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Burgess, Jacquelin; Stirling, Andy; Clark, Judy; Davies, Gail; Eames, Malcolm; Staley, Kristina; Williamson, Suzanne

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Deliberative mapping: a novel analytic-deliberative methodology to support contested science-policy decisions

Jacquelin Burgess, Andy Stirling, Judy Clark, Gail Davies, Malcolm Eames, Kristina Staley and Suzanne Williamson

This paper discusses the methodological development of *Deliberative Mapping* (DM), a participatory, multi-criteria, option appraisal process that combines a novel approach to the use of quantitative decision analysis techniques with some significant innovations in the field of participatory deliberation. DM is a symmetrical process, engaging “specialists” and “citizens” in the same appraisal process, providing for consistency of framing, mutual inter-linkage and interrogation, and substantial opportunities for face-to-face discussion. Through a detailed case study of organ transplantation options, the paper discusses the steps in DM. The analysis shows that DM is able to elicit and document consensual judgments as well as divergent views by integrating analytic and deliberative components in a transparent, auditable process that creates many opportunities for personal learning, and provides a robust decision-support tool for contested science-policy issues.

1. Introduction

Over the last decade, the rhetoric of public engagement in science policy has been complemented by increased experimentation with a range of more sophisticated decision-support tools that seek to bring experts and lay members of the public into dialogue. This action-oriented, often interdisciplinary work is fusing different traditions of decision-making, creating new cultural-political policy processes in different countries around the world (e.g. Fiorino, 1990; Marris and Joly, 1999; Kasemir et al., 2003; Goven, 2003; Wilsdon and Willis, 2004; Jasanoff, 2005). The outcome is a growing number of hybrid processes whose common elements include processes able to articulate key elements of established expert-based procedures within wider frameworks for deliberation and inclusion (Renn et al., 1995; Irwin, 2001; Joss and Bellucci, 2002; Petts et al., 2004).

This paper addresses methodological issues in designing and implementing an analytic-deliberative process for a health question but draws on a decade’s experimentation in environmental and socio-technological policy appraisal by some of its authors. *Deliberative Mapping* (DM) is a participatory, multi-criteria, option appraisal process that combines a novel approach to the use of quantitative decision analysis techniques with some significant innovations in the field of participatory deliberation. Notably, DM is a symmetrical process,

in which panels of specialists and small groups of citizens follow essentially the same multi-criteria option appraisal procedure. Parallel strands of the process engage “specialists” and “citizens,” with careful attention to providing for consistency of framing, mutual inter-linkage and interrogation, and substantial opportunities for face-to-face discussion and debate. DM has been developed and evaluated in two full-scale trials since 2001. The first explored options for organ transplantation in the UK (Davies et al., 2003); the second demonstrated that citizens could participate in an option appraisal process for the disposal of the UK’s legacy radioactive wastes (Burgess et al., 2004). Here we focus on the development of DM to appraise options for closing “the kidney gap” between the number of patients requiring a new kidney and the number of organs available for transplantation.

2. The turn to analytic-deliberative decision-support tools

The term “analytic-deliberative” (A-D) was coined in the risk field to describe characterization processes able to reconcile “technocratic” and “citizen-centric” approaches (Stern and Fineberg, 1996). The *analytic* comprises “ways of building understanding by systematically applying specific theories and methods that have been developed within communities of expertise” (p. 97). Whilst discursive argument demands the exercise of logic and reasoning, here *analytic* refers mainly to scientific and technological data/methods of risk assessment in decision processes. *Deliberation* is defined as a communicative process: “people confer, ponder, exchange views, consider evidence, reflect on matters of mutual interest, negotiate and attempt to persuade each other ... deliberation implies an iterative process that moves towards closure” (p. 73). A-D processes are not confined to risk assessment and examples may be found in health policy and natural resource management (Kerr et al., 1998; Abelson et al., 2003; Pellizzoni, 2003). A key driver is the failure of technical-expert and bureaucratic-rationalist modes of option appraisal to engage effectively with the knowledge, values and interests of stakeholders and wider society.

