular and risk perception studies in general.

KEY WORDS: European cross-national; food; qualitative methods; quantitative methods; risk perception

1. INTRODUCTION

This article presents a comparative study of public perceptions of food risk. It is based on data from the 2005 Eurobarometer survey on "Risk Issues", (European Commission, 2006), fielded to nationally representative samples of 1,000 respondents in the 25 countries of the European Union (EU). The survey employed both rating scales and free associations in the assessment of risk perception, allowing us to use both quantitative and qualitative methods of analysis. Within the broader context of mapping cross-national differences in risk perception in Europe, we address both substantive and methodological issues. First, using quantitative methods, we investigate whether there are national differences in the extent to which respondents are concerned about 14 expert-defined food risks. Second, cross-national differences in the structure of concern about these food risks are explored. Third, in the qualitative tradition, we map national differences in the range and salience of respondents' spontaneous views on problems and risks associated with food. Finally, we draw together

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the quantitative and qualitative findings and assess the extent to which the two methods of studying risk perceptions converge.

Concern about the production, preparation, and consumption of food has a long history, with origins in the writings of the ancient Greeks (Zwart, 2000). Yet, empirical research on food risk is relatively recent and can be traced to the debates about genetic modification of food and a number of significant food scares in the 1990s, in particular mad cow disease (BSE) in cattle. By and large, most studies of food risk have been informed by the psychometric paradigm developed in the 1970s to investigate public perceptions of the risks of nuclear power, natural hazards, and chemicals.

This paradigm takes a broadly realist conception of risk; risks are taken to be objective properties of the environment. Formative empirical studies identified discrepancies between expert and actuarial risk assessments, and the public's estimation of risk (Lichtenstein *et al.*, 1978). This led to further exploration of the structure of lay perceptions of risk. Research in this tradition points to four conclusions of relevance to our current concerns. First, by and large, there are three dimensions that account for judgment of risks—the extent to which risk is dreaded or not, known or unknown, and the number of people affected (Fischhoff *et al.*, 1978; Slovic *et al.*, 1980). Second, these dimensions have been found in a number of countries, including the United States, Japan, Norway, France, and Poland, suggesting cross-cultural similarities in the underlying structures (Boholm, 1998). Third, there is cross-country variation in the judgment of particular risks, and finally there are not sufficient comparative studies to go beyond Kleinhesselink and Rosa's (1994) conclusion that cross-cultural perception of risk is both uniform and variable. This raises the question as to whether the uniformity attests to the use of similar empirical methods in the psychometric paradigm or to common cognitive structures. On the other hand, the variability may support the cultural or social constructionist explanations of risk sensitivities. For example, cultural (in contrast to realist) conceptions propose that risk perception is, in part, the outcome of societal habits and choices (Douglas & Wildavsky, 1982).

In studies of food risks, Sparks and Shepherd (1994) and Fife-Shaw and Rowe (1996) identify three dimensions labeled "severity," "unknown," and "number of people exposed." As noted by the authors, these are quite similar to those reported in studies of the perception of technological risks. Working in the cultural or social constructionist tradition and using qualitative interviews, Miles and Frewer (2001) also find that food risk perception is multidimensional and includes not only health risks but also risks related to the environment, the economy, animals, and future generations.

In cross-national research on perceptions of food risks, Rozin *et al.* (1999) found substantial country differences in the extent to which food is perceived as a "stressor" as opposed to a source of "pleasure." For example, the Americans and Japanese are more stressed about food than the French and Belgians, as evidenced by greater worry about the link between diet and health. Furthermore Green *et al.* (2005) uses focus group interviews to show cross-country differences in food worries in Finland, Italy, Germany, and the United Kingdom. Echoing Miles and Frewer (2001), these concerns extend beyond safety issues to include the provenance of food, and trust in those providing food and information about it.

1.1. Data Source, Research Questions, and Methods

Our exploration of European perceptions of food risks is a secondary data analysis of a Eurobarometer survey on "Risk Issues" commissioned and designed by European Food Safety Authority (EFSA) and the European Commission's Health and Consumer Protection Directorate General (DG SANCO). To ensure consistency of meaning across different languages spoken in the European countries, the questionnaire was developed using a back-translation process.[2] Fieldwork was conducted in September and October 2005. A multistage random sampling procedure provides a statistically representative sample of national residents aged 15 and over. The total sample within the EU was 25,000 respondents, giving 95% confidence limits of $\pm 0.6\%$ for the total sample, and of about $\pm 3.1\%$ within individual countries.

[2] The Eurobarometer surveys are managed by TNS Opinion. To ensure consistency of meaning across the European countries, the initial questionnaire is translated from English (or French) into the local language by two translators familiar with surveys. The two translators and a project leader compare the two versions and produce an agreed translation. TNS Opinion checks this version, which is then back-translated into English (or French). The initial- and back-translated questionnaires are compared and differences resolved.

2. QUANTITATIVE APPROACHES: RATINGS OF FOOD RISKS

For experts there is little ambiguity about the food risks confronting Europeans. In the survey, respondents were asked how much they worry about 14 risks identified by experts in EFSA and DG SANCO. These were: pesticides in fruit and vegetables, residues in meat, pollutants, chemicals that form during baking, frying, or barbecuing, bacteria, new viruses like avian influenza, mad cow disease, additives, allergies, concern about putting on weight, lack of hygiene outside and separately inside the home, the welfare of farmed animals, and genetically modified (GM) food. While few experts consider GM food to constitute a risk, this was included as the risks of GM have featured prominently in the public debate in Europe since 1996 (Gaskell & Bauer, 2001). Respondents rated each of the 14 risks on a four-point scale, ranging from 1 = "not at all worried" to 4 = "very worried."

