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The Media and Genetically Modified Foods: Evidence in Support of Social Amplification of Risk

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Empirical examinations of the "social amplification of risk" framework are rare, partly because of the difficulties in predicting when conditions likely to result in amplification effects will occur. This means that it is difficult to examine changes in risk perception that are contemporaneous with increases and/or decreases in social or media discussion of the risks associated with a particular risk event. However, the collection of attitude data before, during, and after the increased reporting of the risks of genetically modified food in the United Kingdom (spring 1999) has demonstrated that people's risk perceptions do increase and decrease in line with what might be expected upon examination of the amplification and attenuation mechanisms integral to the framework. Perceptions of benefit, however, appeared to be permanently depressed by negative reporting about genetically modified food. Trust in regulatory institutions with responsibility for protecting the public was not affected. It was concluded that the social amplification of risk framework is a useful framework for beginning to explain the potential impact on risk perceptions of a risk event, particularly if that risk event is presented to the public as a new hazard occurring in a crisis context.

KEY WORDS: Risk perception; media reporting; genetically modified foods; social amplification of risk

1. INTRODUCTION

The social amplification of risk framework was proposed to explain why "risk events with minor physical consequences often elicit strong public concern and produce extraordinarily severe social impacts."[1:177] Pidgeon *et al.*[2:70] have commented that the social amplification of risk framework serves as "a useful analytical tool for describing and organizing relevant phenomena, for exploring and integrating relationships between rival constituent theories concerning risk perception and its communication, and for deriving new hypotheses about the societal processing of risk signals." The framework itself has been described elsewhere[1] and will not be detailed here. The research reported here aims at demonstrating the utility of the framework in the context of recent media events in the United Kingdom; specifically, the impact on public perception of high levels of media reporting regarding the risks associated with genetically modified foods.

To some extent, empirical work utilizing the framework must be opportunistic, as the risk events that trigger risk amplification or attenuation are not easily predicted. Without foreknowledge of such risk events, planned empirical data collection assessing public attitudes before and after amplification or attenuation has occurred is difficult. The framework proposed by Kasperson *et al.* posited that where there is no direct personal experience, information about risk and risk events reaches individuals through two primary communication networks—the news

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media and informal personal networks. It is difficult to predict whether a particular risk event will result in the media coverage necessary to trigger public fears about a particular risk, or to provide sufficient cues to mobilize collective fears and increase risk perceptions. Consider two examples from the United Kingdom. The announcement, in March 1996 by the then UK Minister of Agriculture, Stephen Dorrell, that there was a potential link between new variant Creutzfeldt-Jacob Disease (CJD) in humans and bovine spongiform encephalopathy (BSE) in cattle resulted in enormous media attention and had a negative impact on the UK beef industry.[3] There is some evidence that social amplification of risk associated with BSE occurred in the United Kingdom following this announcement.[4,5] Public perception of risk associated with beef consumption increased.[6] This was reflected in actual consumer behavior; beef consumption dropped by 17% in 1996, a 10% greater decrease than expected.[7,8] However, such effects were short lived. Inspection of meat-consumption patterns indicated that the British had, by 1997, returned to consuming beef and beef products at the same level as they would have done had the BSE crisis not occurred.[9] Specifically, the downward trend in consumption temporarily became more acute following the BSE scare. This pattern was matched by a short-term contemporaneous increase in risk perception. Thus, the case of BSE might be used as an example of risk amplification via the media.

In contrast, a report published by the Royal College of Physicians and the Royal College of Psychiatrists[10] indicating that exposure to organophosphate pesticides was detrimental to human health did not result in the media attention that might have been predicted. An increase in media attention was deemed likely because previous UK government recommendations had made organophosphate pesticide use compulsory in certain agricultural practices (for example, it was compulsory to use organophosphate sheep dips between 1976 and 1992). Additionally, media and pressure group discourse about possible similarities between the health effects associated with agricultural use of organophosphate chemicals and "Gulf War Syndrome" (where military personnel experienced debilitating health effects following exposure to organophosphate chemicals) might have facilitated the amplification process. However, publication of the joint report resulted in virtually no media attention, preventing the assessment of potential amplification effects on public perception.

