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"Americans' Potential Responses to Deliberate Food Contamination: A Risk Perception and Communication Study"

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Abstract

This study examines public perceptions of, and likely reactions to, an act of bioterrorism targeting the US food supply. Results from factor analysis of survey data suggest a range of responses including; public panic, raised fears or emotions, a controlled response or a an acceptance that such an event is inevitable. Reactions are reflective of peoples' cognitive interpretations or affective responses to the risks posed. Cluster analysis and regression results suggest that authorities may successfully position risk communication messages based on the condition that people believe the government and private institutions can function in the face of a food attack. This finding underscores the pivotal role played by trust and confidence in institutions in restoring calm after a bioterrorist event. Fine tuning of communications for different population groups may be necessary if certain Americans' perceive the risk of a bioterrorist event in a less rational manner.

Keywords: Bioterrorism; Risk perceptions; Response to bioterrorism; Factor analysis

Introduction

To date government and industry have committed substantial resources toward developing preparedness measures targeting prevention, response and recovery from possible terrorist attacks including attacks on the food supply. While such efforts are commendable there is a dearth of research about how consumers may react to potential food contamination attacks [1]. Information on how different people react to potential bioterrorism will provide the necessary input to help classify audiences and tailor risk communication messages before, during and after such events. This study attempts to fill this apparent gap in the bioterrorism literature, contributing toward food defense.

While considerable knowledge about public risk perceptions, likely response, and effective communications about terrorism and other hazards in general now exist, little is known about how people may react to potential deliberate attacks on the food supply. On one hand it may be reasonable to extrapolate from responses to unintentional contamination. However, given the novelty of these risks and related uncertainty (in particular regarding speed of response and scale of threat) such parallels may be tenuous. This study examines Americans' perceptions of, and likely reactions to, acts of bioterrorism (i.e., attacks targeting the food supply). Using survey data, the paper specifically attempts to unveil behavioral reactions to a range of food contamination hazards. The specific objectives of this study are: (i) to identify and estimate the importance of the various dimensions characterizing public reactions to deliberate food contamination; (ii) to identify distinct consumer profiles based on their reactions to potential deliberate food contamination; and (iii) analyze how consumers' socioeconomic and value characteristics are related to the principal factors associated with risk perceptions and likely response to deliberate food contamination.

Although bioterrorism may seem unlikely, [2] provides compelling reasons why a terrorist might target the food supply. Contaminating the food supply does not require as much technical skill and organization as does weaponizing anthrax or some other biological hazard. Opportunities for access to the food supply stretch from farms and feedlots to restaurants and cafeterias. Terrorists could potentially introduce an agent at many points along the harvesting, packing, shipping, delivery, or preparation points of the food supply chain. Food may also be a vulnerable target since it may not be easy to differentiate intentional and unintentional attacks; it takes time to investigate and identify the threat. By that time the culprit could have caused damage and be long gone.

Deliberate attacks on the food supply have occurred in the past; however, such attacks never featured in the minds of most Americans prior to September 11th, 2001. Previous attacks for example, include the notorious 1980 Salmonella contamination of salad bars in Oregon by the Rajneeshee Cult [3]. Unequivocally, deliberate contamination of the food supply could have devastating public health and economic impacts extending across international borders. The fearful public reaction to BSE or "mad cow disease," resulted in the refusal of Europe and Japan to import United States beef and demonstrates how quickly a domestic food-related health issue can become a global economic concern. Despite many experts placing lower probabilities on terrorist attacks targeting the food supply, such attacks remain a real threat with unique challenges (The U.S Department of Health and Human Services, 2005). The challenges posed necessitate increased infrastructure, food inspection, disease surveillance, laboratory capacity, and awareness among health professionals and the general public.

This study contributes to the bioterrorism discourse by providing information on consumer reactions to deliberate food contamination

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events. Knowing what consumers are thinking is useful to agribusiness and the food industry but will also inform public policy in terms of risk communication design and dissemination [4]. Holloway et al. demonstrated the need for government and private agencies to incorporate social and behavioral dimensions in bioterrorism planning. Information generated by this study will provide a basis for understanding and anticipating such public responses to hazards and help improve risk communication among lay people, technical experts, and decision-makers.

