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Report of a Pilot Study of Uncertainty, Decision-Making and Communication of Information about Climate Change and Food Safety

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Abstract

This report gives a brief overview of the main findings and theory of decision-making under uncertainty and perceptions of climate change and food safety. An online survey, completed by 964 participants, assessed a range of decision-making behaviour in uncertain situations, communication needs and perceptions of climate change and food safety, specifically Campylobacter. Results showed that people rated climate change as more important than Campylobacter and wanted to be informed about it by scientists. Campylobacter was rated as a more serious threat than climate change but people perceived themselves as being more in control and more able to prevent possible negative consequences. Gender differences were found in relation to decision-making behaviour. Women felt more anxious and less able to make decisions under uncertainty than men. Women expressed a greater desire for scientific communication than men. Implications for scientist and policy-makers are discussed.

Key words
Climate change, food safety, decision making

Introduction

In our everyday life we constantly have to make decisions about potential risks and uncertainties, be they health, environment or food related. This could be a decision about the consumption of a certain food, which has been open for a number of days, or how to protect our homes from flooding. To help us make these decisions scientists strive to predict potential hazards and problems as accurately as possible and try to communicate these to the public. However, uncertainties surrounding a lot of risk factors. There tends to be a low level of trust in scientists and government regulatory bodies as well as an, often limited, understanding on the part of the public of the underlying science (Poortinga and Pidgeon, 2003). These issues demand a better understanding and improved bi-lateral communication between the public and scientists.

This project is part of multidisciplinary research to improve scientists' understanding of how people make decisions in uncertain situations and the specific type and format of information the public requires. Feedback to the scientific community and governing bodies will in turn be able to provide information tailored towards communities, which will help them to make better and more accurate decisions when faced with risk and uncertainty.

This paper provides a summary of some of the main findings of the first phase of a programme investigating decision making under uncertainty with specific relation to climate change and food safety. The project is funded under the EPSRC Ideas Factory, a programme designed to support and advance inter-disciplinary research with a focus on decision-making under uncertainty. The researchers involved in this study are from a range of disciplines, and reflect the composition of the team formed at the EPSRC event.

This report will provide an overview of some of the theory and main findings of the first part of the project. The data and findings of the programme will be covered comprehensively in other academic and practitioner articles.

The reason why climate change and food safety were chosen as topics is that both are surrounded by uncertainties as science cannot predict either of them accurately. Furthermore, both topics contrast with each other since climate change is a risk whose effects can be felt on a macro-level, ie by the whole of society, whereas food safety effects are felt on a micro-level,

ie the individual. Specific examples from each topic were chosen to focus participants' responses. The topics were aviation and frequency of flying for climate change, because of the link between the emission of greenhouse gases by air-traffic and the effect this has on climate change. For the food safety topic, infection through Campylobacter was chosen. This is a common bacterium that can frequently be found in chicken meat and which can affect humans in various ways from causing mild food poisoning to serious conditions such as Guillane-Barre syndrome, an auto-immune disease. However, with the use of appropriate food hygiene, such as using a glass chopping board rather than a wooden one and storing raw chicken lower than other food in the fridge, Campylobacter, can be almost entirely eliminated.

The main aims of the project were as follows:

1. To gain in-depth information regarding differences in individual and group, or 'interpretive communities', decision-making under uncertainty. In particular, we focus on situations involving climate change and food safety.

2. To collect data on information requirements and style of information presentation on uncertain hazards. What kind of information is most useful in aiding participants' decision-making?

3. To improve communication between the public and the scientific community.

Overview of Literature

Decision-making theory suggests that there are two very distinct modes of reasoning involved in human decision-making. Evidence (eg Sloman, 2002) points to a cognitive-rule based process as well as an emotion-based heuristic one.