Stern and Fineberg (1996) eschew philosophical discussion but their argument is underpinned by Weblér’s (1995; Weblér et al., 1995) highly influential reading of Habermas which led to identification of *fairness* and *competence* as two fundamental discourse standards for participatory processes. These inform Stern and Fineberg’s seven normative principles for A-D processes. Briefly, *fairness* addresses potential participants’ access to a process, and their ability to shape the agenda, contribute to discussion, and decide outputs. Ideally all whose interests will be affected ought to have the opportunity to take part and all citizens should feel that their interests are being properly represented even if they do not become involved themselves (Dryzek, 1990; O’Neill, 2001). Three sets of social actors are identified: *public officials* charged with implementing a decision; *natural and social scientists* supporting the analytic elements of the deliberation; and *interested and affected parties* identified on the basis of a democratic right to engage in decisions that are of either political and/or material interest to them. The US phrase “interested and affected parties” serves to underline the more litigious basis of US policy-political culture (Jasanoff, 2005). In UK terminology, the more likely phrase is “stakeholders and the wider public.” The discursive standard of *competence* addresses the capacity of participants to contribute and assess knowledge claims. The analytic elements of a process are integral to building competence. Stern and Fineberg stress the need to maintain the “integrity of the analytic process” (1996: 158–9) by, for example, addressing scientific uncertainties in ways comprehensible to participants and ensuring that it is not compromised by political or other pressures. Thus, the deliberative components must be understood, not as public consultation but specifically as a means “to improve understanding.”

Whilst fairness and competence are widely discussed, questions of process conduct and style have tended to be downplayed. An exception is Dryzek whose “standard deliberative virtues” comprise not only equality and openness but also “respect and reciprocity” (Dryzek, 2001: 664) which do not, however, imply lack of contestation. Deliberative inquiry, as a process of public reasoning, requires that differing views and knowledge claims should be freely aired and reasons for holding them explained. But the manner of doing so should be cooperative, giving space for participants to reflect, perhaps modify their beliefs and agree common understandings (Bohman and Rehg, 1997; Bohman, 2000). This contrasts with adversarial or coercive styles of decision-making, whereby partisan opinions compete to win: one example is the “adversarial analysis” model where “contesting groups ... generate competing technical knowledge claims for the purpose of gaining an advantage in policy debates” (Busenberg, 1999: 2) which often lead to stalemate or poorly informed decisions.

A-D processes should inform decisions under conditions of (often fundamental) disagreement (Bell et al., 1977; Collingridge, 1982; Stirling, 2003). The normative presumption is that solutions identified through deliberative processes will often (if not always) be “better” because they ought to be based on a spirit of searching for the common or public good. Authentic deliberation is not about winning arguments but about reasoned exchange and social learning over the possible resolutions. This may (eventually) lead to the identification of a single most reasonable course of action—a “right answer” (Shapiro, 2002). However, “right” may mean no more than workable in the sense of agreeing on a circumscribed area of common ground (Bohman, 2000; Bloomfield et al., 2001), or identifying an outcome acceptable to the majority, even if reluctantly. Sometimes conditional agreement may be reached on the assumptions, priorities or values under which different possible courses of action would be justified, even without such agreement on the favored action itself (Pellizzoni, 2001). In this regard, A-D processes may provide valuable social learning, even when they are aimed at “opening up,” rather than “closing down” the array of potential policy actions (Burgess, 2000; Stirling, 2005). Where process is oriented towards exploring the contending merits of a range of policy alternatives, without forcing closure around just one, then the outputs to policy making will be all the more transparent, accountable and robust. The challenge is to create “a decision framework that stresses not only technical information but also the explicit input of values, insights and tradeoffs” (Petts, 2004: 116). Ideally participants will be able to determine rules and procedures as well as framing the issues and establishing agendas for discussion (Webler, 1995), but in practice the starting point is never one of complete amorphousness. Rather, achieving “good” deliberation will depend on the design of the process, and on the conditions under which deliberation proceeds; how the process is facilitated and how those doing the deliberating relate to one another. Our aim in this paper is not to revisit these normative arguments in an abstract sense but rather, acknowledging their force and importance, to discuss specifically methodological questions about how we have designed and implemented an A-D process which is fit-for-purpose.