It has been argued that social amplification may be influenced by a number of attributes of the information provided about a risk event, resulting in increased concern.[1] Media reporting of genetic modification of foods in the United Kingdom was characterized by these factors: a large volume of information, which may serve as a risk amplifier, independent of the accuracy and actual content of the information; disagreement between various actors in the risk debate; dramatization of risk information, e.g., through presentation of risk "scenarios" and examples; and the symbolic connotations of terms or concepts used in messages.

1.1. Media Reporting of Genetic Modification of Food

Genetic modification (GM) of food has been associated with a great deal of media attention (in both the United Kingdom and Europe more generally), particularly in early 1999.[11] Genetically modified soya was first imported into Europe from the United States in 1996; however, it was not until 1998 that media attention to this issue began to intensify. In late 1998, articles written about Dr. Arpad Pusztai of the Rowett Research Institute reported his (at the time, unpublished) research as providing support for the potential of negative health effects for humans as a result of consuming genetically modified foods. Later that year, the media reported the findings of an independent analysis, conducted by the Royal Society, which criticized Dr. Pusztai's research as flawed and argued that no conclusions should be drawn from the work.[12] Nonetheless, in the spring of 1999 there was extensive media reporting about the potential risks of genetically modified foods.[13]

1998 also saw reports of more than 1,000 UK schools taking genetically modified foods off their menus and the banning of genetically modified food from restaurants and bars in the House of Commons. Beginning in 1998, and continuing in 1999, Prince Charles expressed his concerns about genetic modification, questioning the necessity of the technology and calling for a public debate on the issue. Additionally, numerous genetically modified crop trial sites were destroyed around the country. A particularly well-reported case involved the destruction of a crop site in Norfolk, where Lord Peter Melchett, executive director of Greenpeace UK, was remanded into custody. The summer 1999 crop trial destructions led to discussions about the possible secrecy of locations of future crop trials. Crop trial sites were also destroyed in the United States and France in 1999. Debates about the threat of cross-contamination to non-GM crops, including organic crops, were reported

in 1999. The media also presented discussions of the potential for a conflict of interest for scientific advisors to the government, who were simultaneously providing advice about the safety of genetically modified foods and potentially profiting from the development and application of this technology through industrial interests. In particular, there were reports questioning the independence of the Science Minister, Lord Sainsbury, on matters relating to genetically modified food due to his business connections with the GM food industry.[13]

Since 1998, most of the major UK supermarkets have eliminated genetically modified ingredients from their own brand products in response to consumer concern.[14] This move was begun by Iceland (a UK national food retailer) in mid 1998. It was paralleled by other food manufacturers in 1999 (e.g., Unilever, Nestle, and Northern Foods), and restaurant chains (e.g., Wimpy and Pizza Express). The supermarkets also set up telephone help lines, started a policy of voluntary labeling, and began working to remove genetically modified products from animal feed.

2. METHOD

The aim of this research was to investigate the effect of increased media reporting about the risks associated with genetically modified food on public attitudes to the technology. Attitudes to genetic modification of food were initially assessed in February 1998 before the media attention to genetic modification increased in amount and intensity to the level found late in 1998 to early in 1999. This was fortuitous, rather than by design. The occurrence of high levels of media reporting in late 1998 and early 1999 provided the opportunity to test its impact on attitudes. Thus, the data collection was repeated approximately one year later, in March 1999, when reporting was peaking. The third wave of data collection was conducted in July 2000, when the level of media attention was subsiding.

2.1. Sample Characteristics

Just over 300 participants took part in each phase of the experiment. A between-subjects design was utilized, where a new sample was surveyed at each time of data collection. Recruitment, using hall tests (where participants are recruited in a town shopping center and taken to a local hall where they complete the questionnaire), was conducted by a social research company to enable quota sampling for gender, age, and social class.

At Time 1 (February 1998), 309 usable questionnaires were collected. Of this sample, 54% were female. The mean age of participants was 45.3 years (SD $\pm$ 14.74). Thirty-six percent of the participants were categorized as social classes A/B, 15% as C1, 10% as C2, and 17% as D/E. The remainder were unclassified (houseperson, retired, unemployed, or student), or had missing data. At Time 2 (March 1999), 306 usable questionnaires were collected. Of this sample, 51% were female. The mean age of participants was 42.9 years (SD $\pm$ 17.40). Twenty-six percent of the participants were categorized as social classes A/B, 23% as C1, 11% as C2, and 15% as D/E. The remainder were unclassified or had missing data. At Time 3 (July 2000), 306 usable questionnaires were collected. Of this sample, 52% were female. The mean age of participants was 42.3 years (SD $\pm$ 16.43). Twenty-one percent of the participants were categorized as social classes A/B, 27% as C1, 21% as C2, and 14% as D/E. The remainder were unclassified or had missing data. The similarity in demographic profile of participants between the three samples was judged to be acceptable for comparisons across time to be made (Table I). There were some differences in the social-class profile of the three samples, and for this reason statistical analysis included examination of demographic characteristic x time interactions. However, as will be noted in the Results section, there were no interactions.