The cognitive-rule based process, the more traditional model of thinking about decision-making, sees the decision maker thinking through each alternative outcome in a consequential way before reaching a decision by weighing up the probabilities of the different outcomes arising. Thus, the thinking process utilises sequential cognitive processing and is mainly conscious. However, subconscious processes, such as time and cognitive capacity limitations as well as decision heuristics, might influence the conscious process.

The second mode of processing, the emotion-based heuristic decision-making process, is a sub-conscious process of associative reasoning. It relies on non-conscious emotional responses to the decision options. It has been suggested that emotions play a role in both processes, the cognitive and the associative reasoning (Damasio, 1994), however the distinction between the processes is the conscious and separate evaluation of the consequences and probability of each option in the latter compared with a sub-conscious evaluation of the option as a unitary whole in the former.

Although the two processes often come to the same conclusion in decision choice, at times they might clash. You might have had situations yourself where the logical and analytical solution did not fit well with how you felt about the problem. This can happen in highly emotive, important, novel or uncertain outcome situations especially and often it is our intuition that wins over the logical conclusion. Imagine you are on holiday in Mexico and you are really hungry. There is nothing open that serves food apart from a food-stall in the street. The food-stall looks really makeshift and the food is something steamed in banana-leaves. There is a big queue and loads of people are eating from the stall. You are so hungry you could eat anything yet the situation is novel to you and you are uncertain whether the food is safe to eat. Your cognitive-rule based process is weighing up the consequences in a logical way. You are very hungry, nothing is open. There are a lot of people eating from the food-stall, which is probably an indication that the food is OK to eat. Because of the high demand there is a quick turnover of food, thus the food is not sitting around for a long time as new food is constantly being cooked. Therefore, your logical conclusion is that it should be completely fine to eat the food. However, you still walk away hungry as your gut feeling, ie your emotion-based heuristic decision-making process, came to a different conclusion, that it doesn't feel right to eat there.

To understand people's decision making in uncertain situations, especially those involving risk, one therefore needs to take into account that both decision processes will be involved and influenced by the public presentation of the problem. Thus, scientists need to gain better understanding of the individual and contextual factors that will influence which system is more likely to dominate in a certain type of situation.

The difficulty for scientists in communicating risk and uncertainty-related information, in such a way that the public can make an informed and accurate decision, lies in the fact that

not only is the cognitive rule-based reasoning process biased with unconscious factors, but often it is not used at all, and decisions are entirely based on the emotion-based heuristic process. Scientific research and decision making, on the other hand, is based on achieving effective and accurate decisions which are more informed and unbiased than the general public cognitive rule-based decision process (Loewenstein *et al*, 2001). Scientific decision-making seems to go against most values of public decision goals, such as minimising negative emotions and effort and maximising justification for the decision (Shafir, Simonson, Tversky, 1993).

Furthermore, it is noteworthy that emotion-based heuristic decisions are not necessarily of worse quality than cognitive-based decisions even if considerable time and effort has been put into the conscious evaluations of all alternatives. Dijksterhuis *et al* (2006) found that unconscious decisions can be of better quality than conscious ones, especially in cases of complex decisions, such as situations involving uncertainties where subjective assessments of value are required for each alternative on many dimensions.

It is clear that individual decision-making is influenced by a multitude of factors, and providing clear information in order for people to make the best and most accurate decisions when faced with risk and uncertainties is a big challenge for scientists.

Group level decision making is also important to understanding choice and communicating information. This project combines individual difference and interpretive communities research (Leiserowitz, 2005). Leiserowitz (2005) suggests that interpretive communities are groups of individuals that have the same view on risk and can be characterised by socio-demographic factors such as gender, age, political affiliation and income.

This paper will only focus on one defining socio-demographic characteristic: gender. Other areas will be explored in more depth in other outputs. First, perceptions of climate change and food safety of the researched population will be analysed and, second, gender differences in terms of perceptions of climate change and food safety will be explored. General decision-making tendencies will also be examined.

