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Living with Nuclear Power: A Q-method Study of Local Community Risk Perceptions

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Abstract

The issue of building new nuclear power is once again high up on the public policy agenda in several countries because of the challenge of meeting climate change emission targets and concerns about continuity of electricity supply. In the UK candidate sites are likely to include those with existing nuclear power stations. There is however a dearth of contemporary data on the perceptions of nuclear power within communities which have hosted such facilities for an extended period. This study contributes to filling this gap. It will be important to understand how local people perceive and conceptualise nuclear power and its risks, both to facilitate more informed policy decisions, and to design better considered risk communication and public engagement processes. The study uses Q-method to investigate the subjective perspectives on 'living with nuclear risk' amongst people (n=84) drawn from communities near to two longstanding nuclear power stations, at Bradwell-on-Sea and Oldbury-on-Severn, in the UK. The study revealed that beliefs about nuclear power in local communities were subtle and complex, avoiding simplistic bipolar dichotomies such as 'for' or 'against', with four main perspectives identified accounting for 53% of total variance. These are labelled: 'Beneficial and Safe'; 'Threat and Distrust'; 'Reluctant Acceptance'; and 'Normalisation'. These perspectives are discussed in the context of the current nuclear policy debate, while in theoretical terms the findings also suggest that expressions of trust and distrust in nuclear power can have different origins. The usefulness of Q-method for investigating the ways in which people live with risk is also highlighted.

Introduction

After a long period in which the civilian nuclear power industry has appeared to be in terminal decline across many parts of the globe, the issue of building new nuclear power stations is once again high up on the public policy agenda in many countries. The challenge of meeting climate change emission reduction targets, set alongside concerns about ensuring continuity of electricity supply, have forced a reappraisal of the potential future contribution of nuclear power. In the UK nuclear power stations currently contribute just under one fifth of total electricity generation, but most are nearing the end of their operational lifetimes, such that by 2025 only a single station will remain in operation. In response, recent UK government policy proposes that new nuclear power stations should form a part of the future energy mix of the country (DBERR, 2008), although the assumptions underlying this position have been vigorously contested by both environmental groups and academic commentators alike. Further development of nuclear power is still fraught with uncertainties over its fundamental economics, worries about accident risks and nuclear proliferation, and perhaps most importantly the need to find long-term solutions for the considerable accumulated legacy of radioactive wastes alongside those that a new reactor programme would inevitably generate. However, what is clear is that the debate about nuclear energy policy is no longer as clearly polarised as it once was in the 1980s and 90s (Pidgeon, Lorenzoni and Poortinga, 2008).

Aside from technological and economic uncertainties, the feasibility of new nuclear power programmes will also depend upon the response of members of affected publics – not only national dispositions, but perhaps more importantly the positions taken up in communities which are asked to host (or themselves volunteer to host) any new facilities. The process currently being followed in the UK, as well as other countries, strongly suggests that initial candidate sites are likely to include those with existing nuclear power stations[1]: because of their relatively remote locations; well-developed power transmission and other infrastructure; and ready access to cooling water etc. From a risk communication perspective an *additional*, critical characteristic of existing sites will be the set of physical, economic, social and psychological relationships, in

[1] A confidential report commissioned by the UK government as part of its 2006 energy review, and only made public after pressure from Green groups, discusses some of the technical issues for new build on existing nuclear power sites (see Jackson and Jackson, 2007).

some cases built up over several generations, between a nuclear power facility and those currently living in local communities. Somewhat surprisingly, while we have a relatively detailed picture of attitudes to nuclear power at the national level from major polls, and very extensive work on perceived risks and benefits from more experimental studies, there is far less detailed contemporary data with samples drawn directly from communities which host existing nuclear facilities. From a policy maker's point of view, it will be important to understand not just *what* local people think about nuclear power (through simple measures of support or opposition) but also precisely *how* they perceive and conceptualise its risks. Such insights should facilitate more informed policy decisions, as well as better considered risk communications and public engagement processes. Similarly, from any community's point of view, it is important that research is conducted that assists in the process of articulating and communicating the full spectrum of views, beliefs and concerns to policy makers, irrespective of whether people support nuclear power and believe that it is an important energy source, or consider that nuclear power has no place in a sustainable future and wish to express their concerns and objections.

The literature on nuclear power points to long-standing public concerns in many Western nations about a technology that came to be associated with technological 'hubris' and the overoptimistic claims of its initial promoters. Major accidents including the 1957 Windscale fire in England, and those at Three Mile Island and Chernobyl, coupled with environmental concerns about waste disposal, only served to reinforce such concerns. Rosa and Freudenburg (1993) report that, in national samples, opposition to the building of more nuclear power plants in the USA increased from around 20% in the mid-1970s to more than 60% in the early 1980s. European data shows a similar historical pattern, but amplified further by the impacts of the Chernobyl accident in 1986 (van der Pligt, 1992). During this period risk perceptions of nuclear energy and radioactive waste were also extensively studied in psychometric surveys, where both were found to be uniquely 'dreaded' and unknown to both the public and to science (see e.g. Slovic, 1987; Pidgeon et al, 1992). A further factor associated with the nuclear industry's original fall from grace has been intense public distrust of regulators and governments, as well as of the industry itself, to provide truthful information to the public and to manage risks responsibly (Wynne, 1992; Rosa and Clark, 1999; Poortinga and Pidgeon, 2003). However, although recent polls have shown that the British public continues to oppose the replacement of nuclear power stations, although that opposition has been steadily

decreasing (Knight, 2005; Pidgeon et al, 2008). Recent European survey data shows a similar trend (European Commission, 2006; 2008). US public opinion from recent surveys is also somewhat less opposed to nuclear power than it was in the past, but still shows an overall opposition to the construction of new nuclear power stations, with, according to Rosa (2005), respondents particularly opposed to new installations in close proximity to their own communities.

Findings from national polls and experimental surveys are only of partial use for understanding responses in communities already living in very close proximity to nuclear facilities, where other more local factors come into play. One such factor is that host communities can experience stigmatisation arising from the presence of a facility (e.g. Edelstein, 1987; Gregory, Flynn and Slovic, 1995; Flynn, Slovic and Kunreuther, 2001). Such locations can become regarded as 'contaminated' even without a distinct accident or reported episode of contamination ever having occurred, while the notion that a local place has become 'spoiled' can lead to wider perceptions of the community as blighted by pollution, ill-health, and social deprivation more generally, and perceptions of the area and its actual inhabitants as being in some way flawed or undesirable (Bush et al., 2001; Kasperson et al, 2003).

Set against the stigmatising and other well-documented negative aspects of nuclear facilities, is the contention that segments of local populations experience a degree of co-dependence with such facilities, as when much needed jobs or other economic and community benefits are generated in what would otherwise be highly marginalised regions (Blowers and Leroy, 1994; Hecht, 1998). Past studies in the USA provide evidence that host communities can give strong majority support for local nuclear facilities (Melber at al, 1977), while quantitative survey evidence obtained in Britain during the 1980s (Eiser et al., 1995) also suggests that communities close to nuclear power stations view them somewhat more favourably than more distant populations. Eiser at al. report that the presence of a nuclear power station was believed to bring specific local benefits such as increased employment opportunities, trade for local businesses, and improved road maintenance. They also report that in proximal samples pro- and anti-nuclear attitudes were not polar opposites, but reflected the different weightings and values that people placed upon specific aspects of the issue (local jobs, pollution, infrastructure improvements, accident risks etc.). In contrast, however, community studies around major reprocessing facilities in England and France suggest that even where people express 'acceptance' of the local presence

of nuclear technology, apparently confident discourses can conceal underlying anxieties and concerns about health risks (Macgill, 1987; Zonabend, 1993).