2.2. Materials

2.2.1. Items Common to All Three Studies

Participants were asked to rate their agreement, on a seven-point scale anchored by *completely agree* and *completely disagree*, with 53 attitude statements (see Table III for wording of the statements). Nineteen of these statements were based on the public's own concerns, as identified in a previous interview study.[15] The remaining 33 statements included key attitudinal themes identified in previous studies investigating attitudes to various hazards.[16–18]

2.2.2. Additional Items Presented at Time 2

Additional items were included at Time 2 to investigate whether the participants had seen the reports about genetically modified foods in the media, and provide information about their perception of these reports (Table II). These were included at the end of the questionnaire so as not to influence responses to the other items.

	Time 1	Time 2	Time 3	
Date of Study	February 1998	March 1999	July 2000	
N	309	306	306	
Gender				$\chi^2(2) = 0.550$, ns
Male	142 (46.4%)	151 (49.3%)	148 (48.4%)	
Female	164 (53.6%)	155 (50.7%)	158 (51.6%)	
Age: Mean (SD)	42.25 (14.74)	42.94 (17.40)	42.33 (16.43)	$F(2,905) = 0.167$, ns
Social Classes				$\chi^2(8) = 45.461^{***}$
A/B	111 (35.9%)	79 (25.8%)	65 (21.2%)	
C1	45 (14.6%)	69 (22.5%)	82 (26.8%)	
C2	31 (10%)	34 (11.1%)	64 (20.9%)	
D/E	51 (16.5%)	45 (14.7%)	42 (13.7%)	
Unclassified	71 (23%)	79 (25.8%)	53 (17.3%)	
Education (after 11):	147 (49%)	168 (57.5%)	141 (46.2%)	8.236 (2)*
Mean (SD)	153 (51%)	124 (42.5%)	164 (53.8%)	

Table I. Demographic Details for the Three Samples Assessed

$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

3. RESULTS

3.1. Principal Components Analysis

Principal components analysis (PCA) was conducted on the 53 attitude items with the aim of reducing the data to enable the creation of subscales that could be used as dependent variables in further analysis. PCA was conducted on the data for the three years separately. A strict criterion was employed to determine which items should be included in the separate subscales. It was decided that items had to load onto the same principal components (PC) with loadings of 0.3 or above for each of the three years. Items that did not meet this criterion were not included. This was the case for nine of the attitude items (see items with no bold loadings in Table III). The method of extraction used was principal components and varimax rotation was used to clarify ambiguous loadings. The scree plot was considered to determine the most likely number of components to be extracted. This suggested three components for each of the PCAs. The amount of variance explained for each PCA was: Time 1 = 43.1%; Time 2 = 43.2%; Time 3 = 47.2%. The resulting PCAs were very similar across the three times of assessment, suggesting that the structure of people's attitudes had not changed over the time period. As a result, the data for the three years was combined, and the loading table from the PCA conducted on this combined data set is reported below (the separate loading tables for each time of assessment can be obtained from the authors). The amount of variance explained was 44.2%. Three components emerged from the analysis. The first was composed of items associated with the potential of genetically modified foods for negative effects, and was labeled "Risks and Negative Effects." The second was labeled "Trust and Choice" and the third included items related to the potential benefits associated with genetically modified food and was labeled "Benefits" (Table III).

Table II. Additional Items Presented at Time 2

Have you noticed reports about genetically modified foods in the media recently? *Yes/No*
I thought the reports were alarming.
I thought the reports were reassuring.
I thought the reports were informative.
I thought the reports were a good example of "media hype."
I thought the reports presented a balanced picture.
I thought the reports were more to do with trust in regulators and less about risk.
I thought the reports were more to do with trust in science and less about risk.
I think the public should be more involved in decisions about genetically modified foods.

1 = agree completely, 7 = disagree completely.