Method

Participants

An online survey was completed, 964 people (42.2% men, 57.7% women, 1 participant did not report their gender). Participants' mean age was 37.2 years (range = 18 to 75). They came from mixed educational and occupational backgrounds. Of the participants, 91.8% reported to be White, 4.5% Asian, 1.6% Black, 1.5 % of mixed ethnic background and 7% reported to be of other backgrounds than those categories given; 43.3 % of participants stated that they either had children or other caring responsibilities.

Measures

The questionnaire assessed biographical factors (eg age, gender, educational qualifications, parental status and caring responsibilities) and socio-demographic factors (eg employment status, occupation, salary and political preferences).

A collection of decision-making scales assessed preferences for the *use of heuristics* (adapted from Trumbo and McComas, 2003), *intolerance of ambiguity* (uncertainty) and *intolerance of scientific ambiguity* (scientific uncertainty) (adapted from Buhr and Dugas, 2002), *additional information search* and *procrastination* (Dewberry and Narendran, 2007).

The *use of heuristics* (eg 'Past experiences with other situations like this have made it easier for me to decide how I feel about climate change/Campylobacter'), *intolerance of ambiguity* (uncertainty) (eg 'In general, when I am uncertain, I can't go forward and make a decision') and *intolerance of scientific ambiguity* (scientific uncertainty) (eg 'When I am uncertain about scientific information, I can't go forward and make a decision') scales each have a five point response range from *strongly disagree* to *strongly agree*.

The other two decision making scales, ie the *additional information search* (eg 'When I have an important decision to make, I spend quite a lot of time looking for new information to help me decide') and *procrastination* scale (eg 'If I have a difficult decision to make, I often put it off until later, even though I could perfectly well make it straight away') have got shorter responses ranges with three response options from *disagree* to *agree*.

Furthermore, the questionnaire included a range of questions specific to climate change (in particular aviation) and food safety (in particular infection from chicken-borne Campylobacter). Specifically, it contained questions about current reported behaviour as well as current perceptions of food safety relating to hygiene factors linked with Campylobacter and climate change issues such as aviation. These are: *salience* (eg 'How important is the issue of Campylobacter to you personally?'), *general importance* (eg 'How important do you think the issue of Campylobacter is to society in general?'), *seriousness* (eg 'How serious is Campylobacter likely to be for the health of future generations?'), *responsibility* (eg 'To what extent is it your responsibility to protect yourself from the risks from Campylobacter?'), *control* (eg 'To what extent can scientists control your personal likelihood of infection from Campylobacter?') and *prevention* (eg 'To what extent do you trust the government and regulators to prevent you being infected with Campylobacter?') of climate change and Campylobacter. Each scale was also adapted for the climate change and Campylobacter scenario and included a five point response range with appropriate wording for each scale, including: *not at all important - extremely important*, *can not control at all - can control completely* or *no trust at all - complete trust.*

The questionnaire included an *information* (*for personal use*) scale, which measured the importance of further information from scientists about the hazards (climate change and Campylobacter) and the associated uncertainty. An example item of this scale is 'The consequences of Campylobacter' with answers ranging from '*this information has no importance for me'* to *'this information is very important for me'* (adapted from Miles and Frewer, 2003)

Finally, a scale measuring the personal importance of reduction of uncertainty through improved scientific knowledge, ie *information for scientists* scale was also included in the questionnaire. One item was 'Scientists are uncertain about the number of people infected with Campylobacter each year' and had a five point response scale ranging from *'It is not important to me that scientists find out more about this issue'* to '*it is very important to me that scientists find out more about this issue'* (adapted from Lion, Meertens and Bot, 2002).

Both scales were again adjusted to fit the climate change and the Campylobacter scenario.

Procedure

Recruitment was via a market research database (Ipoints) and participants were invited through email to complete the questionnaire on-line. Batches of emails including a link to the survey were sent until a sample size of 1000 completed questionnaires was reached. There were 36 incomplete questionnaires yielding a sample of 964.