All of the above considerations suggest that local 'publics', and their understandings of nuclear power, should not be viewed in simplistic or undifferentiated terms (Pidgeon et al, 1992). Accordingly, the present study draws upon the tradition of contextual risk perception research, an approach which seeks to capture the complexity of understandings as they are shaped in specific hazard locations, and by a range of local influences and factors (see e.g. Fitchen, Heath and Fessenden-Raden, 1987; Baxter and Eyles, 1999; Irwin, Simmons and Walker, 1999; Bickerstaff and Walker, 2001; Horlick-Jones, Sime and Pidgeon 2003). Such an approach contends that the *context* within which a risk object is located is invariably as important as the hazard itself in shaping local attitudes to an issue, and in amplifying or attenuating perceptions of risk. Spatial context can be particularly important for particular places and communities that are associated with sources of technological risk, while 'sense of place', the significance of a location as both a physical setting for economic and social activities and as a focus for expressing individual and shared meanings and values (cf. Satterfield, 2001), may also be a powerful mediating factor in determining how people make sense of living close to risky facilities (see Boholm & Löfstedt, 2004, esp. Simmons & Walker, 2004). Strong identification with a region or place may lead also some individuals to distance themselves from the risks associated with local hazards in order to avoid acknowledging the despoilment of a valued location or the potential for social stigma (Bickerstaff 2004). Accordingly, in this paper we argue that community responses to nuclear risks in existing site locations are likely to reflect the lived experiences of particular individuals in that particular location and their particular social context. Understandings will depend not only upon how people have come to live alongside such a major industrial facility but also on other factors such as: attitudes towards the presence of the power station within the geographical landscape; beliefs its contribution (or not as the case may be) to the social and economic life of the community; trust relationships between people and local plant operators; knowledge of the local history of incidents; and media reporting of these issues. Gaining such a nuanced understanding of local responses to nuclear power, in samples drawn from two such locations in the UK, is the principal focus of the present study.

Method

Design

The participants in the study were living near to the nuclear power stations at Oldbury in South Gloucestershire or Bradwell-on-Sea in Essex, both in England. The sites and stations were chosen for a number of reasons. Both have had a single British designed twin-reactor Magnox station operating over a very long period of time. They are also relatively similar in a geographical sense: the surrounding countryside is sparsely populated, rural, and bounded in both cases by wide tidal estuaries. Both, however, are within commuting distance of major conurbations. As a result, while both stations clearly contribute to their areas in a variety of ways, in neither case do the local communities rely solely upon the nuclear industry for their economic health. Neither site has seen much in the way of organised opposition to the power stations themselves (compared to other UK civilian nuclear installations). The existing reactors at both sites were either close to or already at the end of their operational lives.

Oldbury

Oldbury nuclear power station is located in South Gloucestershire, England, on the southern bank of the Severn Estuary. Oldbury-on-Severn itself is a small, rural village (population approx 708)[2]. The nearest towns are Thornbury (population approx 12500), approximately 4 miles from the power station, and Chepstow (population approx 11000), which is on the opposite bank of the Severn. The site is relatively close to the M4 motorway, the Severn Bridge crossings, and the major conurbation of Bristol (population approximately 400,000). In addition, there is significant industrial activity, primarily petrochemicals and shipping, within 10 miles further down the estuary. The power station itself consists of two Magnox gas-cooled reactors, and began generating in 1968. We identified no major local incidents or past instances of major organised opposition; although a 'Stop Hinkley, Close Oldbury' campaign has existed since 2000. This emerged as an expansion of a long-established campaign opposing the Hinckley Point power station some 40 miles further down the Severn Estuary rather than originating in the community local to Oldbury. At the time of data collection the plant was operational, with decommissioning due to start in 2008.

[2] All population figures are from the UK Census data of 2001 available from: www.statistics.gov.uk/census2001

Bradwell

Bradwell-on-Sea is a small village in Essex, England, with a population of approximately 550 adults. The main towns in the district are Maldon (population approx 13,000), Heybridge (approx 6,500) and Burnham-on-Crouch (approx 7,500), all about 9 miles from the power station. There is also a small town about 2.5 miles away across the Blackwater Estuary at West Mersea from which the power station is highly visible (population approx 6500). However, most people adjacent live in small rural villages, many of which originally drew their livelihoods from the coastal or agricultural economy. Although just under 50 miles from the centre of London the area, being on a peninsula, remains quite isolated, with poor transport links. Opened in 1962, the Bradwell nuclear power station is a very early example of the Magnox type. The initial siting proposal was contested at a short public inquiry held in 1956 (Welsh, 2000), and subsequent industry efforts to investigate the feasibility of a repository for low and intermediate level waste adjacent to the Bradwell site prompted intense local opposition in the mid-1980s, but this was not directed at the local power station. The reactors were shut down in March 2002, and the lengthy decommissioning process is ongoing.

The Q-method Approach

The study adopts the Q-method approach (also referred to as Q-methodology), a long-established technique for identifying and differentiating between shared viewpoints amongst a given group of individuals (Brown, 1980; McKeown & Thomas, 1988). In a typical Q-study a participant is required to sort a set of predefined statements (the Q-sort) with respect to the issue at hand, which are then subjected to statistical analysis and further interpretation by the researcher. Q-method does not represent views in a statistically representative sense, but is particularly well suited to the study of the complexities and distinct configurations in understandings common to sub-sets of participants within well-defined populations or expert communities. It has recently been utilised in a range of risk studies (see Simmons and Walker, 1999; Niemeyer, Petts and Hobson 1995; Tuler, Webler and Finson, 2005; Chess and Johnson, 2006). Q-method has been employed in one other study of people living with nuclear power, conducted more than 20 years ago around the Diablo Canyon plant in California (Hill, 1992), but the study differs in at least two important ways to the present research. Firstly, Hill's research was conducted just as the plant began operations following an unusually protracted and controversial siting and

construction process, stretching over a period of 16 years or more, whereas the research reported in this paper was concerned to investigate local citizen's perspectives at long-established sites. Secondly, Hill's study was designed to test a particular theory of the process by which citizens assess new technology and consequently employed four separate Q-sorts, each investigating a discrete aspect of the process. The present study has carried out a holistic analysis in order to capture the overall views of respondents and to examine the *relative* importance of different aspects of perceived risk.

Development of the Q-sort

Statements for the Q-sort were drawn mainly from 32 biographical narrative interviews with people living close to the Bradwell station conducted during 2004 and 2005. As in other Q studies (e.g. Eden, Donaldson and Walker, 2005), elements of grounded theory were adopted to ensure that all relevant perspectives were covered (Glaser & Strauss, 1967; Pidgeon and Henwood, 2004). An initial sample of statements, representing the range of topics covered, was derived from qualitative analysis of the interview transcripts: this generated a corpus of 400 statements (in Q-method terminology, the 'concourse'). The selection process was halted when theoretical saturation was reached – i.e. no new insights or perspectives could be identified in the statements being generated. These statements reflected the beliefs, perspectives and values of respondents with regard to a wide variety of issues relating to living with the nuclear power station in their locality. Examination of the main themes within the data enabled a proportional and representative sub-sample of statements (the 'Q-sample') to be developed from the larger corpus. A small number of additional statements were added by the research team to reflect additional theoretical concepts, current policy discourse, and the potential for social mobilisation. A final statement was also added folLowing feedback from a small pilot study. At the conclusion of this intensive iterative process, a Q-sample of 62 statements was generated, grouped under 9 major themes (see Appendix).

Participants

Data was collected between April and October 2007. Most participants were identified initially using professional recruitment agencies which used local press advertising, canvassing (door to door and at local events), and social networking to construct a sample of local people, residing in towns and villages close to both stations. Samples were designed to represent an approximate cross section of gender, age group

and length of residence at both locations. The final sample comprised 42 participants from each location (Table 1).