Subscales were created for the three principal components by taking the means of each item loading onto each PC. Reliability analysis, using Cronbach's alpha as a measure of internal consistency, was applied to see how well the different characteristics loading onto each component were measuring the same psychological construct. The analysis revealed high alphas (Risks and Negative Effects = 0.96; Trust and Choice = 0.84; Benefits = 0.74).

3.2. Changes in Attitude Toward Genetically Modified Food Over Time

A MANOVA was conducted to investigate the effect of time of assessment on attitudes to genetic

Table III. Factor Loadings for the Attitude Items, All Three Years Combined

Attitude Items	Risks and Negative Effects 28%	Trust and Choice 9.6%	Benefits 6.56%
GM of food will have adverse effects on human health	**0.83**	−0.06	−0.20
GM of food will have adverse long-term health effects	**0.80**	−0.05	−0.23
GM of food will adversely affect future generations	**0.79**	−0.03	−0.24
The use of GM in food production is dangerous	**0.79**	−0.11	−0.19
The use of GM in food production is harmful to humans	**0.78**	−0.04	−0.16
The use of GM in food production is unethical	**0.77**	−0.07	−0.15
I personally worry about the use of GM in food production	**0.73**	−0.20	−0.04
GM of food will have adverse effects on the environment	**0.73**	−0.08	−0.15
The use of GM in food production makes me wonder what we're eating	**0.73**	−0.10	0.01
There will be negative long-term effects of the use of GM in food production	**0.72**	−0.12	−0.11
The use of GM in food production is immoral	**0.72**	−0.04	−0.15
GM foods causes other problems in the food	**0.71**	−0.03	−0.19
GM of food is interfering with nature	**0.70**	−0.18	−0.01
The use of GM in food production is tampering with nature	**0.69**	−0.17	0.07
The use of GM in food production is unnatural	**0.69**	−0.19	0.07
I don't agree with genetically modifying food	**0.69**	−0.24	−0.15
The use of GM in food production will have negative effects on human welfare	**0.69**	−0.04	−0.16
The use of genetic modification in food production has adverse health effects for humans	**0.69**	0.00	−0.12
The use of GM in food production is risky	**0.69**	−0.18	−0.03
GM of food affects the food chain	**0.66**	−0.13	−0.10
I personally object to the use of GM in food production	**0.65**	−0.20	−0.04
The real risks of the use of GM in food production are hidden from consumers	**0.65**	−0.19	−0.02
There are unknown side effects of GM of food	**0.64**	−0.20	0.03
Profit will come before safety with GM foods	**0.64**	−0.28	0.07
BSE and similar food scares increase my concern about GM food	**0.62**	−0.08	0.03
The use of GM in food production is an important risk (and so requires attention)	**0.55**	−0.19	0.16
The use of GM in food production is beneficial to the consumer	−0.50	0.40	0.39
Public awareness of GM in food should be increased	**0.45**	−0.18	0.18
The consumer has no control when if comes to GM food	**0.42**	−0.31	0.16
I am personally uninformed about the use of GM in food production	0.36	0.04	0.20
The effects of the use of GM in food production are widespread across the UK	**0.33**	0.20	−0.04
I lack knowledge about GM of food	0.32	0.08	0.28
The use of GM in food production is a common risk	0.28	0.20	0.07
It is difficult to detect the negative effects of GM	0.27	−0.07	0.27
The consumer has the right to choose what he/she eats	0.20	−0.02	0.12
I can choose whether or not to encounter the use of GM in food production	−0.03	**0.78**	−0.11
I can choose whether or not to eat food produced using GM	−0.04	**0.77**	−0.10
The use of GM in food production is avoidable by the consumer	−0.04	**0.73**	−0.07
I trust those responsible for regulating the risks of GM in food production in the UK	−0.31	**0.66**	0.24
The use of GM in food production is a voluntary risk	−0.10	**0.65**	0.04
I trust those responsible for regulating the risks of GM in food production in other countries	−0.24	**0.64**	0.14
The use of GM in food production is controllable by the consumer	−0.09	**0.61**	0.02
The use of GM in food production is necessary for good health	−0.28	**0.56**	0.13
It is important to trust those responsible for regulating the risks of GM in food production	0.01	**0.35**	0.24
The use of GM in food production is advantageous to the farmer	−0.13	0.06	**0.62**
The use of GM in food production is advantageous to the food industry	−0.03	−0.11	**0.60**
GM of food will lead to less wastage of food	−0.20	0.17	**0.60**
GM of food will lead to cheaper food	−0.14	0.07	**0.59**
GM foods will last longer	−0.01	0.01	**0.57**
The use of GM in food production is progressive (moving forward, modern)	−0.35	0.31	**0.52**
The use of GM in food production is advantageous to the consumer	−0.40	0.34	0.43
I would like to know more about the use of GM in food production	0.21	−0.13	0.31
There will be positive long-term effects of the use of GM in food production	−0.11	0.29	0.30

Note: Factor loadings in bold indicate which subscale each attitude item was included in. Attitude items with no bold factor loadings did not meet the criteria for inclusion.