Literature review: Terrorism, rare events and public responses

The literature review focuses on acts of terrorism including attacks on food, rare events such as earthquakes and public responses to such events. Terrorism may be defined as acts orchestrated by an intelligent and motivated individual to harm defenseless people economically and psychologically. Although characterized by low probabilities and high consequences, the potential for bioterrorism to be an extreme event is fostered by the fear it can generate. Other extreme events include natural catastrophes such as floods, earthquakes or storms. Others may follow technological failure or unintentional human error, such as the Chernobyl or Bhopal tragedies, this category may be predictable but rare [5].

Studies in the social science domain have demonstrated that risk perceptions to rare events including terrorism acts are not objective judgments of danger. Perceptions of risk may vary by situation and over individual characteristics. Risk perceptions are a consequence of a projection of value, representations and meaning of certain events, practices and objects in any similar circumstance [6]. People have broad and complex conception of risk which incorporates factors such as "uncertainty, dread, catastrophic potential, controllability, equity, risk to future generations and unknown risk" [7,8]. Each of these factors can be influenced by the individual's access to information and will dictate the nature of reaction to specific risk. Psychologists and others working in the field have well demonstrated that consumers willingly accept high levels of risk voluntarily, but are unwilling to be subjected to risk or uncertainty that is involuntary [9,10]. Consumers must eat to live; ultimately an involuntary but familiar act. Death or severe illness caused by eating deliberately contaminated food is an involuntary risk, and therefore more troubling than a risk taken voluntarily such as smoking or air travel. Studies on social amplification of risk by Kasperson, et al. [11] indicate that it is not necessarily the objective valuation of the risk that comes into play in risk perceptions, but rather the subjective valuations that give rise to either an amplified or attenuated risk situation. This can happen for relatively minor risks or events, and often elicit strong public concerns and result in substantial impacts upon society and the economy.

According to prospect theory, rare events such as terrorism tend to be heavily weighted relative to events occurring more often [12]. A possible response to heavily weighted rare events (e.g., bioterrorism) is to brace for the worst, where respondents become overly pessimistic. Alternatively, rare events may elicit an optimistic response. The responses are highly influenced by people's predictions about how the future events influence their thoughts, feelings, and therefore actions in preparation for and response to possible outcomes [13]. A study by [14] finds that associations with past risks have strong correlations on future unknown risk perceptions. Associations, including emotions, often serve as an "early-warning" system. For example, associations with past known risks enabled human beings to survive the evolutionary period and have remained the most natural and common way to respond to threats, even in the modern world [15].

While this may be true, one's experience with past events may not necessary signal how best one will cope in face of a new risk. It is possible that experience with previous events may give rise to an unexpected irrational response in the future [16]. Assally's study correlates past experiences with behavioral response to natural catastrophes. The study shows that if anything, past experience may be counterproductive, as people behave as if the subsequent event is bigger than the previous one, and may act irrationally and lose self-control. That is, the experience of an extreme situation is not a guarantee of subsequent adapted responses.

Elsewhere, it has been shown that the threat magnitude determines individual resource allocation toward a defense mechanism [17,18]. Lazarus & Folkman show that as long as a person's psychological well being is not threatened, no resources are allocated towards any form of defense. Requisite responses and resource allocation will be based on an event being appraised as harmful, beneficial, threatening or challenging. It is the psychological evaluation that triggers a response to confront the danger based on the personal resources on hand [19]. Moreover, [20] Lazarus and Launier show that the coping mechanism could be either active or passive.

Findings from risk perception studies using demographics as explanatory variables show that risks tend to be judged lower by men than by women and by Caucasians than by people of other ethnicities [21]. This finding is supported by [22] Lagattuta with findings that females of all ages tend to worry more than males. Women also tend to perceive more risk in situations and grow more anxious than men. In addition the study finds that women are more likely than men to believe that past experiences accurately forecast the future. Other studies have shown that young females use emotion-based strategies more than males to respond to stress. Males depict higher levels of disengagement responses. Such strategies include; acceptance, positive thinking, and emotional expression. Rumination as stress response decreases with age, whereas intrusive thoughts were more prevalent in the older groups [23].