Across the 25 European countries, people say they worry most about forms of food adulteration, in particular about chemical contamination from pesticides (2.9), residues (2.9), pollutants (2.8), additives (2.8), and genetic modification (2.8). People showed similar high concern about microbiological contamination from new viruses (2.9), bacteria (2.8), and hygiene outside the home (2.8). Respondents are somewhat less concerned about chemicals produced during heating, baking, or frying (2.5) and mad cow disease (2.6), and least concerned about putting on weight (2.4), developing an allergy (2.3), and lack of hygiene in their homes (1.9). In reality, food poisoning traced to poor domestic hygiene is the most frequent food-borne illness in Europe (European Food Information Council, 2006a). The low level of worry may be attributable to greater perceived personal control over domestic hygiene that attenuates risk perception (Frewer *et al.*, 1994).

2.1. National Differences in Food Risk Concerns

Here, we are interested in two types of national differences. First, there may be differences in the extent of worry about particular risks and, second, differences in the underlying structure of food worries. Beginning with the first, the extent of food risk worry, Table I shows for each EU country the mean level of worry over the 14 risks.

On average, the Mediterranean countries of Greece, Cyprus, Malta, and Italy are most worried while least worry is expressed in the Northern countries of Finland, Sweden, and the Netherlands. The European mean is 2.7 and with 15 out of the 25 countries scoring between 2.6 and 2.8 there is considerable homogeneity.

Table I. Mean Rating of Worry about 14 Food Risk Items by Country

Mean Rating of Worry Across 14 Food Risks (1 = not at all worried to 4 = very worried)					
	Mean	*SD*		Mean	*SD*
Sweden	2.3	0.50	France	2.7	0.57
Netherlands	2.3	0.53	Slovenia	2.7	0.55
Finland	2.4	0.54	Luxembourg	2.7	0.61
Estonia	2.5	0.62	Portugal	2.7	0.67
Slovakia	2.5	0.57	Hungary	2.8	0.67
Austria	2.6	0.56	Lithuania	2.8	0.66
Spain	2.6	0.74	Latvia	2.8	0.69
Ireland (Rep)	2.6	0.68	Poland	2.9	0.55
Belgium	2.6	0.57	Malta	2.9	0.65
Denmark	2.6	0.60	Italy	3.0	0.57
Czech Rep	2.6	0.63	Greece	3.0	0.62
Great Britain	2.6	0.60	Cyprus	3.0	0.65
Germany	2.6	0.65	EU Total	2.7	0.64

While this comparison of raw means gives some indication of the cross-national differences and is suggestive of a European North-South divide, a multilevel model yields additional information about the origin of this variation. A two-level variance-components model distributes the variance in average response to the country level and to the individual level. In other words, the model shows the extent to which differences in food worries can be attributed to shared country effects rather than individual characteristics.

The resulting intra-class correlation is 0.09, meaning that only about 9% of the variance in *individual* response to the food worry scale can be attributed to country-level characteristics. While 9% may not appear to be that substantial, national borders may not fully capture cultural boundaries, and a nation is a heterogeneous group of people from a wide range of socioeconomic backgrounds and life stages. More formally, Muthén (1994) suggests that 5% cross-cultural variance needs to be present before proceeding with a multilevel analysis. Taking these points into account, it seems worthwhile to scrutinize the nature of the observed nationally shared variance in greater depth.

2.2. National Variability: Food Worry or General Risk Sensitivity?

Is it possible that the observed national differences in food worries are a reflection of wider national sensitivities to personal risks in general? In order to

Variables	Model 1		Model 2		Model 3	
	Coeff.	*p*-value	*Coeff.*	*p*-value	*Coeff.*	*p*-value
Fixed part						
Country-level covariates						
Risk sensitivity (mean)	–	–	0.81	*<0.001*	0.82	*<0.001*
Individual-level covariates						
Risk sensitivity (dev. mean)	–	–	–	–	0.47	*<0.001*
Female (reference category: male)	0.20	*<0.001*	0.20	*<0.001*	0.16	*<0.001*
Age	0.01	*<0.001*	0.01	*<0.001*	0.01	*<0.001*
(Constant)	(2.47)	*(0.001)*	(0.52)	(0.25)	(0.47)	(0.28)
	SD	*SE*	*SD*	*SE*	*SD*	*SE*
Random part						
Cluster level (25 countries)	0.19	*0.03*	0.14	*0.02*	0.14	*0.02*
Individual level	0.60	*0.00*	0.60	*0.00*	0.54	*0.00*
Intraclass correlation	*0.09*		*0.05*		*0.06*	
Log likelihood	−19,648		−19,641		−15,284	

Table II. Regression Models Explaining Individual Mean Worry about the 14 Food Risk Items

test this, we introduce a covariate that controls for the overall risk sensitivity. This is derived from a set of questions asking respondents about the likelihood of being a victim of crime, being a victim of terrorism, having a car accident, getting a serious illness, damage to health from food, damage to health from consumer goods, and, finally, damage to health from environmental pollution. Respondents rated each hazard on a four-point scale from 1 = "not at all likely" to 4 = "very likely." The average score on the scale is used as a measure of what we call generalized risk sensitivity—denoted hereafter as GRS.[3]

To examine whether the GRS of the (national) public helps to explain the cross-national differences in food risk perception of individual respondents, we regress mean country GRS on the individual response to the food worry scale in a two-level random-intercept model. Both indicators are measured on a four-point scale, with higher values indicating greater food worry and greater GRS, respectively. Age and gender are introduced as control variables.

Table II presents the results. Model 1 is the baseline model, containing the demographic control variables only. Model 2 regresses mean GRS at the country level on individual concern about food risk. The effect is significant ($p < 0.001$) and substantial; a 1.0 point increase in *country* GRS is associated with an average increase of 0.81 points in *individual* response to the food worry scale, controlling for age and gender. The unexplained country-level variability in food worry drops from 9% to about 5% when introducing GRS as an explanatory variable. The results suggest that individual food risk perceptions as well as cross-national variability in food risk perception are both strongly associated with national GRS. In other words, in countries where the public is more concerned about personal risks in general, people also tend to be more concerned about food risks.