Table IV. Mean (and Standard Deviation) Attitude Ratings for the Three Years

Attitude Subscale	Time 1	Time 2	Time 3	Univariate F (df)
Risks and Negative Effects	2.86 (1.07)[a]	2.58 (1.17)[ab]	2.97 (1.32)[b]	8.693 (1,910)***
Trust and Choice	4.57 (1.29)	4.68 (1.46)	4.47 (1.44)	1.785 (1,910)
Benefits	3.04 (1.05)[ab]	3.74 (1.32)[a]	3.64 (1.32)[b]	28.524 (1,910)***

*** $p < 0.001$. Means associated with the same letter are significantly different at the $p < 0.05$ level (Tukey HSD) for that dependent variable.

modification, as measured by the three subscales. Significant differences were obtained (Pillai's Trace $F(6,1818) = 12.723$, $p < 0.001$). Additionally, there were univariate effects (where the dependent variables are examined individually) for "Risks and Negative Effects" and "Benefits," but not for "Trust and Choice" (Table IV). *Post hoc* analysis indicated that these effects were due to participants being more likely to perceive more "Risks and Negative Effects" at Time 2 compared to initial and final assessments. Participants were more likely to associate genetically modified foods with "Benefits" at Time 1, compared to Time 2 or Time 3. This indicates that perceptions of risk increased, and perceptions of benefit decreased, between Time 1 and Time 2. However, at Time 3, perceptions of risk dropped back to the Time 1 level, but perceptions of benefits remained depressed. Perceptions of the "Trust and Choice" items remained stable across the whole time period.

3.3. Reactions to Reports about Genetic Modification in the Media

Eighty-seven percent of the Time 2 sample claimed to have noticed reports about genetically modified foods in the media. It was not possible to compare the attitudes of those participants who claimed to have noticed media reports with those who had not, as only 13% of the sample had not noticed any reports, making for a small group size. Further analysis was conducted on the attitude to the media report items using only those participants who had noticed media reports.

Participant responses to the item "I thought the reports were alarming" were used to divide the sample into two groups each containing approximately 50% of the sample. It was found that 46% of the sample "completely agreed" that the reports were alarming. As a result of this skewed response to this item all of those participants who were in total agreement that the reports were alarming (n = 121) were in Group A, and all the remaining participants were in Group B (n = 143).

A MANOVA conducted to compare these two groups on the three subscales was significant (Pillai's Trace $F(3,259) = 22.551$, $p < 0.001$). All three univariate tests were significant (Table V). The data indicated that those participants who were in complete agreement that the reports were alarming perceived more "Risk and Negative Effects" to be associated with genetically modified foods. They also perceived genetically modified foods to be associated with less "Benefits," expressed less trust, and felt that they had less choice.

A further MANOVA was conducted to compare these two groups of participants on their responses to the other items measuring attitudes to the media reports. The overall MANOVA was significant (Pillai's Trace $F(7,244) = 9.132$, $p < 0.001$), as were the univariate tests (Table VI). It was found that those participants who completely agreed that the reports were alarming did not think that they had been reassuring, nor were the messages perceived to be "media hype." These participants also expressed the view that the public should be more involved in decisions about genetically modified foods. Thus, perceptions of the media reporting about genetically modified foods seemed to align with people's perceptions of the risks and benefits associated with genetically modified foods. Perception of negative reporting was

Table V. Mean (and Standard Deviation) Attitude Ratings for Participants Allocated to Groups A and B