Methods

The Food Policy Institute, Rutgers University designed and implemented a survey instrument to collect data on public attitudes towards bioterrorism. The survey was conducted between October and November of 2004, using telephone interviews. The interviews were completed using computer assisted-telephone interview technology (CATI). Non-institutionalized adult American respondents were selected from the 50 states, using random digit dialing, and proportionally selecting for gender. U.S. Census Bureau population estimates were used to verify the approximate distribution for proportionate national coverage. Although many of the numbers dialed were excluded, 60.1% of working residential numbers yielded completed interviews. A total of 1,010 interviews were completed (sampling error ±3.1%), with the interviews taking approximately 23 minutes to complete.

The survey collected respondents' knowledge and perceptions of the effect of four different food bio-agents (anthrax, botulism, cyanide, and salmonella), the purpose was to determine if public responses differed depending on the nature of the agent. Respondents were randomly assigned into one of the four aforementioned contaminant groups and

were told based on this assignment that their selected food product had been contaminated with anthrax, botulism, cyanide, or salmonella. By asking individuals for their most favored food product rather than simply offering an arbitrary product such as water, milk, bread, etc., we are able to generalize their reactions to food contamination. Respondents were told that terrorists had contaminated the food supply - specifically the food item that the respondents offered earlier in the survey as their most frequently purchased food using one of our four contaminants. Early analyses based on this data showed no significant difference in risk perceptions across various the contaminants [24].

Another section of the survey was devoted to gathering demographic, economic and value characteristics information on the respondents, including age, gender, ethnicity, education, income, family size, employment status, religious practice and social/political views. The survey also collected information on respondents' knowledge about the food supply chain (i.e., the farm to folk continuum), general food safety knowledge and respondents confidence/trust in the food supply and the ability of the federal government to ensure food safety. Also collected was respondents' knowledge pertaining to the food chain continuum (starting from food production at the farm, manufacturing, processing, transportation to the food outlets-groceries), food safety and respondents confidence in the groceries and federal government to ensure safety of foods eaten in case of a contamination

This study's analysis is based on responses to 15 questions relating to Americans' reactions to a potential intentional food contamination event from the survey described above. Respondents were asked to state whether they were in agreement or disagreement to a number of statements about food contamination. For purposes of this analysis, the responses were recorded using a metric a scale ranging from 1 through 4 with 1=strongly disagree, 2 =somewhat disagree, 3= somewhat agree and 4 =strongly agree. Other possible responses were "don't know" and "refused" which were excluded from the analysis. Principal Component Analysis (PCA) approach is based on eliciting attitudes toward some stimuli, in this case food contamination, to reduce the constructs represented by these opinions to a manageable number of interpretable dimensions. A natural progression of PCA is to then associate particular demographic variables with the resulting factors. The analysis (PCA) was used to reduce the 15 questions to a smaller set of dimensions (factors). In this analysis we used a Varimax rotation to obtain factor loadings that represent both how the variables are weighted for each factor and the correlation between the variables and the factor.

A standard latent root equal to one and a screen test were used to establish the number of factors to retain, followed by a confirmatory analysis to ensure internal reliability of the factors. Finally, a regression analysis was applied to the standardized factor scores obtained from principal component analysis to explore the relationship between the identified dimensions and the socioeconomic attributes of consumers.

Empirical Results

Dimensions of Americans' potential responses to deliberate food contamination

Table 1 presents the mean, standard deviation and factor loadings on deliberate food contamination. The factors are ranked in order of the proportion of variance explained and labeled to reflect the latent stimuli underlying reactions. Virtually all the estimated means were above the average (>2) they ranged from 2.43 to 3.71 suggesting that the variables were appropriately used and were relevant in defining the latent dimensions of the food contamination issues. The analysis identified four factors relating the Americans' reactions. Together, the factors accounted for 57 percent of the variance as summarized below.