Table 1: Sample characteristics

Characteristic	Category	Oldbury n (%)	Bradwell n (%)	Total (%)
Gender	Male	23 (55)	19 (45)	42 (50)
	Female	19 (45)	23 (55)	42 (50)
Age group	18-29	6 (14)	2 (5)	8 (10)
	30-39	8 (19)	8 (19)	16 (19)
	40-49	8 (19)	8 (19)	16 (19)
	50-59	8 (19)	10 (24)	18 (21)
	60+	12 (29)	14 (33)	26 (31)
Affiliation	Power Station	7 (17)	9 (21)	16 (19)
	NGO	0 (0)	4 (10)	4 (5)
Total		42 (50)	42 (50)	84

To reflect the local population, individuals with specific affiliations to the local nuclear power station were explicitly included in the sample (n=16). Affiliation was defined by past or present employment at the nuclear power station, either directly (e.g. power station employees), or indirectly (e.g. building contractors involved with on-site work), and also by close family links (i.e. spouses, parents, and adult children who had past or present employment links with the power station). Individuals who described themselves as having had past or present involvement with organised anti-nuclear groups were also included in the sample (n=4,

Bradwell) although we were unable to identify any such participants during recruitment in the Oldbury area[3].

Procedure

The study was conducted primarily at participants' own homes[4]. The Q-sort was administered according to procedures described by McKeown and Thomas (1988). Cards were manually shuffled to ensure a random order before each sort, and were then sorted according to the following condition of instruction: 'Sort the cards according to the extent to which each statement reflects your point of view'. The sorting board followed the Q convention of a 'forced normal distribution', with column heights ranging from 3 statements at the extreme left and right, to 10 (central column). The left and rightmost columns were labelled 'Least like my point of view' and 'Most like my point of view' respectively. None of the other columns were labelled, including the central column. At the conclusion of the research appointment, participants completed 2 additional attitude questions. An affect measure eliciting overall feelings towards nuclear power on a five point scale ranging from 'Very negative' to 'Very positive', and support or opposition to the building of a new nuclear power station on the existing site, on a five point scale ranging from 'Strongly oppose' to 'Strongly support'.

Data Analysis

[3] The majority of participants in the Bradwell sample had originally been recruited for the interview phase of the project in 2004-5, and were re-contacted for the present study. From our original database of 37 potential participants at Bradwell, 24 agreed to take part in the Q study, 9 were not contactable, and 4 refused to participate. As in the recent Q-method study by Johnson and Chess (2006), additional participants (n=18) were identified via snowball sampling at this location. In Oldbury, however, all of the recruitment was through a local professional agency.

[4] Q sorts conducted at addresses in the Oldbury area formed part of a longer research appointment that also involved a biographical narrative interview lasting approximately 1 hour. Sorts conducted at Bradwell were the sole purpose of the research visit, given that narrative interviews had been conducted previously (in 2004/5). To update those interviews, particularly in the light of more recent UK policy debates, participants at Bradwell were invited to talk about whether their perceptions of living close to the nuclear power station, or of nuclear power in general, had changed in the intervening two years. None of the participants considered that this was the case. Additional Bradwell participants recruited in 2007 (for whom there was, therefore, no earlier interview), were also asked to briefly describe their opinions on the same subject at the end of the Q-sort procedure.

Data were analysed using PQmethod version 2.11, freeware statistical analysis software designed specifically for Q-method studies (available from http://www.lrz-muenchen.de/~schmolck/qmethod/). Since a very similar factor structure was obtained when conducting separate analyses for each site, all data and analyses here are reported for the overall Q-analysis incorporating all 84 individuals. Unlike standard factor analysis where one is attempting to group item scales in terms of an underlying theoretical construct, Q-analysis inverts this analysis by grouping *participants* in terms of the extent to which they produce similar sorts, indicating underlying shared perspectives. Groups of correlated sorts ('factors') can then be interpreted as distinct 'points of view' within the overall participant sample. The data were subjected to principal components analysis (PCA) with Varimax rotation, chosen because it attempts to load a small number of cases highly onto each factor or group, and therefore was most likely to produce an interpretable set of factors (Field, 2000, p.449). Eigenvalues greater than 1, one commonly applied criterion for retention (McKeown & Thomas, 1988), were observed in 23 groups. Cattell's Scree test, widely regarded as the best solution to selecting the correct number of factors when using PCA (Kline, 1994), was adopted, together with an interpretability criterion, in order to determine a manageable and useful number of factors. The results of this suggested that 4 factors should be selected accounting for 22, 20, 7 and 4% of the variance, cumulatively explaining 54% of the total variance (Table 2).

Table 2: Factor characteristics: n = participants grouped in each factor; % of variance explained, number of distinguishing statements, and numbers of subjects within each factor from each geographical location

Factor	Total n (participts.)	Oldbury n (%)	Bradwell n (%)	Variance exp. (%)	No. dist. statements
Beneficial and safe	37	22 (59%)	15 (41%)	22	28
Threat and distrust	29	10 (34%)	19 (65%)	20	30
Reluctant acceptance	8	5 (63%)	3 (37%)	7	20
Normalisation	4	2 (50%)	2 (50%)	4	15

Cases that loaded primarily on one factor only according to PQmethod pre-flagging criteria ($p \leq .05$) were flagged to those factors. PQmethod then uses the flagged cases to create prototypical factor scores, which were the transformed by PQmethod back into the original Q sort format (factor array) using a weighting formula originally devised by Spearman (Brown, 1980; Stainton-Rogers, 1995). An additional consideration was that the correlations between factor scores for these pure cases were of low to medium strength, the greatest being -.56 (between Factors 1 and 2) and .43 (Factors 1 and 4) (Table 3). In many circumstances Q-method factor scores are not significantly correlated, but this result suggests that the identified 'points of view' associated with the grouped sorts might not be completely independent, a point to which we return in the discussion section.

Table 3: Correlations between factor scores

Factor	**1**	**2**	**3**	**4**
Beneficial and Safe	**1.00**	-.56	.33	.44
Threat ands distrust		**1.00**	.13	-.08
Reluctant Acceptance			**1.00**	.25
Normalisation				**1.00**

Results: the Four Factors

Factors were interpreted from the 4 prototypic sorts, with additional reference to interview transcripts and individual sorts of those who loaded highly on each factor. Just two of the 62 statements were consensual (i.e. did not discriminate between any two pairs of factors, $p<.01$). The highest (+5 and +4) and lowest (-5 and -4) ranked statements for each factor are presented in Table 4, representing items that were most strongly endorsed or rejected within a particular perspective, while the Appendix lists rankings on each factor for the full 62 statements. Because an interesting pattern also emerged across the four factors with respect to the ranking of the trust items (but without those items necessarily receiving the highest rankings of +/-4 or +/-5), these are also presented separately in Table 5. Drawing upon the rankings shown in both Tables 4 and 5, the factors were interpreted as follows:

	Position	Beneficial and safe	Threat and distrust	Reluctant acceptance	Normalisation
Most like my point of view	+5	I'd rather live close to a nuclear power station than a coal fired one, or a factory billowing out toxic fumes	We need to move towards using renewable energy sources as soon as possible	Nuclear power has drawbacks but at the end of the day it will be necessary if we want to have a secure energy supply – we can't rely on imported gas and oil	There's no point worrying about the risks, otherwise you'll spend your whole life worrying
	+5	I'm confident that this nuclear power station is safe	There are far less risky ways of generating electricity than nuclear	I don't like the idea of nuclear power but I reluctantly have to admit that we may need it if we are to have any chance of combating climate change	I've never given the power station a thought – it's just part of the landscape
	+5	Nuclear power has drawbacks but at the end of the day it will be necessary if we want to have a secure energy supply – we can't rely on imported gas and oil	If they tried to put a permanent radioactive waste store on the power station site, I for one would do whatever I could to stop them	I don't really want nuclear power here, but these things have got to go somewhere	According to the news, everything is going to give you cancer, so I don't let it worry me
	+4	Nuclear power is one of the best forms of electricity generation. The country needs it and will have to build more nuclear power stations	I don't like the idea of radioactive waste being stored on the power station site after decommissioning	Nuclear power is one of the cleanest ways of producing energy	Any little incident is blown out of proportion by the media and treated as a major nuclear catastrophe
	+4	Nuclear power is one of the cleanest ways of producing energy	When you get a study that shows there's more cancer here than there should be, they just say it's a 'statistical blip'. You get the feeling they are trying to hide something	I don't like the idea of radioactive waste being stored on the power station site after decommissioning	Nuclear power is one of the cleanest ways of producing energy
	+4	The power station has been a great asset to the community over the years	The nuclear industry doesn't really consult – they go through the motions but the important decisions have already been made	There's no point worrying about the risks, otherwise you'll spend your whole life worrying	There's nothing to stop terrorists crashing a plane into the power station and causing a major disaster
	+4	People are only worried about nuclear power because they don't understand it	The nuclear industry tries to brainwash people into thinking that nuclear power is safe and acceptable	If there was a major incident at the power station, it would affect me wherever I lived	People are only worried about nuclear power because they don't understand it
Least like my point of view	-4	The nuclear industry tries to brainwash people into thinking that nuclear power is safe and acceptable	Nuclear power is one of the cleanest ways of producing energy	Because of the power station, this will be a polluted, hazardous place forever	If they tried to put a permanent radioactive waste store on the power station site, I for one would do whatever I could to stop them
	-4	I worry something will go wrong because of people cutting corners or making mistakes	I find the power station quite comforting rather than a threat	I would welcome a new nuclear power station being built here	If there was a problem, there is a very good, fail-safe system. The power station would just cut out, like pulling a plug out of the wall. It would just shut down, and that would be that
	-4	A lot of people are unhappy about the power station but they don't do anything about it. Only a few of us are willing to stand up and be counted	The nuclear industry is open and honest	The power station has provided good jobs for the area - without it, this place would have ceased to exist	We can trust the industry to come forward and tell the truth about any discharges and incidents
	-4	There's just something about nuclear power that makes me feel uneasy	I'm confident that this nuclear power station is safe	The Chernobyl accident focused my mind on the fact that I was living with that potential danger	I am reminded of the potential risks of the power station only when I see it, or when someone nearby has got cancer
	-5	The power station is a terrible eyesore	We can trust the industry to come forward and tell the truth about any discharges and incidents	I find the power station quite comforting rather than a threat	Because of the power station, this will be a polluted, hazardous place forever
	-5	There are lots of cancer risks associated with the power station	Nuclear power is one of the best forms of electricity generation. The country needs it and will have to build more nuclear power stations	The presence of the power station is just another example of this area being picked on	There are lots of cancer risks associated with the power station
	-5	Because of the power station, this will be a polluted, hazardous place forever	I would welcome a new nuclear power station being built here	A lot of people are unhappy about the power station but they don't do anything about it. Only a few of us are willing to stand up and be counted	The Chernobyl accident focused my mind on the fact that I was living with that potential danger

Table 4: Highest and lowest ranked statements for each factor

Table 5: Rankings for 'Trust' statements

Statement	Beneficial and safe	Threat and distrust	Reluctant acceptance	Normalisation
The nuclear industry is open and honest	+1	-4	-3	-3
The government is more concerned with money and big business than our best interests	+1	+3	+3	+1
When I hear spokespeople for bodies like the Environment Agency telling us we have nothing to worry about, I do not find that reassuring	-1	+3	+1	+2
If there was a problem, there is a very good, fail-safe system. The power station would just cut out, like pulling a plug out of the wall. It would just shut down, and that would be that	+2	-3	-3	-4
The nuclear industry doesn't really consult – they go through the motions but the important decisions have already been made	0	+4	+2	0
We can trust the nuclear industry to come forward and tell the truth about any discharges and incidents	+1	-5	-3	-4
We can trust the power station staff to make sure it is safe – they are ordinary people just like us	+3	-1	+1	+1
The nuclear industry tries to brainwash people into thinking that nuclear power is safe and acceptable	-4	+4	-3	0
When you get a study that shows there's more cancer here than there should be, they just say it's a 'statistical blip'. You get the feeling they are trying to hide something	-2	+4	-1	0
The regulatory authorities in this country are probably the best in the world. There's never any question about nuclear safety at all, in any of the plants	+2	-3	0	-3
I worry something will go wrong at the power station because of people cutting corners or making mistakes	-4	+2	-2	-3
When it comes to nuclear power, you can't trust the government	0	+3	-1	+3

Factor 1: Beneficial and safe

This factor was characterised by two main constructs: the benefits that nuclear power brought both locally and nationally, and safety associated with relatively high levels of trust in the competence of the power station operatives and moderate confidence in the regulators. Supplementary questions regarding respondents' attitudes to nuclear power indicated that almost all respondents flagged on this factor (36, 97%) were positive about nuclear power in general, with 30 (81%) indicating that they would support the building of a new nuclear power station on the existing nuclear site (Tables 6 and 7).

Nuclear power was regarded as both safe and clean in this point of view, and respondents were also emphatic (ranking +5; Table 4) that they would rather live near to a nuclear power station than a coal fired one or by a dirty industrial site. Nuclear power was considered necessary for the UK's energy security, although the need for renewable sources of energy production running alongside nuclear was not dismissed. At a local level the nuclear power station was regarded as an asset which brought benefits to the community, and people with this perspective did not feel that the area would be contaminated and stigmatised by its presence. Trust within this perspective was placed primarily in the competence of the power station operatives to ensure nuclear safety (Table 5). These were regarded as 'ordinary people just like us' who could be relied on not to cut corners or take chances., whilst fear amongst the public was regarded by these participants as 'irrational' and borne of a lack of understanding about nuclear power. Interestingly, although clearly a perspective that views nuclear power as highly beneficial, the highest ranked statement (statement 48, ranked +5; Table 4) expresses a degree of *ambivalence*, acknowledging that while nuclear power is not perfect and has drawbacks it is the best option available.

Factor 2: Threat and distrust

This factor was based strongly on themes of threat, distrust and, to a lesser degree, social mobilisation. As noted above, there was a negative correlation with factor 1 of moderate strength (-.56; Table 3). This factor produced the most unequivocal sort pattern overall, and as such represented a clear anti-nuclear stance, with 24 of 29 (i.e. 86%) of the

grouped respondents indicating that they were opposed to nuclear power in general, and 28 (96%) indicating that they were opposed to the building of a new nuclear power station locally, on the general attitude measures (Tables 6 and 7).

This perspective emphasised, above all, a perceived need to stop using nuclear power and to move towards using renewable sources of energy as soon as possible. Nuclear power was regarded as risky, and neither clean, nor a 'necessary evil' which might be required to help combat climate change or improve energy security. There was a marked sense of distrust, particularly of the nuclear industry, and terrorism and day to day emissions were major concerns for people with this point of view. The storage of radioactive waste on the site following decommissioning was a strong concern and there was a clearly stated willingness to mobilise against any attempt to establish a permanent waste facility on the site, and, to a lesser degree, to protest against new power station proposals.

Factor 3: Reluctant acceptance

This factor was defined by far fewer flagged sorts (8) than the previous two perspectives. It retained elements of the other main points of view but very clearly placed strong emphasis on particular aspects of nuclear power and in doing so defined a unique stance. Unlike factors 1 and 2, the perspective was dominated by a cluster of similar statements with high factor scores indicating the *reluctant* acceptance of nuclear power. The majority of people associated with this factor (7 out of 8) were either neutral or positive about nuclear power in general, while half of these respondents were neutral on the issue of a new power station locally (Tables 6 and 7).

The reluctant acceptance of nuclear power captured by this factor showed the respondents holding this point of view were persuaded that it may be necessary in order to combat climate change and ensure a secure energy supply. Nuclear power appeared to be regarded as clean and efficient, and although the existence of associated risks was acknowledged, these were presented as something best not dwelt upon. It was notable that individuals with this perspective appeared to be uncertain about who to trust about potential risks, distrusting the nuclear industry on the matter and to some extent the government too. Holistic reading of the sort suggests that the perspective expresses a sense of duty to look beyond individual concerns in order to see 'the bigger picture'. In other words, a

feeling that as nuclear power may be necessary in the future whether people like it or not, a new station might be tolerated in the locality since they would have to go somewhere.