We must be cautious about the interpretation of this nationally shared "cultural" GRS effect because it is the only covariate at the country level and thus likely to be overestimated; it may be confounded with other relevant country-level variables that are not included in the model. This problem of ecological inference is addressed in Model 3.

In Model 3 the effect of GRS is decomposed into the part explained by mean country GRS and the individual respondent's deviation from his or her own country's mean GRS. Only the estimate for the cross-level effect is prone to bias due to omitted country-level variables, while the individual (same)-level effect is not. Turning to the results, a 1.0 point increase in country GRS results in a 0.82 point increase in individual response to the food worry scale, and a 1.0 point increase in individual GRS results in a 0.47 point increase in individual food worry, suggesting that while there are other relevant, yet unobserved, country-level variables, the national GRS effect

[3] One of the seven items comprising the GRS measure is risk of "the food you eat damaging your health." However, there is no evidence for an autocorrelation problem since response to this item is only moderately correlated with the response variable ($r = 0.34$, compared to $r = 0.43$ for the composite GRS score) and the item only contributes to the GRS score with a factor of 0.14.

remains highly significant and of substantial magnitude.[4]

2.3. The Structure of Food Risk Perceptions

We now turn to the second type of cross-national difference, the extent to which there are similarities and differences across countries in the structure of perception of food risk.

First, we split the European data[5] randomly, stratified by country, into an exploratory and a confirmatory sample. Principal components analysis is applied to the exploratory sample ($n = 11{,}618$). Based on the component loadings of the major principal components, a factor model is developed to capture the main features of the response pattern. The other half of the data then serves as a confirmatory sample to test this model in a confirmatory factor analysis ($n = 11{,}523$).

The results of the principal components analysis show that five to seven components are required for an adequate summary of the data (explaining about 70% to 80% of the total variance), indicating that food risks are multidimensional. Our interpretation is based on the first three components. Components four to seven had eigenvalues substantially less than 1.0 and, with loadings close to zero on all but a single item, were not interpretable.

Although we identify three components, all food risk items are a measure of concern about food safety, since all risks load positively on the first component, accounting for about half (47%) of the total variance. Risks of chemical contamination (pesticides, residues, and pollutants) have the highest loadings, concern about putting on weight and a lack of hygiene in the home have relatively small loadings on this first component (Table III).

Contrasts between positive and negative loadings on the second and third component (Table III) lead us to the following interpretation of categories or groupings of food risks. First, there is a grouping related to *adulteration and contamination*, which includes pesticides, residues, pollutants, genetic modification, additives, and, to a smaller extent, bacteria, new viruses, and BSE. The second grouping, tentatively labeled *health effects,* is characterized by putting on weight and developing an allergy. The third grouping, *production and hygiene,* includes concerns about animal welfare and hygiene.

Table III. Factor Loadings on First Three Principal Components

	Factor Loadings on Principal Components		
Percentage of Total Explained Variance	1 47%	2 8%	3 7%
Residues in meat	0.80	−0.22	0.03
Genetic modification of food	0.72	−0.22	0.12
Pesticides in fruit or vegetables	0.79	−0.21	0.05
Pollutants, e.g., mercury	0.78	−0.16	0.02
Additives	0.73	−0.13	0.16
New viruses such as avian flu	0.73	−0.11	−0.02
BSE (the mad cow disease)	0.71	−0.07	0.02
Bacteria, e.g., salmonella	0.75	0.00	−0.01
Chemicals formed during, e.g., frying	0.74	0.05	−0.02
Welfare of farmed animals	0.57	0.08	−0.32
Lack of hygiene outside home	0.68	0.11	−0.28
Develop an allergy	0.63	0.30	0.17
Lack of hygiene in the home	0.46	0.59	−0.48
Put on weight	0.38	0.63	0.57

In the next step, the other half of the sample is used in a confirmatory factor analysis to formally test this three-factor structure. In particular, we assess whether the contrasts on the second and third components have empirical validity despite leaving about 40% of the total variance unexplained, and whether they have sufficient discriminant validity even though all items are positively correlated (captured by the first component). Fig. 1 depicts the model in a path diagram specified using LISREL, together with common and unique factor loadings.

While the model does not fit the data judged by the exact measures of goodness of fit ($\chi^2 = 3{,}408$; $df = 74$; $p < 0.001$), the alternative test of approximate fit is good (RMSEA = 0.064 CFI = 0.98). As expected, the three components are significantly correlated, indicating good convergent validity, but the discriminant validity of the components *adulteration and contamination* and *production and hygiene* is weak ($r = 0.88$).

Turning to the analysis of the individual items, all factor loadings are highly significant ($p \leq 0.01$). We use the cut-off points suggested by Fornell and Larcker (1981) to evaluate measurement reliability

[4] The effect of the GRS variables still remained highly significant and of similar magnitude ($b_{ind.} = 0.45$, and $b_{country} = 0.81$) as in Model 3 when controlling for all other plausible individual-level variables available from the survey; these were: trust in European regulative authorities with regard to food safety, whether respondents felt that food safety became better/worse/stayed the same compared to 10 years ago, media exposure to health risk and food risk issues, and presence of a child in the household.

[5] Cyprus, Malta, and Luxembourg have been excluded from the analysis due to small sample size.