Factor 1 Panic/Fatalistic: This is the major factor representing people's reactions accounting for approximately 20 percent of the variance. The dimension reflects a feeling of hopelessness leaving Americans' with little or no option to avoid the threat. This may result from people sensing high levels of risk culminating into a panicked reaction. The factor loadings on the variables are all high with coefficients (>.6), indicating strong relationships between the variables and the latent dimension. Although the dimension was responsible for a large proportion of the variance, there was no consensus on certain of the individual variables with individual variable standard deviations (>1.0). For example, there was divergence of opinion as to whether deliberate food contamination threatens future generations, or if an individual eats contaminated food s/he will die at once. The only area where there was general agreement was the view that deliberate food contamination can kill many people at once.

Factor 2 Fearful/Emotional: This is the second most important factor accounting for 16 percent of the variance. This factor captures important emotional reactions to extreme and rare events such as a deliberate food contamination. In such an event people may respond by feeling angry, sad, worried and often frightened. The mean scores of the variables in this factor are all (> 3) with a tight standard deviation of (<1) implying greater agreement by respondents in their reaction to a deliberate food contamination event.

Factor 3 Optimistic/Controlled: Although explaining about twelve percent of the variance, the importance of this dimension stems from the fact that people seem able to control bad situations (i.e., a terrorist attack on the food supply). This may be interpreted as a positive, rational reaction that may suggest that effects of the risk of food contamination can be reduced and the widespread damage arising from contamination controlled. Unlike in factor 1 where the people's reaction/response was characterized by a sense of hopelessness and defeatism, this dimension may suggest public confidence and trust in its institutions to quickly respond and put in place remedial measures to restore regularity in the food supply thereby ensuring safety. It is important to note that of the four factors, this is the exception where respondents were in consensus across all the variables (standard deviation less than 1.0). Wide spread deliberate food contamination events can be controlled; the risk of buying contaminated can be reduced and consumers felt there are things they can do to prevent death during a deliberate food contamination event.

The fact that all variables in this dimension loaded highly with means above the above the average (>3) underscores the pivotal nature that this dimension occupies among the four factors. The factor may as a result suggest that Americans' trust the food supply system (technology, surveillance, etc.) to minimize effects of widespread contamination.

Factor 4 Accepting: This factor embraces public perceptions that terrorist attacks targeting food may be inevitable. There is consensus among the respondents that an intentional attack against the US food supply is a new type of risk. However, opinions are still divided as to whether deliberate attacks on food are likely to rise. Similarly, there is less agreement as to whether people will respond calmly if a food contamination event occurs. In terms of overall reactions to deliberate food contamination (mean scores less than 3 for two of the variables)

this factor accounts for about eight percent of the error variance. The dimension may suggest similar risk communication recommendations as factor three, in the sense that messages may be received with limited skepticism given Americans' beliefs that bioterrorism is a new reality to contend with.

Explaining reactions to deliberate food contamination

Table 2 presents descriptions and summary statistics for the socio-economic variables used in the regression analysis. The regression analysis identifies and estimates the relationships between the respondents' reactions to an act of deliberate food contamination and these variables. In addition to profiling the respondents, in terms of their reactions to deliberate food contamination, the regression results may assist policy makers and the food industry in developing targeted risk communication strategies and a general education campaign about deliberate food contamination. The dependent variables in the regression analysis are the standardized factor scores that were obtained from the PCA. It may be observed from the regression results (Table 3) that the adjusted R2 ranged between 0.04 and 0.10, with F-statistics of model performance being significant across all

	Mean	SD	Factor 1	Factor 2	Factor 3	Factor 4	Total
Factor 1: Panic/Fatalistic response to food contamination : (Strongly Disagree=1, somewhat Disagree=2, Somewhat Agree=3 Strongly agree=4)							
I will certainly die if I get sickened by contaminated food	2.55	1.06	0.816				
Consuming contaminated food will kill me immediately	2.47	1.14	0.793				
USA food supply contamination may cause global catastrophe	2.70	1.16	0.696				
Deliberate food contamination threatens future generations	2.85	1.13	0.643				
Deliberate food contamination can kill many people at once	3.24	0.93	0.641				
Factor 2: Fearful response to food contamination : (Strongly Disagree=1, somewhat Disagree=2, Somewhat Agree=3 Strongly agree=4)							
Deliberate food contamination frightening	3.49	0.85		0.832			
Deliberate food contamination worrying	3.55	0.81		0.817			
Deliberate food contamination angering	3.71	0.71		0.622			
Deliberate food contamination saddening	3.15	1.09		0.574			
Factor 3:Controlled response to food contamination :(Strongly Disagree=1, somewhat Disagree=2, Somewhat Agree=3 Strongly agree=4)							
Widespread damage from food contamination is controllable	3.08	0.93			0.791		
Risk of buying contaminated food can easily be reduced	3.06	0.93			0.729		
There are things I can do to prevent death in a food contamination event	3.25	0.96			0.557		
Factor 4:Sobering reaction to food contamination : (Strongly Disagree=1, somewhat Disagree=2, Somewhat Agree=3 Strongly agree=4)							
Food contamination risk is increasing	2.44	1.02				0.680	
I can think calmly about food terrorism	2.98	1.05				0.530	
food contamination new type of risk	3.13	0.99				0.482	Total
Percent of total Variance explained			20.26	16.20	11.52	8.49	56.48