3. Deliberative Mapping: design and implementation

Background

DM draws on two prior methodologies: multi-criteria-mapping (MCM) developed by Stirling, Mayer and Eames, and stakeholder decision analysis (SDA) developed by Burgess and Clark. Both use a multi-criteria-analysis approach, moving through *problem framing*, *option scoping*, and *criteria elicitation* to *option appraisal*. MCM is based on a long interview (2–3 hours) with

individuals who, supported by the researcher, work interactively with a piece of dedicated computer software known as *MC-Mapper*. SDA involves facilitated discussions with groups of people (up to 20) who meet for five sequential sessions to deliberate each stage of the appraisal process. Group members work interactively, using low-tech pen and paper techniques throughout. MCM has been used in the appraisal of options for energy policy (Stirling, 1994), for food production (Stirling and Mayer, 2001), and developing criteria for the evaluation of public consultation and engagement processes (Clark et al., 2001; Burgess and Clark 2006). SDA has been applied in a number of environmental planning contexts (Burgess, 2000) and is being taken forward in a process to support implementation of the European Union Water Framework Directive in England and Wales (2006–8).

Although members of the family of multi-criteria-analysis decision-support methods, by adopting the *simplest* of theoretically valid mathematical procedures, both MCM and SDA avoid many of the proliferating complexities and hidden variables that are sometimes a feature of methods in this field (Starr and Zeleny, 1977; Vlek and Cvetkovitch, 1989; Stewart, 1992; Munda et al., 1994). Equally, both are distinct from other multi-criteria methods: specifically, in allowing participants freely to develop their own appraisal criteria, define their own additional options, and perform their own assessment. A key difference between MCM and SDA is the social context in which the process takes place: the former has a structured interview process that highlights uncertainties at each stage, and avoids an emphasis on the aggregation of different parameters and perspectives. The strength of SDA arises from facilitation of the group dynamics to support deliberation between all the participants through the process. DM brings together specialists and citizens in one participatory appraisal process, albeit in differentially facilitated contexts. The methodology maintains MCM's consistency and structure but adapts it for small group-based analysis and deliberation. In these ways, we hoped to meet Yearley's challenge (2001: 160) that "further work needs to be done on exactly how MCM can feed into open and participatory policy deliberations ... it can assist in developing a map of the territory to be accounted for, but does not yet offer much assistance with the explanatory work."

The research team, sharing interests in different aspects of xenotransplantation (Nuffield, 1996; Brown, 2000; Einsiedel, 2002), were supported by a two-year grant from the Wellcome Trust (2001–3) to trial a novel process of public engagement in health issues. Through discussions with Wellcome and experts who later joined the Project Advisory Committee (PAC), we settled on the question: What are the options for closing the "gap" between the number of patients with end-stage kidney failure who require a transplant, and the number of available organs?

Appraising options for reducing "the kidney gap" using DM

The process was divided into two strands: one for "specialists"—individuals with acknowledged expertise in aspects of the issue under discussion, the other for "citizens"—members of the public with diverse knowledge and expertise but not within this field of patient health, biotechnology or medicine. Figure 1 summarizes the stages in the DM Kidney Trial. Specialists followed the standard MCM protocol but with two interviews. Citizens were recruited into small groups ("citizens' panels") who met for six sequential sessions that adapted SDA to produce MCM-compatible data. Part way through the process, the specialists and citizens came together in a day-long workshop.