Results

As mentioned in the introduction, this paper only provides an overview of some of the findings of the first phase of the EPSRC funded project into decision-making under uncertainty in relation to climate change and food safety. The results presented in this section summarise some of the main findings regarding people's perceptions of the issues surrounding climate change and Campylobacter as well as gender differences in perceptions and decision-making in uncertain situations.

Overall, people reported that the issue of climate change is more salient to them and more important for society and the government than Campylobacter and its effects.

However, people rated Campylobacter as a more serious threat to themselves and future generations than climate change, and felt that they, as well as the government and regulators, can control and prevent Campylobacter more than climate change. In general people agreed that it is a joint responsibility between government, regulators, scientists as well as the rest of the population to protect us from the risks of climate change and Campylobacter (Figure 1).

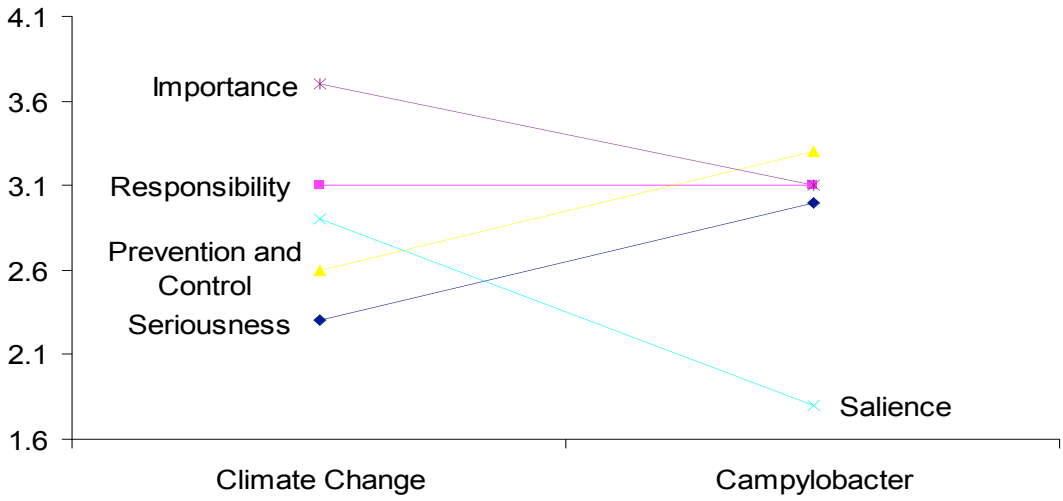

Figure 1: Scores of participants' perception scales for climate change and Campylobacter

When making decisions about issues of climate change or Campylobacter people tended to use more heuristic decisions (rules of thumb) in situations concerning climate change than for situations concerning Campylobacter-related risks. Nevertheless, people rated the importance of information for scientists and for personal use about climate change higher and more important than information of either type about Campylobacter (Figure 2).