Factor 4: Normalisation

As with factor 3, this emerged as a minority position among our sample, with only 4 sorts flagged, but one defined by consistently high factor scores of a small number of similar statements. There was no clear pattern with regard to support or opposition to nuclear power (Tables 6 & 7). Again, as with factor 3, people associated with this point of view acknowledged that there may be risks associated with the nuclear power station but appear to adopt a pragmatic, normalising, approach to having to live with them.

For individuals with this outlook, the power station was normalised as being 'just part of the landscape'. It was not something that they worried about particularly and they barely noticed it was there. Nuclear power was regarded as a relatively clean source of energy. Although there seemed to be some concern about emissions to the local estuaries on which the stations were sited, minor incidents at the power station were dismissed as inconsequential and subject to media exaggeration. Nevertheless, the perspective captured by this factor took a highly critical view of institutions, expressing a lack of trust in government and the nuclear industry in particular, and little confidence in the nuclear and environmental regulators. Closer to home it does express, in common with Factor 1 and to a lesser extent Factor 3, *relatively* more confidence in the workers at the local power station. There was no sympathy for local critics of the power station, who were seen as having the choice to live elsewhere, while 'Greens' generally were seen as blocking progress.

Table 6: Overall affective attitude towards nuclear power by Q group

Q group	Very Negative	Fairly Negative	Neither positive nor Negative	Fairly Positive	Very Positive
Beneficial and safe	0	1	0	18	18
Threat and distrust	14	10	1	4	0
Reluctant acceptance	0	0	3	4	1
Normalisation	1	0	1	1	1

Question: Overall, how do you feel about nuclear power?

Table 7: Attitude towards new nuclear build at the existing local site by Q group

Q group	Strongly oppose	Tend to oppose	Neither support nor oppose	Tend to support	Strongly support
Beneficial and safe	2	2	3	17	13
Threat and distrust	26	2	1	0	0
Reluctant acceptance	1	1	4	1	1
Normalisation	0	0	2	2	0

Question: To what extent would you support or oppose the building of a new nuclear power station on the existing Oldbury/Bradwell site?*

**as appropriate to each sample*

Interpretation and Discussion

As we have seen, analysis revealed four distinct but complex points of view amongst the public sample, which we have characterised as: Beneficial and Safe; Threat and Distrust; Reluctant Acceptance; and Normalisation. We now consider each of these perspectives, the relationships between them, and their relevance for theoretical debates in the risk literature.

The first perspective that we have labelled Beneficial and Safe is strongly associated with a consideration of the perceived benefits of nuclear power at both local and national levels. Nuclear power is regarded as 'one of the best forms of electricity generation' and, at a local level, the power station was described as 'a great asset to the community over the years'. Thus, the perspective reflected a perception of risk shaped partly by economic and political factors (Bickerstaff, 2004). Respondents were clear that they would rather live near to a nuclear power station than a coal fired one or by a dirty industrial site, and also rejected the idea that the station was an eyesore or made their community a contaminated place (cf. Flynn et al, 2001; Edelstein 2003). This finding is consistent with other surveys, suggesting that although nuclear power stations are the form of energy production that the public in general would prefer to live furthest away from, some segments of 'nuclear communities' can show strong support for the local facility (Melber et al., 1977; Eiser et al, 1996). For such individuals, then, the presence of the power station is clearly *not* perceived to be a source of technological stigma – indeed the data suggest quite the opposite.

Alongside the benefits that nuclear power was believed to bring, there was a confidence in this perspective that the power station was safe, seemingly underpinned by a degree of *social trust* in the power station workers. Society's increasing dependence on technology and associated expertise, together with the consequences of the policies and practices of relevant institutions, places an increasing emphasis on the trust relationships between society and those responsible for making decisions (Rosa & Clark, 1999). A longstanding finding in the risk domain is that expressed distrust in managers is positively correlated with the rejection of both nuclear power and radioactive waste. While trust, as a construct related to the management of technological risk, has been theorised in a number of ways, frequently as perceptions of an organisation's competence or care (see Johnson, 1999), more recently Earle and Cvetkovitch (1995) point to the importance of shared values - so-called social trust (also Siegrist and Cvetkovich, 2000; Siegrist, Cvetkovich and Roth, 2000). On the whole the full set of trust rankings shown in Table 5 express negative sentiments and, to a greater or lesser degree distrust. Factor 1 is the one clear exception. These particular individuals emphasise the reliability and competence of the power station staff to do their jobs properly, as well as the sharing of common values: in particular, the statement 'We can trust the power station staff to make sure it is safe – they are ordinary people just like us' received an overall

ranking of +3 (see Appendix) within Factor 1, while the statement expressing concern about operators a cutting corners was strongly rejected (-4). By contrast, people in this factor expressed less confidence in wider institutional actors such as the nuclear industry, the government, and the Environment Agency: for example, the statement 'the nuclear industry is open and honest' only received an overall rank of +1. Expressions of social trust in this context are likely to relate to any of three processes. First, agreement and sympathy borne of shared experiences of the power station amongst local people, and in particular current or former employees (cf. Simmons and Walker, 1999, who report a similar factor associated primarily with chemical plant employees). Although in the present study nuclear employees and their families were indeed most strongly associated with this perspective, so were many others in each community who did *not* have declared direct links to the industry. This suggests that social trust does not depend solely upon shared social values sustained through direct economic linkages, but can be mediated in other ways. A second basis for such trust might reside in a perception of common interest - that power station staff can be trusted not to take risks, because any dangers caused by corner cutting would also be a threat to themselves and their families. Finally, the inability of members of the public to personally resolve the issue of nuclear safety can lead to a degree of reliance being placed in technology and its operators (Poortinga and Pidgeon, 2003). The only other option is to accept a lack of control and, as Langford (2002) has argued, face the true extent of one's helplessness and anxiety (also Giddens, 1990).

Our interpretation of factor 1 does sit somewhat in contrast to the 'dependency syndrome' described by Wynne, Waterton and Grove-White (2007[1992]) in isolated local communities around the Sellafield nuclear complex in Cumbria (*cf*. Blowers and Leroy 1994). In that study, the dominance of the nuclear industry in providing jobs, economic multiplier effects on the local economy, and sponsorship led to the apparent 'burying' of local people's anxieties, ambivalence, and concerns about the power station and the way it is operated. The findings described here indicate that isolation and dependency are not the only reasons why some local people might express positive attitudes towards a nuclear power station. However, with the exception of two items, statements relating to perceptions of threat tended to receive rankings close to zero (i.e. *not* high negative rankings), suggesting again a degree of the ambivalence (as described by Wynne and colleagues) in that Factor 1 participants do not completely reject the possibility of threat – but rather, did not appear to have (or possibly feel able to voice) strong opinions on these issues.

The second factor was characterised by three clear themes, specifically: threat, distrust and social mobilisation. As with the first factor, this second perspective strongly reflected a consideration of costs and benefits. However, in this instance it was the potential *costs* of nuclear power that outweighed the benefits, particularly with regard to issues of safety[5]. Although characterising a clear and unequivocal 'anti-nuclear' perspective, with some factor scores correlating negatively with those of factor 1, its emergence as a separate factor in the Q analysis (together with the moderate strength of the correlation) indicates that the two perspectives represented by factors 1 and 2 do not represent simple bipolar opposites. For some statements the perspectives are indeed in opposition, as when the statement of safety is strongly endorsed (+5) within factor 1 and clearly rejected (-4) by the factor 2 participants (Table 4). However, clear qualitative differences between the factor interpretations relate to beliefs about the forms of energy generation that are considered acceptable, of trust and threat, and of benefits to the local community. For example, the perceived need to move towards using renewable sources of energy as soon as possible was the highest ranked statement in point of view 2, while participants in perspective 1 also endorsed renewable sources (albeit to a lesser degree, rank +3; Appendix) as well as nuclear power. All of the statements relating to nuclear threat received high rankings in the Threat and Distrust factor.