Participants in the DM trial

A *Project Advisory Committee* of 12 individuals representing a wide range of interests in organ transplantation, including medical specialists, commercial biotechnology companies,

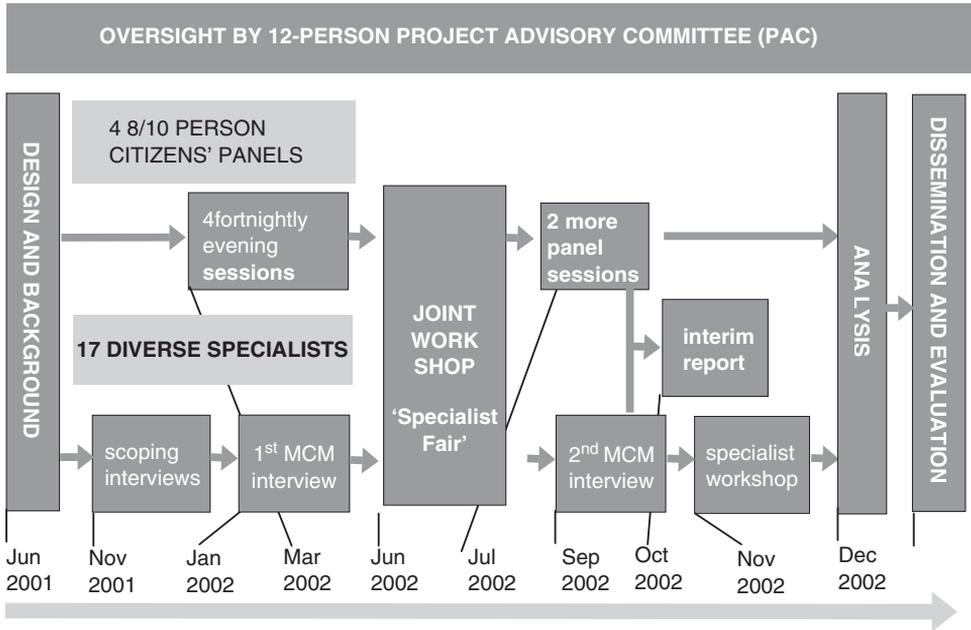


Figure 1. Summary of the structure and timeline of the Deliberative Mapping Project

non-governmental organizations and community development workers provided guidance and advice throughout the project, and commented on all written material. Two independent evaluators for the DM trial attended PAC meetings, the workshop, and received all written materials. In consultation with the PAC, 17 *specialists* were recruited for their expertise in transplant policy (3), medical research (2), biotechnology industries (3), health care policy (3), ethics (2) and wider stakeholders (4) including complementary medicine, animal welfare, religious representation, and a person who had experienced a successful kidney transplantation operation. Although individuals were approached in relation to their institutional affiliations, it was understood that participants' views were entirely personal. Each specialist was offered an honorarium of £300.

Forty *citizens* were recruited to join one of four *citizens' panels*. The key organizing principle was that of creating a supportive environment within which members could be facilitated through the challenging assessment tasks set for them. Previous experience with small in-depth discussion groups (Burgess et al., 1988a, 1988b, 1998) led us to differentiate the panels by gender and socio-economic status, a decision also supported by qualitative studies in health (Wellcome Trust, 1998). Criteria were drawn up to reflect the socio-economic, demographic and ethnic diversity within the London Borough of Camden (the field site), where the proportion of people from non-white ethnic groups was 20 percent in 2001. A specialist company undertook an interview-based recruitment process based on quotas for each panel to ensure they were inclusive of members of hard-to-reach communities such as ethnic minority groups, younger people, and people living on low incomes. Constructing membership of each panel was a painstaking process. A contract was agreed that spelled out the research team's responsibilities to each participant, including a payment of £300. In return, each agreed to attend all the sessions, barring an emergency. Potential panelists were screened to exclude individuals with prior experience in similar participatory processes, direct family