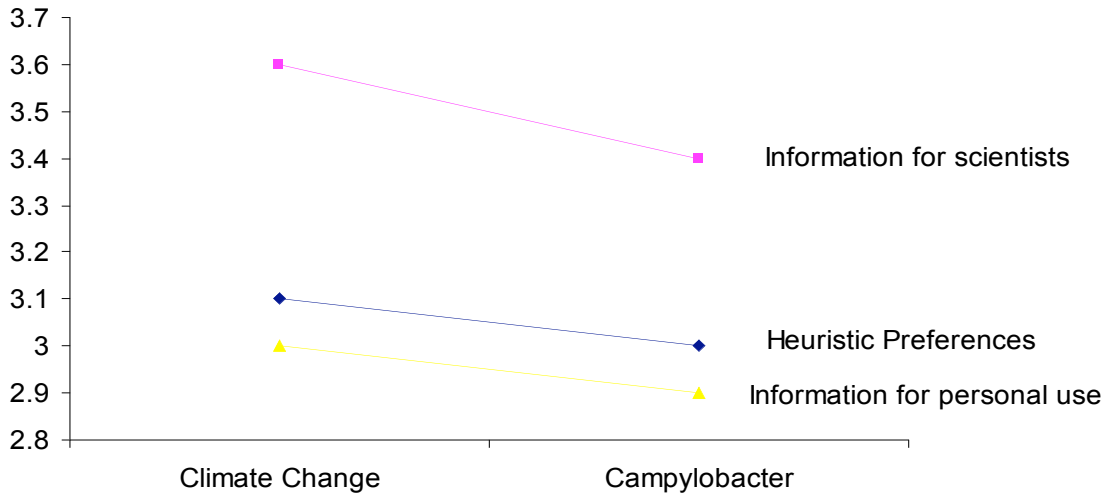

Figure 2: Heuristic preference and desire for information scores for climate change and Campylobacter

Looking at gender differences regarding decision-making in general, the women in this study feel more anxious and stressed and less able to make decisions than their male counterparts, when there is general uncertainty or scientific uncertainty in situations that need a decision. However women did not score significantly higher on the procrastination or additional information search scale (Figure 3).

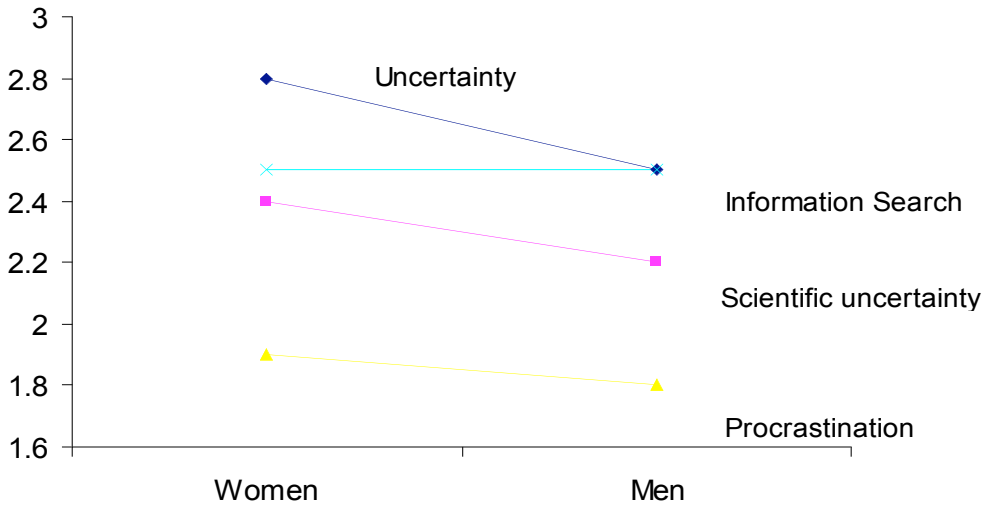

Figure 3: General decision-making scales' scores by gender

Concerning climate change and Campylobacter, women showed more environmental awareness and felt it was more important than men to have more information for scientists and for personal use about the issues of climate change as well as Campylobacter. Women also used more decision heuristics then men regarding issues of climate change but not Campylobacter. The data are shown in Figures 4 and 5.