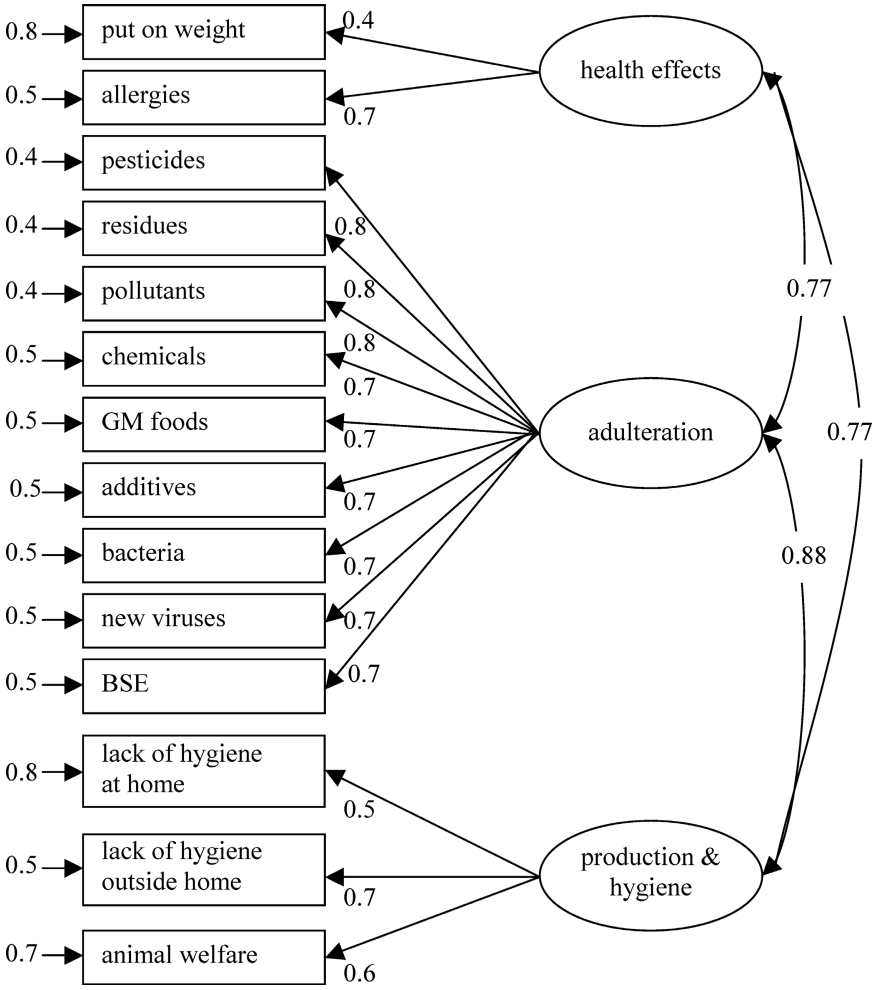

Fig. 1. Three-factor model specified in LISREL.

and validity of single items: communalities (R^2) larger than 0.5 indicate good reliability and common factor loadings above 0.7 indicate good measurement validity. The following items lack reliability and measurement validity: putting on weight ($R^2 = 0.19$), BSE ($R^2 = 0.46$), hygiene in the home ($R^2 = 0.22$), and the welfare of farmed animals ($R^2 = 0.34$). The items pesticides, residues, and pollutants have good, and the remaining items acceptable, measurement properties.

Overall, the results are suggestive of a three-fold structure of food risk—adulteration and contamination, health effects, and issues of production and hygiene. In the confirmatory factor analysis, the model is well fitted to risks of adulteration and contamination (in which the majority of the specific food risks belong), but it does less well in explaining risks falling in either of the two other groupings. However, it has sufficient empirical validity to provide us with a starting point for the analysis of cross-national similarities and differences.

2.4. Cross-National Differences in the Factorial Structure of Food Risk Perceptions

Based on results of the principal components analysis, each individual respondent is assigned a factor score for each of the three components. In a second step, mean scores on the three components are calculated for each country. The results are depicted in Figs. 2 and 3.

Drawing on our interpretation of the three principal components, the score on the first dimension reflects overall concern about food risk. A negative score on the second component indicates a relatively stronger concern about the risks of adulteration and contamination (chemicals, additives, and GM food) than about the other risks. A positive score on the

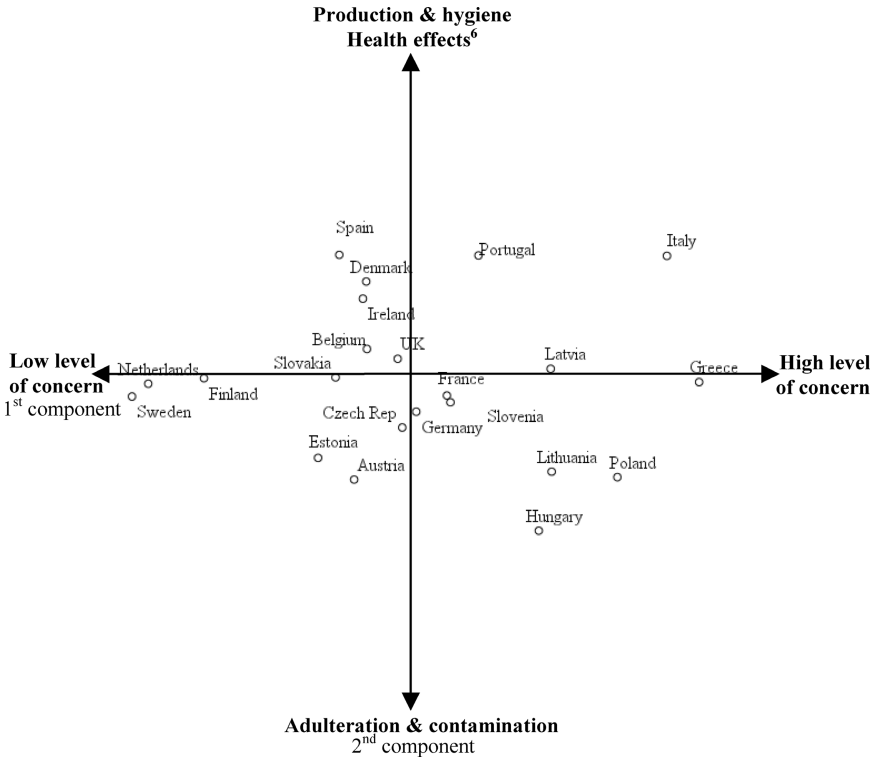

Fig. 2. Country factor scores on the first and second principal components.

third component indicates a relatively stronger concern about "health effects" (putting on weight, allergies) than about "production and hygiene" (lack of hygiene, animal welfare), the reverse pattern results in a negative score on this dimension.