Table 1 Steps in the DM participatory multi-criteria-option appraisal process

SPECIALISTS	Research Activities
Framing /Scoping	<i>Telephone interview:</i> explain structure of DM, project context; establish interviewee expertise; stress MCM-software tool is used as a 'heuristic' to elicit and clarify views in a systematic way, but not to constrain the interviewee to a particular mode of expression; arrange appointment for long interview. Notes taken.
First MCM	<i>Face-to-face interview:</i> individual interviews (2-3 hours) at place of work using the MCM software on a laptop pc. Guidance notes were sent in advance to each specialist. Interview audio-taped and transcribed.
Joint Workshop	<i>Joint Workshop:</i> specialists invited to Workshop. In morning forum, hear and comment on the citizens' viewpoints, and debate their own perspectives. In afternoon 'Specialists' Fair' where individual specialists meet citizens for informal discussion session at citizens' discretion. Specialists unable to attend invited to submit views on the 'kidney gap' to the citizen workshop booklet.
Second MCM	<i>Face-to-face interview:</i> A second interview using MCM to elicit any changes in appraisals, following the Workshop. Interviews audiotaped and transcribed.
Specialist Workshop	<i>Small-group discussions.</i> Held at specialists' request to deliberate on their appraisals, the citizens' appraisals, and wider issues raised by DM project. Audio-taped and transcribed.
CITIZENS PANELS	Research Activities (all group sessions 90 mins; audio-taped and transcribed)
S1. Establish the group/framing the issue	Welcome; introductions to panel members; explain purpose of project; ground rules for conduct of sessions; open discussion around health issues and transplantation; introduction to the kidney and specific scope of the appraisal; handle questions; hand out information booklet.
S2. Scoping the options/establish information needs	Welcome back; review experiences since S1; review booklet content; explain scoping-optionsactivities; split into pairs and choose one option to discuss; bring group together; one pair describe option meaning/issues; discuss; write agreed definition on flipchart. Work through common options; any discretionary option to include? Collate information needs.
S3. Elicit group criteria set	Welcome; review experiences since S2; explain concept of 'criteria' and discuss; split into same pair as S2; each to write possible criteria on separate cards; show, tell and agree criteria with partner; bring group together and do criteria mapping process.
S4. Undertake preliminary option appraisal/plan workshop contribution	Welcome; review experiences since S3; explain scoring posters and work through example with group; distribute sticky dots; encourage free movement to score; facilitators in support; bring group together to review and discuss scoring patterns; discuss what question-issue group will take to Workshop.
Joint Workshop (1 day)	Morning open forum: all 4 panels meet; each makes 10 min. presentation; specialists respond and discuss; Q & A session. Afternoon: each panel meets to review morning, then has freedom to visit any specialists they wish either singly or in groups; final part of afternoon: review and next steps.
S5. Review Workshop experiences/re-appraise options/weight criteria	Welcome back; review experiences at the Workshop; individuals revisit option scoring sheets and adjust any scores if wish; discuss. Introduce idea of weighting; distribute sheet with criteria and explain how to allocate 100 points between the criteria; begin to prepare for termination.
S6. Review the DM outputs/experiences of participation	Welcome back; present result from the appraisal; discuss. Open group discussion about the whole process, including tasks, facilitation, outputs, outcomes; explain next steps in analysis and dissemination. Informal meal.

Table 2 Summary of ‘common’ and ‘discretionary’ options offered for appraisal.

Common options
Option 1. Improved transplant services. Improving existing services, learning from international best practice.
Option 2. Altruistic living donation. Increasing the number of donors through voluntary unpaid living donation.
Option 3. Presumed consent. Increasing the number of donors by giving the medical profession a greater role in making decisions about organ donation.
Option 4. Xenotransplantation. Cross-species transplantation using organs from genetically-modified pigs.
Option 5. Embryonic stem cells. Human tissue engineering using human embryonic stem cells to repair or build kidneys
Option 6. Encouraging healthier living. A preventative approach, involving health education and primary care to help reduce chances of kidney disease.
Discretionary options
Option 7. Improved kidney machines. Building bio-artificial machines that function more like a real kidney.
Option 8. Adult stem cells. Using stem cells from adult humans to repair or build kidneys.
Option 9. Rewarded giving. Providing a small economic incentive for consent to organ donation after a person’s death.
Option 10. Accepting death. Placing greater emphasis on dying with dignity.