Attitude Subscale	Group A: Reports Alarming	Group B	Univariate F (df)
Risks and Negative Effects	1.99 (0.99)	3.05 (1.14)	64.600 (1,261)***
Trust and Choice	5.08 (1.45)	4.59 (1.35)	7.872 (1,261)**
Benefits	4.14 (1.39)	3.46 (1.16)	18.785 (1,261)***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Media Report Items	Group A: Reports Alarming	Group B	Univariate F (df)
Reports were reassuring	6.42 (1.38)	5.24 (1.57)	39.657 (1,250)***
Reports were informative	4.26 (2.22)	3.88 (1.77)	2.319 (1,250)
A good example of "media hype"	3.95 (2.31)	3.33 (1.79)	5.715 (1,250)*
Reports presented a balanced picture	5.02 (1.87)	4.79 (1.58)	1.053 (1,250)
More to do with trust in regulators and less about risk	3.11 (2.11)	3.07 (1.52)	0.028 (1,250)
More to do with trust in science and less about risk	3.05 (2.07)	3.23 (1.69)	0.553 (1,250)
Public should be more involved in decisions about GM foods	1.11 (0.66)	1.84 (1.30)	29.904 (1,250)***

Table VI. Mean (and Standard Deviation) Ratings of Attitude to the Media Reports for Participants Allocated to Groups A and B

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

associated with higher perceived risk, decreased trust in regulation and perceived choice over consumption, and fewer benefits associated with genetically modified foods (relative to those participants who had not judged reports to be negative).

3.4. The Effect of Demographic Characteristics on Attitude Toward Genetically Modified Foods

The effect of demographic characteristics on attitudes to genetically modified foods across the three time periods was also examined. Separate MANOVAs were conducted for gender, age group (three groups were determined by a tertile split, with approximately one-third of the participants in each of the groups), social class, and education level (two groups were determined by a median split). The original analysis included time as a factor for these MANOVAs, but there were no interaction effects so this independent variable was dropped from the analyses.

3.4.1. Gender

Differences in attitude were associated with gender (Pillai's Trace $F(3,907) = 15.503$, $p < 0.001$). Univariate tests were significant for "Risks and Negative Effects" and "Benefits" (Table VII). The data indicated that women perceived greater "Risks and Negative Effects" and fewer "Benefits" associated with genetically modified foods compared to men.

3.4.2. Age Group

Differences in attitude between the three age groups were also observed (Pillai's Trace $F(6,1814) = 11.039$, $p < 0.001$). All three univariate tests were significant (Table VIII). *Post hoc* analysis indicated that participants in the oldest age group (51+ years) perceived more "Risks and Negative Effects" to be associated with genetically modified foods than those in the other two age groups; participants in the middle age group (34–50 years) perceived more "Risks and Negative Effects" than those in the youngest age group. The oldest age group perceived the fewest benefits. The youngest age group was the most trusting of regulators and perceived the most choice associated with the consumption of genetically modified foods.

3.4.3. Social Class

Differences in attitude were also observed for people of different social classes (Pillai's Trace $F(9,2127) = 5.650$, $p < 0.001$). All three univariate tests were significant (Table IX). *Post hoc* analysis indicated that participants in social classes A/B perceived fewer "Risks and Negative Effects" and greater "Benefits" to be associated with genetically modified foods than those in the less affluent social class C1. However, trust in regulators and perceptions of choice over consumption of genetically modified foods tended to increase with decreased affluence.

Table VII. Mean (and Standard Deviation) Ratings of Agreement by Gender

Attitude Subscale	Men	Women	F (df)
Risks and Negative Effects	3.04 (1.24)	2.58 (1.12)	34.456 (1,909)***
Trust and Choice	4.57 (1.40)	4.57 (1.40)	.004 (1,909)
Benefits	3.30 (1.24)	3.63 (1.28)	15.275 (1,909)***

***$p < 0.001$.

Attitude Subscale	18–33 Years	34–50 Years	51+ Years	F (df)
Risks and Negative Effects	3.15 (1.21)[a]	2.75 (1.15)[a]	2.49 (1.16)[a]	24.224 (2,908)***
Trust and Choice	4.29 (1.24)[ab]	4.77 (1.34)[a]	4.67 (1.57)[b]	10.274 (2,908)***
Benefits	3.23 (1.18)[a]	3.46 (1.22)[b]	3.74 (1.37)[ab]	12.345 (2,908)***

Table VIII. Mean (and Standard Deviation) Ratings of Agreement by Age Group

*** $p < 0.001$. Means associated with the same letter are significantly different at the $p < 0.05$ level (Tukey HSD) for that dependent variable.