Since the first component is a measure of overall food risk perception, it is not surprising that the rank order of countries is almost identical to the mean ratings shown in Table I. Northern countries worry least; Mediterranean and Eastern countries worry the most.

The scores on the second and third components are small in magnitude. Only seven (six on the third component) out of 22 countries have scores falling more than 0.2 units from zero. In other words, the response patterns of two-thirds of the European countries are similar on these dimensions. Factor scores of interpretable magnitude are observed for Austria and the Eastern European countries. These countries tend to be relatively more concerned about risks of *adulteration* than about *health effects* and *production and hygiene*. For Spain, Portugal, Italy, and Denmark the reverse pattern is observed with greater concern about *health effects* and *production and hygiene*. Respondents in Finland are relatively more concerned about health effects, especially putting on weight, than about production and hygiene, while in Portugal, Ireland, and Denmark we see the reverse tendency.

The pattern of cross-country similarities and differences is complex because similarity on one factor can go along with substantial differences on the other factors. Thus, similar levels of worry (first factor) may be associated with differing types of concern (second and third factor), and vice versa. For example, Sweden, Finland, and the Netherlands are very similar in the level of food worry, but differ in their relative concerns about health effects and production and hygiene. Conversely, Greek respondents show substantially higher levels of worry than Dutch respondents, but their patterns of concern about the three categories of food risk appear similar.

To summarize, this section analyzed the amount of worry or concern about 14 food risks and the structure underlying these risks. On both the extent of concern and on the underlying structure of risk perception the picture is one of cross-country similarities but also notable differences. While a majority of the 25 EU member states fall within a small range on

[6]The second component separates the "adulteration and contamination" risks from all others, but does not distinguish between the groupings "production and hygiene" and "health effects." These two groupings only emerge from the contrast on the third component.

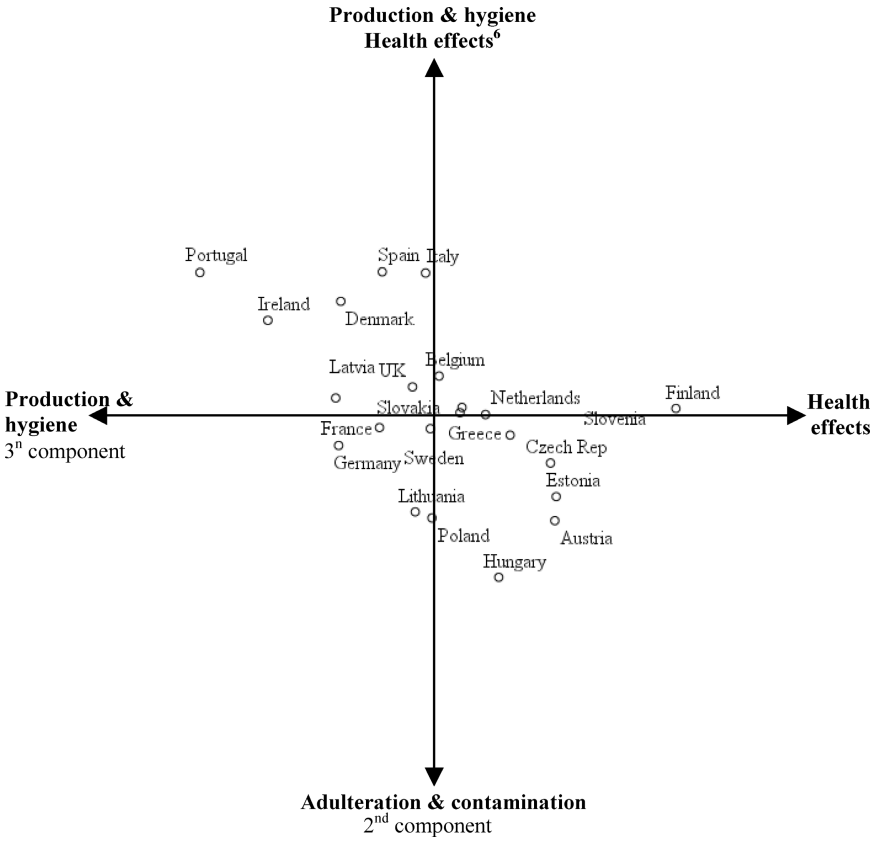

Fig. 3. Country factor scores on the second and third principal components.

the extent of food worry, the extremes on the scale reflect a striking North-South split. Yet, about half of the cross-country variance in the amount of food worry is explained by national differences in what we call generalized risk sensitivity (GRS), the perceived likeliness of experiencing a range of other personal risks. Furthermore, we find three distinct groupings of risks around *adulteration*, *health effects*, and *production and hygiene*. While the structure is reasonably robust across Europe, it only accounts for about 60% of the total variance of responses to the rating scale, leaving ample scope for the unexplained variance to have cross-national significance. And even within the explained structure, we find that the relative salience of the three groupings shows interesting differences for particular countries. In other words, finding three dimensions underlying risk perception cannot be taken as evidence of cross-national uniformity. Could the same hold for studies of other technological risks?

At this point, it is useful to step back from the results and reflect on the survey response process for closed questions. The choice of risks included in the survey, and the rating scales themselves, constrain the structure in which respondents can express their perceptions of risks. Such constraints may militate against capturing people's actual understandings of food risks. Thus, it may be that the Eurobarometer food risk scale, designed to reflect the expert point of view, does not capture how food risk perceptions are subjectively experienced and structured in different national contexts. These considerations provide the rationale for the next section, in which we focus on the qualitative approach, analyzing free associations given in response to an open-ended question concerning problems and risks associated with food.

3. QUALITATIVE APPROACHES: REPRESENTATIONS OF FOOD RISK

To elicit people's spontaneous concerns about food, respondents were asked

> What are all the things that come to your mind when thinking about problems or risks associated with food?