experience of kidney-related disorders, and personal involvement in medical or health policy issues. We took this decision as a means to create a common baseline from which the panels could begin their work on the kidney issue. The outcome was four panels (BC1 women—8 members; BC1 men—8; C2D women—10; C2D men—8); four older people in the BC1 panels failed to show up for the first meeting; two decided not to return after the first session of the C2D men’s panel.

Conduct of the DM trial

Table 1 summarizes the specialists’ and citizens’ DM tasks, which will now be discussed in more detail.

Issues and options: processes of problem framing and option definition

Deciding which technology or policy options might be relevant for the resolution of a problem is part of the framing task and often a major point of contention in participatory technology assessments. If the process is being driven by technical and/or specialist knowledge, then options will tend to privilege technology-based strategies over other policy responses. Politically contentious options, or options without organized lobby groups, may be neglected while participants without specialist knowledge find themselves in a subordinate position because they require access to additional information before being able to assess whether the range of options is comprehensive. Following discussions with the PAC and informed by academic review, the research team developed a set of six “common options” (to be appraised by both specialists and citizens) and four “discretionary options” (which all participants were free to appraise if they wished) (Table 2). The “common” set permits detailed comparisons between the different parties in the DM.

Specialists were introduced to the common set of options at the start of their MCM interview and invited to add other options to address issues that they felt have been neglected or unduly emphasized without compromising on comparability across the common set. During the first session for the citizens' panels, following introductions and an outline of the trial, participants were facilitated through an open discussion of organ transplantation and health issues. Each was then given a booklet to take home (see below). The second session explored the common options and discretionary options described in the booklet. Definitions of what each option meant were discussed in pairs and then shared with the whole group. Different issues associated with each option were recorded on flipcharts so that each panel reached a shared understanding of what it understood by the specific options. Within the time-frame of the trial, we felt it too difficult to invite each citizens' panel to decide on completely new options so the panels were asked to appraise the six common options, but each panel was able to select one or more options from the discretionary list, according to their own interests.

Eliciting criteria

Criteria represent the universe of considerations against which the performance of an option needs to be judged. In the specialist interviews, criteria were elicited by asking the interviewee to make a personal judgment about issues of importance in evaluating the relative merits of the options. In many cases, the considerations may be treated as contending appraisal criteria, between which trade-offs may be necessary, such as economic cost and patient quality of life, for example. Alternatively, considerations may be conceived as fundamental issues of principle, under which no compromises or trade-offs may be contemplated (such as financial reward for donation of a body part, for example). In this latter case, any option that is identified as transgressing such an issue of principle would be documented as being effectively ruled out of consideration for that participant. The citizen panel process followed a similar structure, but here criteria elicitation was a stepwise process of negotiated amalgamation which ensured that no criterion was "lost." Group members were asked first to reflect on possible criteria; coming into dialogue with another member of the group, criteria were shared and redundancies eliminated. Where the wording was different, the meanings were explored to see if there was underlying agreement. The whole group then "mapped" criteria on a large sheet of paper in a process whereby one pair was invited to describe one of its criteria which was then offered to the rest of the group for any with similar meaning. Through this iterative process, the universe of criteria was defined and roughly grouped. The research team took the criteria away to draft concise definitions that were then returned to the participants for approval in the following session.