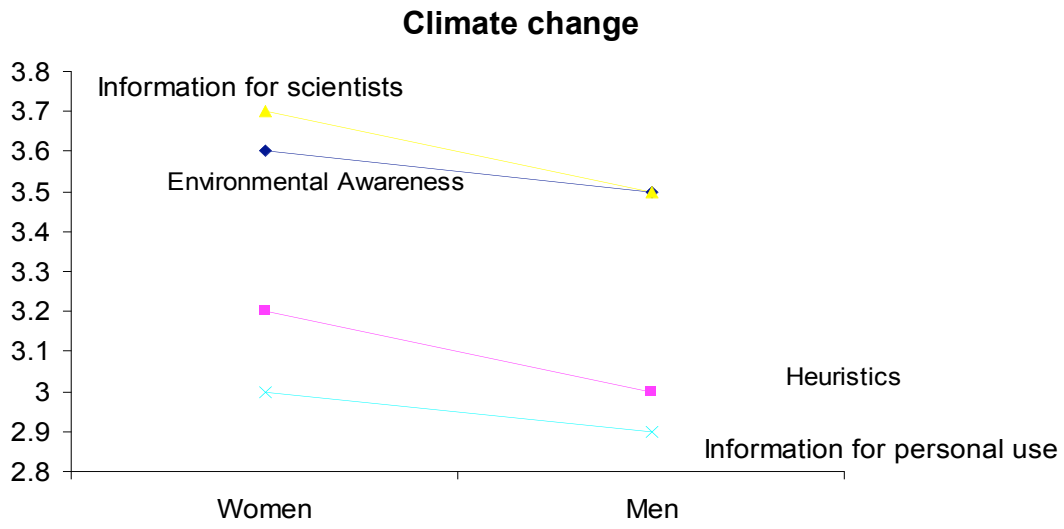

Figure 4: Gender differences in heuristic preferences, information for scientists and for personal use and environmental awareness of climate change

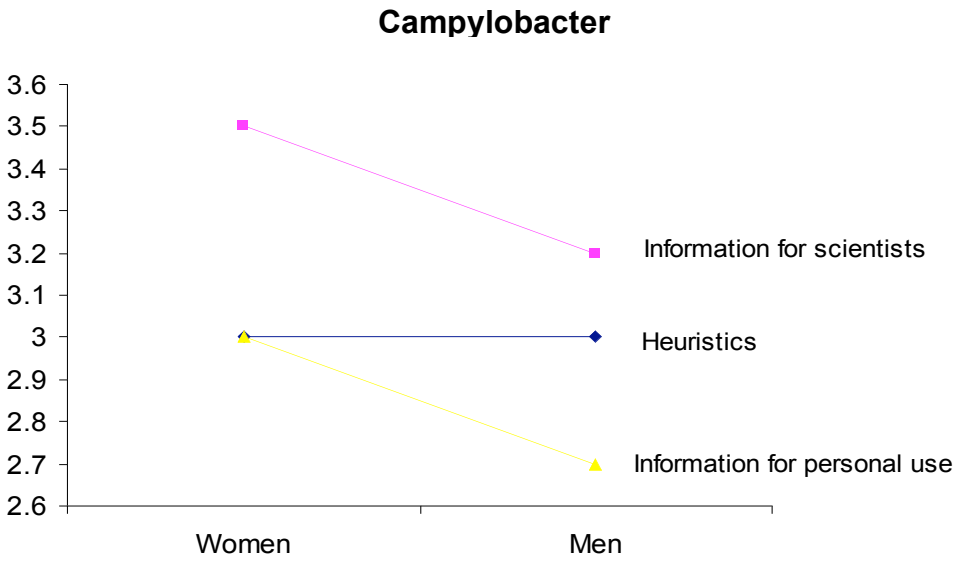

Figure 5: Gender differences in heuristic preferences, information for scientists and for personal use and environmental awareness of Campylobacter

When rating salience and general importance of issues surrounding climate change and Campylobacter women scored significantly higher than men. Women also reported a higher sense of responsibility for the prevention and control of the risks related with these issues, than the men. Thus, it might seem surprising that the men in this study rated the issues of climate change and Campylobacter as more serious than the women (Figure 6 and 7).