To avoid framing effects in the questionnaire, that is, prompting respondents to consider risks of which they may have been unaware, this question preceded the

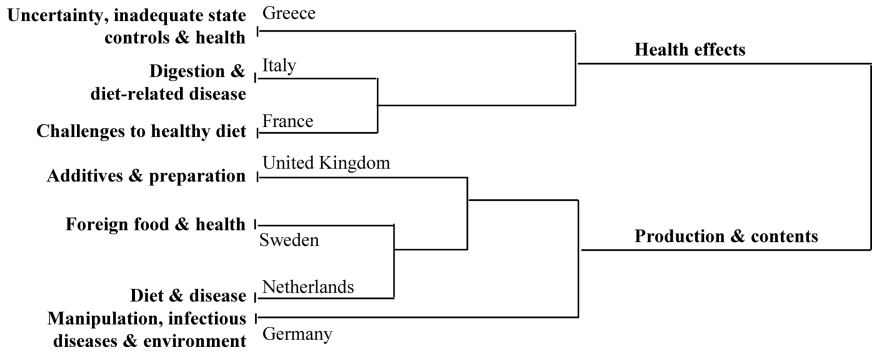

Fig. 4. Dendrogram of word classes in the joint analysis of seven countries.

closed question analyzed in the previous section. The verbatim responses were analyzed with the Alceste program developed by Reinert (1983). The basic idea underlying the program is that for a particular topic different points of view will manifest themselves in different choices of words and phrases, that is, the use of different vocabularies. Alceste uses a combination of statistical methods to explore textual data summarized in a co-occurrence matrix of words. First, the program reduces the vocabulary to its roots—so-called lemmatisation (e.g., *manipulation* and *manipulated* become *manipulate+*) and divides the text into text chunks of about similar length (so-called ECUs) taking into account the grammatical structure of the text (e.g., semicolons and periods). Then, a hierarchical cluster analysis determines distinct classes of vocabulary based on significant similarities in co-occurrences of words within the ECUs. Finally, a correspondence analysis maps the countries onto these vocabulary classes. Here, countries cluster around the previously identified vocabulary classes, and the results indicate which country is, relative to the others, most closely associated with a particular vocabulary class. For a detailed description of the Alceste procedures, results, and applications in social science, we recommend Guerin-Pace (1998) and Kronberger and Wagner (2000).

For an Alceste analysis the data corpus must meet some technical requirements. All the text needs to be in the same language; otherwise, Alceste simply separates vocabulary according to language. Hence, we analyzed the English translations provided by the European Commission.[7] Furthermore, the total data corpus must exceed 10,000 words.

Countries that did not provide verbatim-transcribed responses or did not meet the minimum word-count requirement have been excluded, leaving Britain, France, Germany, Italy, Greece, Sweden, and the Netherlands in the analysis. An average of only 7% did not answer the question and a further 6% said they did not see any risks or problems. This leaves us with an average of about 980 responses per country (the minimum is 844 in France). Thus we can be reasonably confident that the samples are representative of their respective countries.

On the national level, each country is analyzed separately to map out the full range of risk perception themes. On the European level, we organized the individual responses into national texts to explore cross-national differences in these risk themes. The advantage of doing separate country analyses and a joint analysis is that they produce complementary results. The former describes the range of risk themes in each country, while the latter is comparative and identifies cross-national variation in salient risk themes.

3.1. Mappings of Vocabulary Themes

The joint analysis of the seven countries shows seven vocabulary classes. The analysis produced stable results and only 8% of the ECUs could not be classified. The dendrogram (Fig. 4) shows the associations between the vocabulary classes together with a suggested label and the country most strongly associated with each class.

The first point to note is that the dendrogram has two distinct branches, echoing the European North-South split observed in the level of food worry; Greece, Italy, and France are contrasted with Britain, Sweden, the Netherlands, and Germany. This tells us that the salient risks, and the words and phrases people use to talk about food risk, are different in the South and North of Europe implying that food problems and risks have different connotations.

[7] With the exception of the French data. We wish to thank Louise Gaskell for a translation and Prof. Claude Fischler who kindly reviewed the accuracy of the translation.

In the lower, "Northern European" branch of the dendrogram the word class that we label "manipulation, infectious diseases, and environmental impacts" is the most distinct as it is the first to separate from the total vocabulary. The word class contains 17% of the ECUs and is most closely associated with Germany. Judged on chi-square values, highly significant key words[8] for this word class are genetic, manipulation, engineering, chemistry, environment, mad cow, avian flu, plagues, salmonella, livestock, expiry dates, incorrect, and labels.

The same branch of the dendrogram contains three closely related word clusters identified with Britain, the Netherlands, and Sweden. Akin to the German theme, all word classes are linked to some aspect of food handling or food contents. Twelve percent of the ECUs are classified into the word class that we call "additives and preparation," and are most strongly associated with Britain. Highly significant words are salt, additives, E-numbers,[9] cooking, processed, and cleanliness.

The word class that captures Swedish food risk associations is of similar size and tentatively labeled "foreign food and health" (13% of ECUs). Key words are sugar, spraying, bacteria, *E.coli*, animal transport, provisions, imported, and foreign. The "diet and disease" word class is slightly smaller (10% of ECUs) and is closest related to Dutch responses. Key words include overweight, overeating, fat, and cardiovascular.

The three word classes in the second branch of the dendrogram are associated with the Mediterranean countries Italy, Greece and France. All three word classes center on the health effects of food consumption. The largest and most distinct word class (30% of ECUs) is typical for Greek associations. It is a hybrid of concerns about both ends of the food chain. Distrust in manufacturers and supermarkets, and the demand for food safety controls go along with uncertainty and fear about adverse health effects. We call this word class "uncertainty, inadequate state controls, and health" based on the significant words market, profits, controls, state, authorities, cause, health, harm, fear, pure, and afraid.