Table 1: Varimax Rotated Factor Loadings on Americans Responses/Reactions to Deliberate Food Contamination

	Variable Description	Mean	Std.Dev.
FEMALE	1 = respondent is female; 0 = male	0.54	0.50
KNOW_FCN	1 = one has above average knowledge about the food supply chain; 0 otherwise	0.22	0.42
KNOW_SAF	1 = one has above average knowledge about the food safety; 0 otherwise	0.19	0.40
GRC_SAF	1 = holds view that food in the grocery store is safe; 0 = otherwise	0.53	0.50
DEL_TAMP	1 = holds view that food in the grocery store is unsafe due to deliberate tampering; 0 = otherwise	0.81	0.39
ACC_TAMP	1 = holds view that food in the grocery store is unsafe due to accidental errors; 0 = otherwise	0.63	0.48
CONF_GRC	1 = holds skeptic view about Grocery ability to ensure food safety; 0 = otherwise	0.16	0.37
CONF_GOV	1 = holds skeptic view about Government ability to ensure food safety; 0 = otherwise	0.23	0.42
YOUNG	1= age less han 25 years; 0 = otherwise	0.27	0.44
MIDAGE	1 = age is between 25 and 54 years; 0 = otherwise	0.44	0.50
SENAGE	1 = age 55 and 64 years; 0 = otherwise	0.15	0.36
CHILD	1=if respondent has children under 18 years of age;0=otherwise	0.40	0.49
RELIG	1 = attends church (or other house of worship) at least once a week, several times a month or once a month; 0 = otherwise	0.61	0.49
LIBERAL	1 = identifies himself/herself as liberal; 0 = otherwise	0.19	0.39
CONSERV	1 = identifies himself/herself as conservative; 0 = otherwise	0.30	0.46
CENTRIST	1 = identifies him/herself in between; 0 = otherwise	0.51	0.50
WHITE	1 = respondent is white (Caucasian); 0 otherwise	0.81	0.39
INCO_AB5	1 = (annual) income below $35,000; 0 = otherwise	0.50	0.50
INCLT35	1 = (annual) income between $35,000 and $50,000; 0 = otherwise	0.31	0.46
INCOM35_	1 = (annual) income between $50,000 and $75,000; 0 = otherwise	0.37	0.48
INCOM_A7	1 = (annual) income greater than $75,000; 0 = otherwise	0.28	0.45
MIDWEST	1 = respondent resides in Midwest; 0 = otherwise	0.24	0.43
SOUTH	1 = respondent resides in southern U.S.; 0 = otherwise	0.36	0.48
NOR_EAST	1 = respondent resides in Northeastern U.S.; 0 = otherwise	0.18	0.39
WEST	1 = respondent resides in western states.; 0 = otherwise	0.21	0.41
LTHISCOO	1 = Below High school education; 0 = otherwise	0.35	0.48
COLLGD_A	1 = some two year college education to four-year college education; 0 otherwise	0.39	0.49
GRAD	1 = graduate education; 0 = otherwise		

Table 2: Descriptive Statistics.