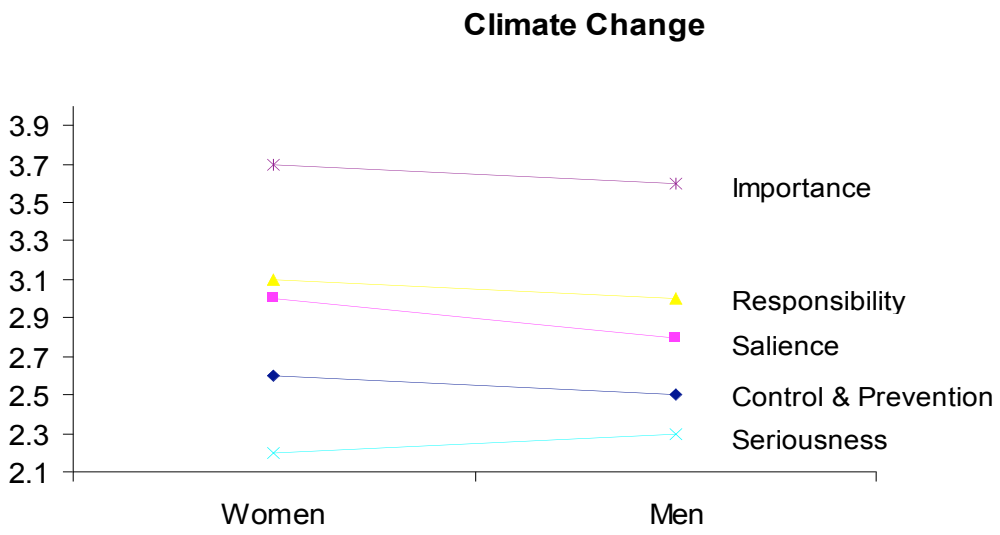

Figure 6: Gender differences in climate change perception scales

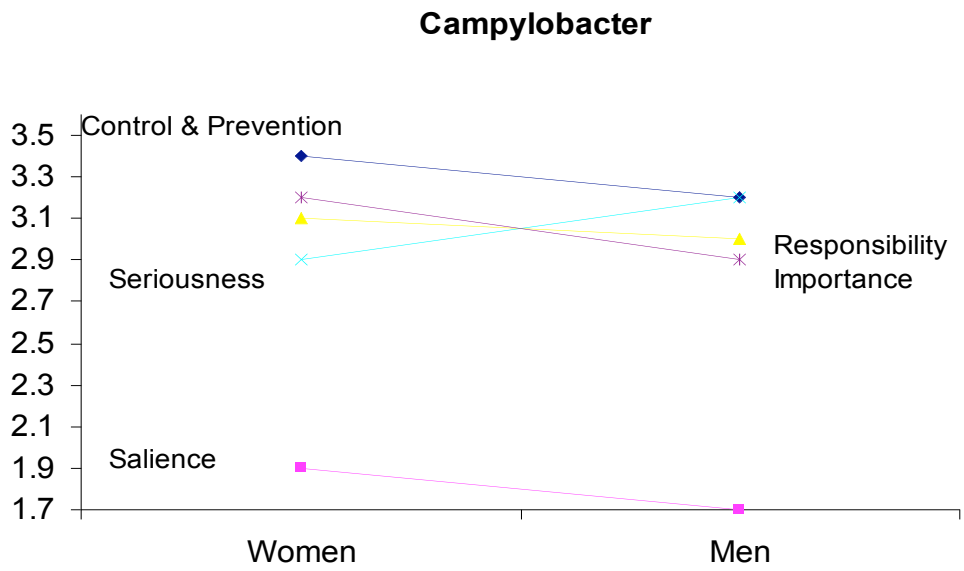

Figure 7: Gender differences in Campylobacter perception scales

Discussion

The paper set out to present a brief overview of some of the main theory and findings of a research programme investigating decision-making under uncertainty with specific reference to climate change and food safety, specifically Campylobacter. Perceptions of climate change and food safety were analysed, general decision-making tendencies explored as well as gender differences perceptions and decision-making styles investigated.

Climate change and Campylobacter

People reported to rate climate change as more salient and generally more important to society than Campylobacter. They want to be informed by scientist and governing bodies about climate change and its possible risks. However, results showed that the extra information might not necessarily influence people's everyday decision-making behaviour in relation to climate change issues as their heuristics, or rules of thumb, could be difficult to change.