The word class "digestion and diet-related diseases" (12% of ECUs) is strongly associated with Italy and is replete with medical terminology, for example, infarction, intolerance, tumor, gastritis, anorexia, bulimia, disease, and indigestion, as well as words that are also significant in related word classes, for example, obesity, cholesterol, and adulterated.

A neighboring word class identified with French respondents is "challenges to a healthy diet" (8% of ECUs). The word class is significantly associated with balanced, excess, quantity, associated, obesity, cholesterol, digestion, and diabetes.

The statistically significant differences in the vocabularies used to express food-related concerns suggest that countries differ in their representations of food risks and problems. The German perspective centers on risks created by human intervention—genetic engineering, the use of pesticides and other chemicals, and in the manipulation of expiry dates. Associations with food scares such as mad cow disease and avian flu blend into these concerns. Greek respondents share the German unease about human intervention along with the French and Italian concerns about food damaging health. However, the Greeks neither use the technical vocabulary typical of the Germans, nor the elaborate medical vocabulary of the Italian and French respondents. For the Greeks the concern about the manipulation of food is expressed in vague terms of "impure" or "contaminated" food, and uncertainty about health damages in general. Food risks tend to be personified, blame is given to the market and to those who put the consumer at risk for their own profit, and there is a demand for protection and control by state authorities.

While Germany and Greece have distinct risk themes, respondents in the other countries share vocabularies with their geographical neighbors, but differences show in the portfolio and salience of these word classes. The French and Italians both understand food risk in the context of diet and health; in particular the quality, quantity, and healthiness of the food consumed are associated with a range of diseases and discomforts. British, Dutch, and Swedish respondents make use of three associated vocabularies that relate to specific food contents (additives, fat, sugar, or salt), as well as to risks of becoming overweight due to too much fat and sugar, and, finally, to concern about the hygiene, safety, and quality of imported food. All three word classes describe some aspect of

[8] To ease the readability of the results, we converted the word lemmas created by Alceste back into their most frequent natural form, for example, *adult* + into *adulteration*.

[9] E-numbers are codes for food additives and a common way of referring to such additives in many European countries. The numbering scheme follows the International Numbering System (INS) as determined by the Codex Alimentarius committee. The prefix "E" signifies approval of the safety of an additive by the EU (European Food Information Council, 2006b).

Table IV. Summary of Results of the European-Level and Seven National-Level Analyses

Level of Analysis % ECUs classified	Adulteration and Contamination	Unease with Food System	Diet and Health Effects
Europe 92% ECUs	Manipulation & infectious diseases (17% Germany) Additives & preparation (12% Britain)	Uncertainty & controls (30%, Greece) Imports & transports (13%, Sweden)	Health dangers (12%, Italy) Diet & health (8%, France) Obesity & heart disease (10% Netherlands)
Germany 75% ECUs	Tampering with nature (39%) Additives, chemicals, engineering, environment, spraying, genetic, pollution, animal diseases & food scares (20%) Mad cow, avian flu, pesticides, plague, salmonella, viruses	Labeling & animal transports (17%) Expiry date, incorrect, packaging, price, labeling husbandry, livestock, transport	Food poisoning, allergies & diet (26%) Allergies, cholesterol, fat, poisoning, overweight, diet
Greece 84% ECU	Chemicals and GM food (28%) Chemicals, contain, genetically, modified, pesticide, substances, hormones, cancer	Uncertainty, blame, & fear (50%) Consumer, protect, health, risk, control, profit, market, state, future	Food poisoning (22%) Poisoning, spoil, scared, hear, infectious, hospital, television
Italy 78% ECUs	Food scares and terrorism (20%) Avian flu, mad cow, pesticide, terrorist, water, bleach, aqua bomber, pollution Contamination & modification (20%) Adulterated, contaminated, genetic, modified, preservatives		Obesity, heart diseases, and eating disorders (34%) Obesity, cholesterol, infarction, diabetes, anorexia, bulimia, indigestion Dietary issues (26%) Think, pay, attention, fat, diet, healthy, weight, illness
France 79% ECUs	Contamination, modification and food scares (40%) Avian flu, GM, mad cow, poisons, polluted, chemicals, quality, natural		Diet & cancer and heart diseases (60%) Cancer, cholesterol, diabetes, diet, heart, attack, blood, obesity, unbalanced, malnutrition
Netherlands 80% ECUs			Obesity & heart diseases (28%) Cardiovascular, cholesterol, become overweight, diabetes Unhealthy food (34%) Too much, eat, fat, chemical, substances, vegetables, meat, harmful, hormones Food poisonings (38%) Food poisoning, bacteria, salmonella, diarrhea, hygiene
Sweden 86% ECUs	Tampering with nature (34%) Animal, chemicals, genetic pesticides, manipulation, environmental pollution, transport, husbandry	Unsafe imports (20%) Bad, contaminated, import, handling, Swedish, know, abroad, foreign, safe, industry, economic, quality	Heart disease, obesity and diabetes (22%) Heart attack, blood, cancer, cardiovascular, diabetes, obesity, overweight Bad diet: sugar and fat (24%) A lot of, eat, sugar, eat unhealthy, wrong, diet
Britain 71% ECUs	Artificial & unhealthy contents (40%) Additives, chemicals, content, E-numbers, fat, genetic, modified, salt, sugar, preservatives, pesticides	Everything is unsafe (20%) Careful, buy, risky, things, damage, cook, chicken, beef, eggs, fruit	Hygiene, salmonella, and poisonings (40%) Hygiene, salmonella, poison, out of date, cleanliness, sell, *E.coli*, proper, preparation, standard, trust, outside

making "informed" consumer decisions when buying, preparing, and eating food.

Alceste searches for statistically significant differences and identifies particularities in vocabulary use, possibly at the expense of accentuating differences between countries. For example, we cannot infer that Germans are not at all concerned about health effects, or that French and Italian respondents are not concerned about mad cow disease and pesticides.