Factor 2 was also accompanied by strong feelings of distrust towards the nuclear industry, in particular; with regard to its honesty and openness regarding incidents, the integrity of its consultation efforts, and a perception that it engages in propaganda regarding plant safety (Table 5). Distrust was also expressed, although to a lesser extent, towards both the government and the Environment Agency. Overall the expression of distrust in perspective 2 received greater emphasis in the statement rankings than the expression of trust in factor 1. We interpret this finding in terms of the asymmetry of trust hypothesis described by Slovic (1993).

[5] Although, as noted above, the factor *structure* was essentially similar at both locations, one difference was the number of individuals associated with each factor. More individuals from Oldbury are associated with factor 1 and more from Bradwell with factor 2 (see Table 2). In part this reflects the samples constituted at each location, which in Bradwell comprised some people who were actively engaged in anti-nuclear groups plus a small number of others networked through these initial contacts. At Oldbury by contrast no such individuals could be identified. This difference may also reflect in part the long history of social mobilisation at the Bradwell site compared to Oldbury.

Slovic demonstrates in an experimental sample that trust is much harder to gain than it is to than lose; our evidence suggests, in a similar manner, that feelings of trust and distrust might differ in strength. Our data also indicate that there might, in addition, exist a *qualitative asymmetry* between trust and distrust judgements. In the current study, trust (in factor 1) was associated with the perceived familiarity, reliability, and competence of the local power station staff, whilst distrust (in factor 2) was associated with the openness, honesty and integrity of the nuclear industry. In theoretical terms we may need to revisit the notion of trust and distrust as *separate* constructs, rather than being at the opposite end of any single continuum (see also Lewicki, McAllister and Bies, 1998; Poortinga and Pidgeon, 2003), Clearly, further detailed research is required to establish the extent and potential generality of this finding. A further important difference was evident with regard to the power station's perceived contribution to the local community. Whilst community benefit was emphasised in the Nuclear Power is Beneficial and Safe perspective, individuals in the Threat Distrust and Social Mobilisation factor were relatively non-committal. This illustrates the point reported by van der Pligt et al. (1986) that issues which are salient to those with one point of view on nuclear power are not necessarily denied by others with an opposite view – they may simply be considered unimportant. Indeed, the pattern of results reported here is consistent with several previous studies suggesting that rather than being simple opposites, local people with 'pro' and 'anti' views on nuclear power emphasise different aspects of the issue (Otway et al., 1978; Woo & Castore, 1980; see also Eiser & van der Pligt, 1979; van der Pligt et al., 1982; van der Pligt et al., 1986).

The statements emphasised in factor 2 also reflect long standing public concerns over trust, waste management and the secrecy of the nuclear industry (Grove-White et al., 2006). What is also clear is that individuals associated with the Threat and Distrust perspective are the most likely within our sample to engage in actively protesting against any new nuclear facility. Indeed, the four individuals who were, or had been involved in such social mobilisation all loaded highly on this factor (range: .76 - .80), and included the single highest loading individual. However, many individuals loading on this factor had no prior connection to such activity, and examination of individual sorts revealed that there were few qualitative differences between the 'activist' and the 'non-activist' sorts within the factor. This suggests that these individuals have essentially similar attitude structures on this issue, the difference only being the 'activists' have been sufficiently motivated in the past to

actually protest about the power station, an observation we return to in the conclusion section. Thus, it is possible that *strength* of feeling was masked by the ranking requirements of the Q sort as the divisions are ordinal, not ratio (McKeown & Thomas, 1988). Nevertheless, there was clear potential for social mobilisation, focused particularly strongly on the issue of potential local disposal of radioactive waste (ranked +5). In the Bradwell area, from which most of the individuals associated most strongly with this factor were drawn, this issue had of course provoked widespread local protest activity in the late 1980s. This potential for mobilisation was also evident, albeit to a lesser extent, in relation to the siting of any new power station on the two sites.

In addition to these two main factors, two minority points of view were identified, together incorporating 12 of the 84 people sampled, and accounting together for 11% of total variance. The first of these appeared to relate to an emerging discourse identified by Bickerstaff et al (2008) as 'Reluctant Acceptance' of nuclear power, exemplified by the three statements with highest rank in factor 3 (Table 4). As noted in the introduction, for some years now the UK has seen a renewed policy debate regarding the role of nuclear power for combating climate change and providing a degree of energy security for the country. Using exploratory focus groups Bickerstaff et al found that some general public participants originally concerned about radioactive waste and nuclear power were prepared to tentatively accept nuclear energy if it would help combat climate change. However, framed in this way nuclear power was only conditionally endorsed as 'the best of a bad lot'. In a follow-up quantitative survey Pidgeon et al (2008) confirm the contingent nature of this form of acceptance of nuclear power, with very few people actually preferring nuclear power generation over renewable sources of energy when given the choice. Given that such sentiments correspond closely with recent policy discourses on the future of nuclear power expressed by both government and the industry, it seems likely that that such respondents were engaged with recent media coverage of the UK nuclear debate and/or local debates over the future role of nuclear power at the sites. Despite endorsing current policy discourses, people associated with this point of view nevertheless considered both the government and the nuclear industry to be somewhat untrustworthy, and harboured concerns about living near to a nuclear power station. Apparently contradictory thinking, reinforced by the feelings of uncertainty ('There's so much contradictory information on the risks, in the end you just don't know who to believe'), suggested that some people who outwardly support these policy arguments in favour of nuclear power, remain unsure about

who exactly to believe, and harbour significant doubts about whether they are able to trust the authorities on the issue. In terms of how people sharing this perspective approach living with nuclear risk, the factor array suggested that individuals with this perspective consider that personal objections alone are insufficient to warrant its rejection perhaps through a sense of national interest or civic duty.

The fourth of the factors had only four participants associated strongly with it and explained just 4% of the variance in this sample. However, it was clear and straightforward to interpret, reflecting a view that the nuclear power station was just a normal (and generally unremarkable) part of the landscape and place (cf. also Simmons and Walker, 1999). It is a perspective that we had predicted would arise as a result of our analysis of the initial narrative interviews obtained at Bradwell – what is perhaps more surprising is the relatively small number of individuals (4) who load strongly onto this factor. People with this perspective did not appear to be particularly motivated to consider potential risks: evidenced by statements suggesting there is little point to worrying (column 4; Table 4). Accordingly, we have labelled this factor Normalisation, although it also expresses elements of the disengagement from risk issues described by Langford (2002). Thus, statements which expressed criticism of those who objected to, or protested against the power station were ranked positively, while statements expressing personal activism were rejected by these participants. Despite their apparent indifference to risk, however, people in this factor were highly distrustful, harbouring a sense of cynicism towards the government, the nuclear industry, the regulatory authorities and nuclear technology. Such expressions may relate to deeply entrenched notions of social distrust – not only a belief that individuals neither bear the brunt of the responsibility, nor have the power to make a difference, but also that one cannot trust those with the ability to make a difference cannot be trusted to act (Bickerstaff, 2004; Bickerstaff, Simmons and Pidgeon, 2008).

Study Limitations

In this study Q-method was deliberately employed as a method that could simplify, and in doing so clarify, complex issues across large numbers of individuals each holding their own, unique point of view, and in this respect the exercise was a success. Care is needed, however, when identifying sets of people with particular ‘points of view’ in this way not to assume that the resultant groupings correspond to empirical social groups: on the contrary, our results illustrate how the perspectives

identified may be may shared to varying degrees across the boundaries of established social networks. Nor should these perspectives be taken as fixed points of view; Factor 3, Reluctant Acceptance, is an example of a newly emerging point of view and other, more established perspectives may also adapt to contextual changes. In addition, our study was not a representative survey, and we are unable to predict the extent to which the various idealised points of view described here might apply to a larger population of individuals similarly living with nuclear risk; nor are we able to extrapolate from our results to populations not living in close proximity to nuclear power. Q-method itself has also been subject to generic critique. In particular (and a clear methodological learning point from our experience here) the development of statements is time consuming but success depends entirely upon ensuring that this process is complete (Eden et al., 2005). Finally, while statements placed in the central columns of the Q sort were interpreted as being of zero to low salience in this study, there is a legitimate debate regarding the meaning of centrally ranked statements (see Tuler et al., 2005), and indeed some of our participants had difficult using the forced normal sort for precisely this reason.