3.4.4. Education Level

Finally, the effect of education level on the three attitude scales was analyzed and found to be significant (Pillai's Trace $F(3,886) = 23.430$, $p < 0.001$). All three univariate tests were significant (Table X). The data indicated that higher perceived risk was associated with lower levels of education. These participants also perceived fewer benefits to be associated with genetically modified foods, but trusted regulators and perceived that they had more choice over their consumption in comparison to those who had achieved higher levels of education.

4. DISCUSSION

The results presented here provide support for the notion that sudden changes in the volume and content of risk reporting about a particular hazard potentially produce attitude changes consistent with what might be expected within the context of the social amplification of risk framework. Specifically, the analysis showed that perceptions of risk (and other negative potential consequences) associated with genetically modified food increased during the highest levels of reporting about genetically modified foods, but were subsequently reduced as reporting levels diminished. This was initially accompanied by decreased perceptions of benefit associated with genetically modified foods. Unlike perceptions of risk, perceptions of benefit remained depressed a year after the volume of reporting had declined. This was possibly because the media debate provided the public with information about what benefits associated with genetically modified foods were currently available; at the time of reporting, these were primarily associated with industrial or producer profitability, rather than specifically focused on advantages to consumers. There is evidence that technology acceptance (at least for food products) is driven by perceptions that benefits of applying the technology will accrue to consumers, as opposed to industry.[18,19]

Another interesting observation relates to the finding that trust (in regulators) was unaffected by media reporting of the risks of genetically modified foods. It has often been assumed that people's reactions to a hazard will depend on their level of trust in the institution or bodies with a remit to regulate the risks in order to protect the public.[20,21] However, it has been reported that trust and perceived risk appear to independently influence people's more general attitudes toward a particular hazard.[22] Thus, amplification of risk may occur independently of any impact made by the same social or cultural events on trust in regulatory institutions, an observation supported by the results of the current research. This might imply that these same attitudes (for example, the value systems that determine technology acceptance) might be influenced by trust independent of risk perceptions; this possibility merits investigation in future research. An alternative explanation is that trust in institutions was so low before the "scare" that it could decline no further; in other words, a "floor effect" occurred. It should be noted that trust in science,

Attitude Subscale	A/B	C1	C2	D/E	F (df)
Risks and Negative Effects	2.92 (1.22)[a]	2.63 (1.15)[a]	2.90 (1.28)	2.68 (1.18)	3.016 (3,709)*
Trust and Choice	4.88 (1.28)[a]	4.73 (1.41)[b]	4.46 (1.50)[a]	4.26 (1.49)[ab]	6.890 (3,709)***
Benefits	3.26 (1.22)[a]	3.70 (1.17)[a]	3.49 (1.32)	3.48 (1.34)	4.542 (3,709)**

Table IX. Mean (and Standard Deviation) Ratings of Agreement by Social Class

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Means associated with the same letter are significantly different at the $p < 0.05$ level (Tukey) for that dependent variable.

Table X. Mean (and Standard Deviation) Ratings of Agreement by Education Level

Attitude Subscale	0–6 Years	7+ Years	F (df)
Risks and Negative Effects	2.64 (1.17)	2.98 (1.21)	17.682 (1,888)***
Trust and Choice	4.40 (1.44)	4.74 (1.31)	13.496 (1,888)***
Benefits	3.68 (1.33)	3.28 (1.16)	22.990 (1,888)***

*** $p < 0.001$.

scientific institutions, and regulatory bodies has been declining since the 1950s.[23] Trust in food risk regulators has been particularly compromised.[24,25] The focus of trust in this study was on "trust in the regulators"; further research could usefully examine different "types" of trust, or trust in different information sources.

The demographic differences associated with risk perception are consistent with previous research and do not appear to be differentially influenced by media reporting.[26–28] To summarize, the results indicated that the women sampled perceived greater risks and negative effects, and fewer benefits, associated with genetically modified foods than the men. Those participants in the oldest age group perceived greater risks and negative effects associated with genetically modified foods than those in the other two age groups; they also perceived fewer benefits. Participants in the youngest age group perceived the least risks and negative effects and they were the most trusting of regulators and perceived the most choice associated with the consumption of genetically modified foods. Participants who had less education perceived greater risks and negative effects, and fewer benefits, associated with genetically modified food than those who had more education. These participants also trusted regulators and perceived that they had more choice over their consumption of genetically modified foods in comparison to those with more education. Finally, participants in social classes A and B perceived fewer risks and negative effects, and greater benefits, associated with genetically modified foods than those in social class C1. Participants in social classes D/E and C1 tended to be more trusting of regulators and perceived greater choice over their consumption of genetically modified foods.