	Response Dimensions to Deliberate Food Contamination			
Variable Description	**FATALISTIC/PANIC**	**FRIGHTHENED**	**CONTROLLED**	**ACCEPTING**
Constant	-0.4090	-0.1186	0.1417	0.0330
	(-6.76)	(-1.94)	(2.36)	(0.54)
Female (Vs. Male)	0.2021*	0.3854*	-0.1638*	-
	(2.80)	(5.30)	(-2.29)	-
Young 18-34 (Vs. Mature age >55 years)	-	-	-	-0.1035*
	-	-	-	(-2.33)
Midage 35-54 years (Vs. Mature age >55 years)	-	-	-	0.1028*
	-	-	-	(2.32)
College Degree and above (vs. Two-year college education and below)	-	-	-0.0026*	-
	-	-	(-2.34)	-
Low income-<$35,000 (vs. High income->$75,000)	0.4405*	-	-0.1547**	0.189*
	(5.45)	-	(-1.93)	(2.18)
Medium income-$35-$75,000 (vs. High income->$75,000)	-	-		-
	-	-		-
Child (vs no child)	-	-	0.0007**	-
	-	-	(1.56)	-
White	-	-	-	0.0005**
	-	-	-	(1.66)
Liberal (vs. centrist)	-0.1302*	-	-	-
	(-2.46)	-	-	-
Conservative (vs. centrist)	0.1298*	-	-	-
	(2.45)	-	-	-
Religious (vs. not religious)	0.0006**	-		
	(1.62)	-	-	-
Knowledge of the food supply Chain (vs.s not)	-	-	-	0.0016*
	-		-	(2.56)
Knowledge about Food Safety	-	-	-	-
	-	-	-	-
Frequency of Deliberate food tampering	-	-		-
	-	-		-
Frequency of Accidental food tampering	-	-		-0.0006**
	-	-		(-1.72)
SAFE_GROCERY	-	0.0007**		
	-	(1.46)		
Confidence in Grocery	-	-		-0.0016*
	-	-		(-2.97)
Confidence in Federal Government	-0.0016*	-	-	
	(-2.09)	-	-	
MIDWEST	-0.1282*	-	-	-
	(-2.17)	-	-	-
SOUTH	0.1010**	-	-	-
	(1.87)	-	-	-
NOR_EAST				-0.0987**
				(-1.53)
Adjusted R^2	0.09	0.06	0.04	0.06
Model F-statistics	3.2	1.96	1.33	2.04

Note: Figures in Paren heses denote the t-ratios. Single asterisk denotes variable is significant at .05 level and double asterisk denotes variable is significant at .10. The variable categories in parenthesis are excluded to avoid dummy variable trap.

Table 3: Regression Results on Dimensions of Americans Responses/Reactions to Deliberate Food Contamination

models. Results describing statistically significant factors influencing the four dimensions of Americans' reactions to acts of deliberate food contamination are summarized below.

Based on the factor analysis the panic/fatalistic reaction emerged as the main concern. An individual's gender, income, religion, and region had a positive and significant effect on this reaction at a five percent or better level. Also significant at a five percent level were party affiliations though with opposite effects. While a conservative party affiliation had a positive effect, being liberal had a negative effect on a panic response to a deliberate food contamination event. The results suggest that women, those with low incomes (<$35,000), those self-reporting to be religious[1], conservatives and those from the South are more likely to exhibit panic about a bioterrorist food contamination attack. On the other hand liberals, those having confidence in federal government to ensure food safety, and those from the Midwest will not panic as

much about such events. Literature on extreme risk events suggest that it may be difficulty to soothe or calm down panicked people when a catastrophe strikes. People are unreasonable and will be unlikely to believe any message from any authority. Any communication efforts should address women, the religious, those with low income and people from the South. These results may also imply that trust is a key issue in communication in addition to how the federal government (the food regulatory agencies) is viewed in terms of safeguarding the food supply. Having children less than 18 years of age, education, age, ethnicity, food safety knowledge, and overall perceptions of food safety did not have any effect on the panic reaction to deliberate food contamination.

Although the frightened factor was the second most important dimension, almost all explanatory variables turned out to be statistically insignificant, the only exception being gender. Results suggest that females are more likely to be frightened by such an event compared to males. If such an event occurs, females will show such emotional responses as worry, sadness and anger. This result confirms a recent study by [22] Lagattuta which shows that females of all ages tend to worry more and have more intense worries than males. Women also tend to perceive more risk in situations and grow more anxious over time.