Conclusions

Whilst numerous studies exist of situations where local communities have mobilised against a source of perceived technological risk, far less attention has been afforded to those rather more typical situations where local communities live in close proximity to the presence of a potentially hazardous industrial site (Simmons 2003). The current study is, to the best of our knowledge, the first contemporary in-depth investigation of how people living in close proximity to existing nuclear power facilities conceptualise and construe their risks. It gains particular significance because of the newly emerging policy debate in many countries regarding renewal of nuclear energy. Through the use of Q methodology, the study has investigated in a contextually sensitive manner the distinctive points of view that exist in two such local communities. Participants were able to sort the statements in ways that defined their own perspectives while also utilising the analytical power of principal components analysis. The approach and the commonalities and differences identified thus bridge the methodological divide between qualitative and quantitative research philosophies – and as such Q-method has much to commend it for contextual risk perceptions research. The patterns of results from the analysis were broadly similar in both locations, suggesting at least some degree of transferability of the findings, at least to other UK nuclear

communities living in similar circumstances, and further research would clearly be desirable to investigate this possibility.

This study has a number of important practical and theoretical implications. First, our results concur with those of Curry et al., (2005), who suggest that nuclear power in the UK continues to elicit strong opposition as well as support amongst local people. Consistent with the hypothesis that the perceived benefits of nuclear power (in particular through its economic and community embedding) are important for local attitudes, there was clear evidence of positive sentiment amongst a large number of individuals within our sample. Equally, these results should not be characterised as demonstrating overwhelming or consistent community support for the respective facilities. Not only did the analysis highlight *ambivalence* associated with aspects of otherwise supportive views of the local facilities, but a significant proportion of the sample, represented by the Threat and Distrust factor, remained implacably opposed to the technology. The most likely consequence of specific new nuclear build proposals in the UK, even on existing sites, would be a polarisation of local opinion in close, relatively isolated communities, leading to significant conflict within the local communities alongside mobilisation of some against such plans.

We also reiterate the important conclusion that the 'landscape of beliefs' about local nuclear power should not be viewed simplistically and especially not in bipolar terms. Not only are the first two factors not clear opposites, but at least two other nuanced points of view have been found, which we have termed Reluctant Acceptance and Normalisation. The former reflects sympathy and agreement with a strengthening policy discourse on nuclear power and the environment, while the latter, although only a minority position among our sample, suggests that hazardous facilities can be discursively positioned as both unremarkable and, crucially, as an un-remarked aspect of a place and of the daily lives of people living there.

The study has also yielded important new theoretical insights into the relationship between trust, distrust and the acceptability of risk. In many past studies a simple empirical correlation between trust and acceptability has been assumed. Our results point to an important qualitative asymmetry, in this context at least, between the bases of trust and those of distrust. Trust and distrust in this study are clearly associated with the perceived actions of *different* organisations and parties (on the one hand

local plant personnel, on the other more distant institutions). The data also suggest the possibility that different dimensions are responsible in each case. In the case of distrust of industry and government institutions a scepticism about their openness and honesty, while in the case of trust in local personnel a combination of perceived competence and more interpersonal (network-based) social trust. Of course the Q-sort was not designed to test this latter suggestion, in the sense of presenting a complete set of 'trust dimensions' for all institutions involved and a clear next step in the research would be to do so using a more experimental design. As a final comment, Welsh (2000), in his analysis of the history of nuclear power and its opponents in the UK, characterises the industry as having descended from its rosy dawn in the 1950s through a dismal afternoon into an almost perpetual twilight. If the 21st century is indeed to herald a different day for nuclear power, then its conception may prove somewhat more problematic than is currently assumed by both policy makers and the industry alike.

References

Baxter, J., & Eyles, J. (1999). The utility of in-depth interviews for studying the meaning of environmental risk. *Professional Geographer*, 51, 307-320.

Bickerstaff, K. (2004). Risk perception research: socio-cultural perspectives on the public experience of air pollution. *Environment International*, 30, 827-840.

Bickerstaff, K., Lorenzoni, I., Pidgeon, N.F., Poortinga, W., & Simmons, P. (2008). Re-framing nuclear power in the UK energy debate: nuclear power, climate change mitigation and radioactive waste. *Public Understanding of Science*, 17, 145-169.

Bickerstaff, K., Simmons, P., & Pidgeon, N.F. (2008). Constructing responsibilities for risk: negotiating citizen - state relationships. *Environment and Planning A*, 40, 1312-1330.

Bickerstaff, K., & Walker, G. (2001). Public understandings of air pollution: The 'localisation' of environmental risk. *Global Environmental Change*, 11, 133-145

Blowers, A., & Leroy, P. (1994). Power, politics and environmental inequality: a theoretical and empirical analysis of the process of peripheralisation. *Environmental Politics*, 3, 197-228.

Boholm, Å., & Löfstedt, R. (2004). *Facility Siting: Risk. Power and Identity in Land Use Planning*. London: Earthscan.

Brown, S.R. (1980). *Political Subjectivity: Applications of Q-methodology in Political Science*. New Haven, CT: Yale University Press

Bryant L., Green, J., & Hewison, J. (2006). Understandings of Down's syndrome: A Q methodological investigation. *Social Science & Medicine*, 63, 5, 1188-1200

Bush, J., Moffatt, S., & Dunn, C. (2001). 'Even the birds round here cough': stigma, air pollution and health in Teeside. *Health and Place*, 7, 47-56

Chess, C., & Johnson, B.B. (2006). From the inside out: environmental agency views about communications with the public. *Risk Analysis*, 26, 1395-1407.

Curry, T., Reiner, D., de Figueiredo, M., & Herzog, H. (2005). *A Survey of Public Attitudes Towards Energy& Environment in Great Britain*. Laboratory of Energy and the Environment. Cambridge, MA: MIT.

DBERR (Department for Business, Enterprise and Regulatory Reform) (2008). *Meeting the Energy Challenge: A White Paper on Nuclear Power*. London: The Stationary Office.

Earle, T.C. & Cvetkovich, G. (1995). *Social Trust: Towards a Cosmopolitan Society*. Westport CT: Praeger.

Edelstein, M.R. (1987). Toward a theory of environmental stigma. In J. Harvey & D. Denning (eds) *Public Environments*. Ottowa: Environmental Design Research Associates, pp. 21-25.

Edelstein, M. (2003). *Contaminated Communities: Coping with Residential Toxic Exposure*. 2nd Edition. Boulder: Westview.

Eden, S., Donaldson, A., & Walker, G. (2005). Structuring Subjectivities? Using Q-method in human geography. *Area*, 37, 4, 413-422.

Eiser, J. R., & van der Pligt, J. (1979). Beliefs and values in the nuclear debate. *Journal of Applied Social Psychology*, 9, 524-536.

Eiser, J.R, van der Pligt, J., & Spears, R. (1995). *Nuclear Neighbourhoods: Community Responses to Reactor Siting*. Exeter: Short Run Press Ltd.

European Commission (2006) *Energy Technologies. Knowledge – Perception – Measures*. Brussels: DG Research, Sustainable Energy Systems.

European Commission (2008) *Attitudes towards Radioactive Waste, Special Eurobarometer 297, June 2008*. Brussels: DG for Communication.

Field, A. (2000). *Discovering Statistics Using SPSS for Windows*. Sage: London

Fitchen, J.M., Heath, J.S., & Fessenden-Raden, J. (1987). Risk perception in community context: a case study. In B.B. Johnson & V. Covello, (eds.) *The Social and Cultural Construction of Risk.* Dordrecht: Reidel, pp.31-54.