To address this problem we analyze each country separately. The results are interpreted in the same way as the joint analysis of all countries and summarized in Table IV. The vocabulary themes group into three areas: adulteration and contamination, production and hygiene, and diet and health effects of food consumption. These groupings are consistent with the three-factor structure underlying response to the risk rating scale (Fig. 1).

The comparison of the seven national vocabularies and the joint analysis suggest three main conclusions. First, the two levels of analysis show some consistency. The largest risk themes at the national level tend to be the most salient for that particular country in the joint analysis.

Second, a subset of the range of risk themes is present in each country, but countries differ in their portfolio of word classes as well as the range of topics. For example, Dutch concerns revolve around diet and health, which comprises three distinct concerns—obesity and heart disease, unhealthy food, and food poisoning. Also of interest in the Dutch profile is what is *absent*: there are no word classes relating to either unease about the food system, or concern about adulteration and modification. By contrast, the French express concern about adulteration and contamination in addition to concerns about diet and health. However, on diet and health effects the French concerns are less diversified than in the Netherlands and center on associations between diet, cancer, and heart diseases.

Third, while the majority of food worries are shared across countries, the same food worry appears in different contexts. For example, Germans associate salmonella with BSE, avian flu, and similar food scares, while the British people talk about salmonella in the context of improper preparation of food outside the homes and other microbiological health hazards.

In all countries, there is a strong representation linking food risk to health and diet, with obesity and related diseases featuring regularly. Other health concerns differ across countries. Relatively speaking, allergies are a German preoccupation; Italians worry more about eating disorders; and the British about hygiene and cleanliness.

4. DISCUSSION

In this study, taking quantitative and qualitative approaches, we identify cross-national similarities and differences in risk perception of food. The results point to both a degree of uniformity across European countries and to interesting and potentially important differences. On the extent of worry about expert-defined food risks the majority of countries in Europe are fairly similar. Outside this majority a North-South split is evident. Southern European countries are the most and the Northern countries are the least concerned. Furthermore, individual respondents' level of concern about food risk as well as cross-national differences go hand in hand with the extent of (national) generalized risk sensitivity (GRS) toward a wide range of personal risks.

On the underlying structure of food risk perception three factors are identified: adulteration and contamination, health effects, and production and hygiene. The majority of countries are again rather similar in the pattern of relative concern about these three factors—with some notable exceptions, for example, Portugal, Spain, Finland, Austria, and some Eastern European countries. The pattern of similarities and differences is complex. Similarity in the overall level of concern or in one particular type of risk in the three-factorial structure may not be associated with similarity in risk concerns described by the other factors.

The findings from the qualitative approach in which we analyzed free associations are largely consistent with regard to two main features of European response to the risk rating scale. There is evidence in support of a North-South split; respondents in Northern countries express different concerns than those in the South of Europe. Furthermore, the three categories of risk themes in the free associations parallel the three-factorial structure underlying response to the risk rating scale.

Yet, the results of the qualitative analysis also point to less uniformity and to larger national differences than the quantitative analysis. This is to be expected as the closed questions impose more structure. All the respondents are presented with the same 14 risk items and asked to express their degree of concern about this given selection only and within the limits of a four-point rating scale. In the free associations, national differences are clearly evidenced in the portfolio of themes, the size of the vocabulary

classes, and the context in which particular risk issues appear. For example, while chemical and microbiological hazards are not distinct on any dimension in the three-factorial structure, in free associations they emerge in different vocabulary themes for some countries. Cross-national diversity in the framing of specific issues is evident for the microbiological hazards of salmonella, *E.coli*, bacteria, and avian flu. In Italy and Germany they are associated with food scares, in the Netherlands, Greece, and Britain they are framed as hygiene-related illnesses, while the Swedish think of them in the context of the perceived unsafety of imported foods.

The two approaches lead to contradictory results on a much debated issue in food-related health policy. On the risk rating scale, concern about obesity received the lowest average rating and this item has low reliability and validity in the three-factor model. In contrast, becoming overweight was a major concern in free associations, and the most widely shared concern across countries. This apparent contradiction may point to the importance of context and framing in the perception of any particular risk. The rating scale places the risk of obesity in the context of only one other health item (allergies), all other items tap into concern about adulteration and contamination of food or unease about issues of production and hygiene. As we have seen in the analysis of free associations, this is clearly not the context in which people spontaneously think of obesity. Across countries, respondents expressed concern about becoming overweight unambiguously in the context of health effects. This has an important methodological as well as policy-related implication. The subjectively "right" framing of a specific risk is central to people's understanding and perceived personal relevance of the risk.

More generally, the findings suggest that people's concerns about food risks are framed in the context of health. People do worry about the scientifically recognized food risks, but they do not appear to make fine distinctions between pesticides, residues, and pollutants, for example. Their concern is the threat to health from contamination and adulteration. This association of food risk with health effects also opens up consideration of further risk concerns. These include diseases linked to diet, chiefly heart disease, diabetes, and obesity; problems with imported food; deliberately false or insufficient labeling of food contents, origin, and expiry dates, and the failure of the "authorities" to ensure market compliance with food safety rules.

We identify a number of further implications from this study. First, the comparison of quantitative and qualitative results shows that closed-format risk rating scales lead to greater uniformity. Second, open-ended questions can be implemented and analyzed even in a large-scale survey. Such free associations elicit a much broader and richer range of food worries than closed questions and, in doing so, throw light on cross-national differences in food worries. Third, the findings raise the question of how we can explain the observed national variation in food risk perception? This would require further contextual information, for example, a documentation of recent food scares that may have shaped public perceptions. Fourth, those wishing to map, understand, and influence the public's food risk perceptions, whether policymakers, risk communicators, or social scientists, need to recognize that food risk is multidimensional; that public concerns extend beyond the traditional scientific definitions of food risk; and that different concerns resonate with different national cultures. Finally, we wonder if these implications for the study of food risk perceptions may be equally relevant to studies of risk perceptions in other domains, and if so, should the widely accepted findings of the psychometric paradigm be revisited.

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