Campylobacter, on the other hand, people rated as a more serious threat to themselves and future generations than climate change and they felt more in control and more able to prevent possible risks from Campylobacter than from climate change. Nevertheless, people expressed less of a need to be continuously scientifically updated on the subject matter. Everyone agreed that the responsibility for the protection from climate change and Campylobacter should be shared between the public, government and scientists.

One reason why people rated the risk of climate change as less serious than Campylobacter, and felt less in control of the prevention of it, may be that climate change effects are not as immediate as with Campylobacter. Furthermore, its macro-level effects may account for the fact that it is not always visible to people in their everyday lives. Leiserowitz (2005), investigating American risk perception of climate change, found that although people were moderately concerned about global warming as an aspect of climate change only 13% believed that this will affect themselves, their family or local community; 68% believed that global warming was mostly going to affect other people around the world. Thus, to keep people engaged and proactive on the issue, as well as aware of the risks and preventative behaviour; politicians, governing bodies and scientists could keep the public regularly informed on scientific issues and focus on the fact that aspects of climate change, such as

food and water shortages, health and property effects due to extreme weather conditions (floods and tornadoes) as well as other threats to nature, including to areas where they live, will effect each and every one of them.

Campylobacter, on the other hand, seems to be an issue that people rate as serious yet do not feel the need to get regular scientific updates about. This may be due to the fact that Campylobacter is an individual threat and the effects of it are almost instant, however, people feel that they are more in control of it. Research has shown that if a threat is of personal relevance people are more likely to adjust their behaviour accordingly (eg Neuwirth, Dunwoody and Griffin, 2000). This study has found that people are less likely to use rules of thumb when it comes to Campylobacter but adjust their decision-making behaviour to fit the situation. It might be useful feedback for policy makers and scientists that people, in general, feel able to cope with these kinds of individual level threats, such as Campylobacter, as they seem to feel more in control.

Gender differences

Women reported to be more troubled by having to make decisions under uncertainty than men and thus it comes as no surprise that they feel a greater desire to have scientific information communicated to them. Research has found that men are bigger risk-takers than women (Byrnes, Miller and Shaffer, 1999; Flynn, Slovic and Mertz, 1994; Powell and Ansic, 1997) which could explain the findings that men are less influenced by uncertainty than women and feel less of a need to be regularly informed by scientists and governing bodies.

Further, women had a higher score on the New Environmental paradigm scale than their male counterparts, thus reporting more environmental awareness. Research in other areas (Dunlap *et al,* 2000; Kornelis *et al*, 2007; Trumbo, 1996) has shown a similar pattern with findings that women tend to take more factors into account when considering the importance of information. Stern, Dietz and Kalof (1993) argued that women show a higher environmental awareness than men because of different perspectives on the world. They suggest that gender socialisation leads women to focus on children's health which includes taking into account environmental risk factors. Men, on the other hand, focus on the child's economic well-being. This difference in attention could also account for the findings below. Although men rated both issues, climate change and Campylobacter, as more serious than the women the women felt more responsible and rated both topics as generally more important than the men.

One could argue that the fact that women are well informed environmentally might explain the higher use of decision heuristics than men in situations concerning climate change issues, as they are well practised in thinking and dealing with environmental problems on a regular basis. There were, however, no gender differences with Campylobacter.

What do the findings mean for policy makers and scientist communicating risks? Should women be specifically informed about risk and prevention? Does the fact that more men than women tend to be in politics affect policy making due to different risk related decisions being made? Should scientists take this into account when advising governing bodies? It seems a main aim for scientists and governing bodies should be to try and match communication patterns to these distinct gender patterns of decision-making and information requirements to optimise the effectiveness of risk communication.

Further research, as part of the programme, will focus on investigating decision making under uncertainty in particular in relation to climate change and food safety further. We are currently in the process of collecting a new and larger set of data with a refined research questions and a revised questionnaire. More detailed reports of this and the second study will be published shortly.

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