Flynn, J., Slovic, P., & Kunreuther, H. (2001). *Risk, Media and Stigma*. London: Earthscan.

Giddens, A. (1990). *The Consequences of Modernity*. Cambridge: Polity Press.

Glaser, B.G., & Strauss, A.L. (1967). *The Discovery of Grounded Theory*. New York: Aldine de Gruyter.

Gregory, R., Flynn, J., & Slovic, P. (1995). Technological stigma. *American Scientist*, 83, 220-223

Grove-White, R., Kearnes, M., Macnaghten, P., & Wynne, B. (2006). Nuclear futures: assessing public attitudes to new nuclear power. *The Political Quarterly*, 77, 238-246

Hecht, G. (1998). *The Radiance of France: Nuclear Power and National Identity after World War II*. Cambridge, Mass: MIT Press.

Hill, S. (1992). *Democratic Values and Technological Choices*. Stanford, California: Stanford University Press.

Horlick-Jones, T., Sime, J., & Pidgeon, N.F. (2003). The social dynamics of risk perception; implications for risk communication research and practice. In N.F. Pidgeon, R.K. Kasperson & P. Slovic (eds.) *The Social Amplification of Risk*. Cambridge: Cambridge University Press, pp 262-285.

Irwin, A., Simmons, P., & Walker, G. (1999). Faulty environments and risk reasoning: the local understanding of industrial hazards. *Environment and Planning A*, 31, 1311-1326.

Jackson, I., & Jackson, S. (2007) *Siting New Nuclear Power Stations: Availability and Options for Government*. London: DTI.

Johnson, B.B. (1999). Exploring dimensionality in the origins of hazard related research. *Journal of Risk Research*, 2, 325-354.

Johnson, B.B., & Chess, C. (2006). From the inside out: Environmental Agency views about communications with the public. *Risk Analysis*, 26, 1395-1407

Kasperson, J.X, Kasperson, R.K., Pidgeon, N.F., & Slovic, P. (2003) The social amplification of risk: assessing fifteen years of theory and research. In N.F. Pidgeon, R.K. Kasperson & P. Slovic (eds.) *The Social Amplification of Risk*. Cambridge: Cambridge University Press, pp 13-46.

Kline, P. (1994). *An Easy Guide to Factor Analysis*. London: Routledge

Knight, R. (2005). What the polls tell us. *Nuclear Engineering International*, April 2005, 24-25.

Langford, I.H. (2002). An existential approach to risk perception. *Risk Analysis*, 22, 101-120.

Lewicki, R. J., McAllister, D.J., & Bies, R.J. (1998) Trust and distrust: new relationships and realities. *The Academy of Management Review*, 23, 438-458.

MacGill, S. (1987). *Sellafield's Cancer-link Controversy: The Politics of Anxiety*. London: Pion Press.

McKeown, B., & Thomas, D. (1988). *Q Methodology: Quantitative Applications in the Social Sciences No. 66*. Thousand Oaks, CA: Sage.

Melber, B., Stanley, N., Hammersla, J., & Rankin, W. (1977). *Nuclear Power and the Public: Analysis of Collected Survey Research*. Seattle, WA: Battelle Memorial Institute.

Niemeyer, S., Petts, J., & Hobson, K. (2005). Rapid climate change and society: assessing responses and thresholds. *Risk Analysis*, 25, 1443-1456.

Otway, H., Maurer, D., & Thomas, K (1978). Nuclear power: the question of public acceptance. *Futures*, 10, 109-118.

Pidgeon, N.F., & Henwood, K.L. (2004). Grounded theory. In M. Hardy and A. Bryman (Eds.) *Handbook of Data Analysis*. London: Sage, pp 625-648.

Pidgeon, N.F., Hood, C., Jones, D.K., Turner, B.A., & Gibson, R. (1992). Risk Perception. In: *Risk Analysis, Perception and Management: Report of a Royal Society Study Group*, London: The Royal Society, pp 89-134.

Pidgeon, N.F., Lorenzoni, I., & Poortinga, W. (2008). Climate change or nuclear power - no thanks! A quantitative study of public perceptions and risk framing in Britain. *Global Environmental Change*, 18, 69-85

Poortinga, W. & Pidgeon, N.F. (2003). Exploring the dimensionality of trust in risk regulation. *Risk Analysis*, 23, 961-972.

Rosa, E.A. (2005). Déjà vu all over again for nuclear power? *Science* 310(5748), p 619.

Rosa, E.A., & Clarke, D.L. Jnr. (1999). Historical routes to technological gridlock: nuclear power as a prototype vehicle. *Research in Social Problems and Public Policy*, 7, 21-57.

Rosa, E.A., & Freudenburg, W.R. (1993). The historical development of public reactions to nuclear power: implications for nuclear waste policy. In R.E. Dunlap, M.E. Kraft, & E.A. Rosa. (Eds) *Public Reactions to Nuclear Waste: Citizens' Views of Repository Siting*. Duke University Press, Durham.

Satterfield, T., (2001). In search of value literacy: Suggestions for the elicitation of environmental values. *Environmental Values*, 10, 331-359

Siegrist, M., & Cvetkovich, G. (2000). Perception of hazards: the role of social trust and knowledge. *Risk Analysis*, 20, 713–720

Siegrist, M., Cvetkovich, G., & Roth, C. (2000). Salient value similarity, social trust, and risk/benefit perception. *Risk Analysis*, 20, 353–362

Simmons, P. (2003). Performing safety in faulty environments. *The Sociological Review*, 51(s2): 78-93.

Simmons, P., & Walker, G. (1999). Tolerating risk: policy, preinciples and public perceptions. *Risk Decision and Policy*, 4, 179-190.

Simmons, P., & Walker, G. (2004). Living with technological risk: industrial encroachment on sense of place. In Boholm, Å & Löfstedt, R. (eds), *Facility Siting: Risk Power and Identity in Land Use Planning*. London: Earthscan.

Slovic, P. (1987). Perception of risk. *Science*, 36, 280-285.

Slovic, P. (1993). Perceived risk, trust and democracy. *Risk Analysis*, 13, 675-682.

Stainton-Rogers, R. (1995). Q methodology. In J.A. Smith, R. Harré & L. van Langenhove, (eds) *Rethinking Methods in Psychology*, London: Sage, pp. 178–192.

Tuler, S., Webler, T., & Finson, R. (2005). Combining perspectives on public involvement: planning for risk characterisation and risk communication about radiological contamination from a national laboratory. *Health, Risk & Society*, 7, 3, 247-266.

van der Pligt, J. (1992). *Nuclear Energy and the Public*. Blackwell: Oxford.

van der Pligt, J., Eiser, J.R. & Spears, R (1986). Construction of a nuclear power station in ones locality: attitudes and science. *Basic and Applied Social Psychology* 7(1): 1-15.

van der Pligt, J., van der Linden, J., & Ester, P. (1982). Attitudes to nuclear energy: beliefs, values and false consensus. *Journal of Experimental Psychology*, 2, 221-231.

Welsh, I. (2000). *Mobilising Modernity: The Nuclear Moment*. London: Routledge

Woo, T.O., & Castore, C.H. (1980). Expectancy-value and selective exposure as determinants of attitudes towards a nuclear power plant. *Journal of Applied Social Psychology*, 10, 22-234.

Wynne, B. (1992). Risk and social learning: reification to engagement. In: S. Krimsky, & D. Golding (Eds.) *Social Theories of Risk*. Praeger, Westport CT.

Wynne, B, Waterton, C, & Grove-White, R. (2007 [original 1992]). *Public Perceptions and the Nuclear Industry in West Cumbria*. Lancaster University : Centre for the Study of Environmental Change.

Zonabend, F. (1993). *The Nuclear Peninsula*. Cambridge: Editions de la Maison des Science de l'Homme / Cambridge University Press.