These demographic differences may reflect different levels of perceived social inclusion in risk management decision making, implying that greater public participation in risk management should be an important part of the regulatory process.[29–31] Related to this are the differences in levels of trust exhibited by participants in different social classes. It was found that people in the lower social classes were most trusting of risk regulators with regard to genetically modified food. This may be because people in lower social classes are more socially excluded and therefore need to depend on institutions (such as risk regulators) more than those groups who feel they have a more active role in protecting themselves.[32] In addition, the research presented here indicates that those most prone to perceive media reports as accurate but alarming also express a preference for increased public participation in risk management processes associated with genetically modified foods. The evidence that public involvement in the institutional frameworks that drive technological development is seen as a positive development by the public increases pressure on institutions to engage in public consultation practices that have an impact on policy formulation and risk management. This is discussed extensively elsewhere.[33] What is of interest is the lack of difference in the extent of the amplification and attenuation over time between demographic groups. For example, increased perceptions of risk in the spring of 1999 were exhibited by the whole population and were not differentially influenced by demographic factors. The idea that increased concern might lead to filtration of news items or other information in order to selectively focus on negative, risk-oriented information that then reinforces the high levels of risk perception already held cannot be dismissed.[34] Participants who perceived that risk reports were more alarming (Group A) exhibited greater increases in risk perceptions at Time 2 compared to those who were less alarmed by the reports (Group B). This might be because those participants who rated the reports as most alarming were selecting and attending to alarming risk information, which acted to amplify their risk perceptions associated with genetically modified foods and increased their beliefs that the reports were alarming. Alternatively, of course, those participants most prone to influence by media reporting of risk might be most likely to rate newspaper reports about a particular hazard as "alarming" to provide consistency between the nature of reporting and changes in their own risk perceptions.

In general, the means by which new information about potential hazards influences attitudes (and, indeed, the correspondence between attitudes and behaviors) is not perfectly understood. Chaiken and Eagly[35] have postulated that differences in the stability of attitudes based on current level of knowledge

are important. That is, the less information possessed by an individual, the greater the change induced by new information. This would suggest that such individuals would be more prone to influence through amplification or attenuation. One might expect the effects of risk amplification to be greater for a relatively novel hazard not yet presented to the public in a crisis context (e.g., genetically modified foods) compared to a more established hazard (e.g., nuclear energy) where people have been exposed to high levels of public debate in the past. This might explain why increases in the volume of media reporting sometimes produce amplification effects and sometimes do not. For example, the effects of Swedish media reporting of the risk of nuclear energy on the 10th anniversary of the Chernobyl accident did not result in amplification of the risks of nuclear energy within the Swedish population (who were initially badly affected by the accident in 1986) because people had been inundated with risk information following the original accident.[36] In contrast, risk amplification following a high volume of reporting of the risks of genetically modified foods (and BSE in 1996) in the United Kingdom may have been less a result of the reporting *per se*, and more directly attributable to attitude changes induced by new information reported in the press. By implication, therefore, risk amplification is less likely to occur under circumstances where people already have firmly held views. A proactive risk communication strategy is likely to provide people with the opportunity to formulate an informed view about the risk, which is less likely to be influenced by risk information presented in a "crisis" context.

In conclusion, the empirical evidence presented here demonstrates that it is possible to utilize real-world events in order to examine parts of the social amplification of risk framework. It should be noted that the media, in isolation, is unlikely to account for amplification processes described within the social amplification of risk framework. There are other elements to the framework in addition to the potential impact of the media, and an examination of how the media and these other elements act and interact within the framework would be a very useful addition to the literature. It is arguable that whether amplification occurs is dependent on other characteristics of a potential hazard (for example, high levels of previous knowledge held by the public about the associated risks may mitigate against amplification occurring). In addition, the impact on behavior will depend on other perceived characteristics (for example, perceived benefit associated with a potential hazard, trust in regulatory institutions). However, the social amplification of risk framework is useful for beginning to understand the potential impact on risk perceptions of a risk event, particularly if the risk event that is the focus of risk amplification is presented to the public as a new hazard occurring in a crisis context.

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