While the first two dimensions may imply that the level of risk is above average thus eliciting panicky and frightened responses that are pessimistic, the controlled and accepting reactions to a bioterrorist event may suggest a below average risk perception and a more optimistic response. In this respect people may feel that they are in control and not all has been lost as there is something that one can do to mitigate or address the risk. The results suggest that males will react with a greater sense of control. Also those with a higher income approach such events with sobriety. However, in terms of education, the results seem counterintuitive as those with college degree will act uncontrollably. Similarly, another anomalous result relates to individuals with children (less than 18 years of age). who respond with control in an event of deliberate food contamination.

Age, race, income, having children, knowledge of the food supply, confidence in the safety of the food supply and region had an effect on the accepting dimension and were statistically significant at 10 and 5% level. Mature people (>55 years of age) and Caucasians were accepting that deliberate food contamination is a new source or type of terrorism. Similarly, people who claim to have a better knowledge about the food chain and those from the West accepted such risk compared to those with no food supply chain knowledge or those from the North East. However, an unexpected result suggested that people with confidence in current levels of food safety were not accepting that such risk could emerge. The results suggest that in targeting risk communication if such event actually occurs, it may be appropriate to target young people (<35 years), people from other ethnicities, and those with limited knowledge about the food supply chain.

Discussion, limitations and future research

Based on the factors describing people's reactions to deliberate food contamination one may draw certain inferences about how risk should be communicated. If the target audience is comprised of the paniced group it would be very difficult for any authority (e.g., government, industry) to effectively convey a message intended to calm the situation or restore order after a bioterrorist event. Some studies have suggested that when people are paniced, it may be very difficult for the authorities to restore calm, as the population remains skeptical of any well-intended measures to restore normality. This may suggest that the population has lost hope in the ability of institutions to safeguard their interests. This is likely to be heightened when people feel that the risk has been involuntarily imposed, for example by a deliberate food tampering event. Possible reactions include being unreasonable and skeptical to messages from authorities attempting to calm the situation [7,25]. As authorities seek to reassure the public, they will be dealing with people who are irrational and skeptical of any information; hence a failure of the post-event communication strategy. A solution might include preparatory trust-building communications in an effort to assuage the public.

The controlled response and accepting dimensions present an opportunity upon which to anchor risk communication messages. Authorities can more easily pass on messages as these Americans' believe that their system can work in the face of such adversities. The role of trust and confidence in institutions is key in restoring order and calm after a bioterrorist event. Additionally, results suggest that females need to be approached differently as they are by far more susceptible to worry and may consequently be less amenable to act rationally in such an event.

Certain limitations of these findings should be noted. We agree that any survey bias might influence the reality of our results. In particular, given the low probability, high consequence, and low familiarity of intentional food contamination events actual responses to an event may be markedly different. Media coverage of a bioterrorism act would likely be considerable and the risks may be quickly amplified. Americans' can only speculate about such a hypothetical situation at this stage. Additional research exploring specific reactions of target sub-populations (e.g., women, low income, etc.) is called for. A blend of qualitative (e.g., why emotions are held) and quantitative (e.g., which messages encourage calm and deliberate responses) research techniques spanning several risk scenarios (e.g., severity, food and bio-agent) should be attempted.

Concluding Remarks

This study examined Americans' reactions to potential deliberate food contamination attacks. The results obtained may inform policy as to how best to target risk communication messages in an event that such a bioterrorist act. Factor analysis results suggest four possible lines of reactions to a deliberate food contamination event; the responses describe either pessimistic or optimistic reactions. Under a pessimistic reaction, respondents were either paniced or frightened. On the other hand, if exhibiting an optimistic reaction, people could either act calmly and more rationally through such tragedies or accept them as a new development in terrorism. Regression results suggest that women, people with low incomes ($35,000 or less) and those reporting to be more religious are more likely to panic.

Male respondents, households with children 18 years and below, and those in the higher income group ($75,000 or more) are more likely to act in a controlled manner. This may be attributable to their trust in institutions ability to restore regularity in the food supply and to control widespread damage from deliberate food contamination This study has provided information as to who will react in which way and what communication strategy is most appropriate to alleviate concerns.

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