Appraising options

All multi-criteria approaches involve some kind of quantified assessment of performance scores of options under each criterion, but the complexity of the mathematical processes varies enormously. MCM employs the simplest possible "linear additive" process (with final performance ranks given as the weighted sum of normalized criteria scores). Specialists were asked to assign numerical performance scores to represent the performance of each option under each of their chosen appraisal criteria, using an arbitrary interval scale of performance. The "units of measurement" in this scoring process would be different under each criterion and were, of course, subjective and specific to the individual interviewees. For this reason, the values for each criterion are "normalized" using a standard mathematical operation in order to reflect all scores as a function of the difference between the best and worst performing options under each criterion. This operation is performed by the software with results displayed in real time as a simple chart. Specialists were asked to assign two scores to each option under each

criterion—one reflecting performance under the most favorable assumptions, the other under the most pessimistic assumptions. Thus, interviewees were able to express any uncertainty they felt in assigning scores, or to take account of variabilities in performance from context to context. Specialists were then asked to express the relative importance of each of their appraisal criteria in terms of numerical *weighting*, to reflect the relative importance of differences between best and worst performance under each criteria. Weighting reflects intrinsically subjective judgments over principles and priorities. It yields an overall performance ranking for each option. However, because interviewees provide “best” and “worst” performance scores, the rankings are expressed not as single numbers, but as intervals. Issues of principle, under which some options may have been effectively ruled out of consideration, do not have to be assigned a weighting.

The challenge was to adapt this process for the citizens’ panels where individuals would have very different levels of expertise and confidence in handling analytic concepts in this way. In the fourth session, having agreed the wording of the criteria, *options were assessed against the agreed criteria* based on a process of individual judgments. Scoring posters, with the criteria at the top and the list of options down the page were prepared in advance. Each criterion was assigned an interval scale to express the likelihood that a given option would perform well under a given criterion. Every panel member was given a unique sticky symbol and asked to place their symbol somewhere on the line of each option for each criterion to reflect their judgment of how well or badly the option would perform. Where necessary, the facilitation team talked individuals through the judgment process. Although the panelists were not asked to make two judgments, the distribution of scores was often across the full spectrum of the scale and thus reflected differences between judgments about how well or how badly the option performed. These highly visible differences were teased out by the facilitator in group review of the appraisal patterns on the posters. The scoring posters enabled everyone to see how their judgments related to those of their colleagues. The group then discussed these preliminary assessments and reached agreement as to which issues they would like to raise at the workshop.

Following the workshop, specialists completed a second MCM interview to explore whether any aspect of their individual appraisal had changed. For the citizens’ panels, Session 5 *reviewed the workshop*, giving members an opportunity to share their experiences of meeting the other panels and the specialists, and to explore whether any of their judgments had been challenged or changed by deliberations during the workshop. Towards the end of the session, everyone was asked to review their option scores, and make any *changes to their assessments* on the basis of what they had learnt through the workshop and subsequent discussion. These changed assessments were recorded on individual sheets of paper. Finally, the panelists were asked to weight the criteria through the allocation of 100 points between the criteria. The scores both before and after the workshop were converted into numerical form and entered into *MC-Mapper* by the research team. In the last session, the group met to *review the outcomes of the appraisal*, review the whole process and give feedback to the facilitation team. This was a session in which there was maximum opportunity for discussion without the demands of completing DM-related tasks.

Information provision

A key challenge is to find effective ways of providing new and often complex information to citizens. A balance needs to be struck between facilitators providing sufficient information for citizens to engage meaningfully with options, and enabling citizens to develop their own perspectives on the issues under discussion. All panels opened with general discussions around

organ transplantation, which drew out existing knowledge of organ transplant options. During panel sessions, facilitators did not take the role of providing technical information on options, but addressed simple questions or reflected queries back to the group for discussion. Detailed information about the options was introduced in a series of steps that were guided by participants' discussions.

- *The citizen panel booklet*: Towards the end of session 1, Staley talked through a previously prepared brief on the basic functions of the kidney, the causes of kidney failure, a brief explanation of kidney transplants, and the gap between organ need and availability. Citizens were given a booklet containing this information, as well as further information on the common and discretionary options to be appraised. The booklet was compiled by the researchers through reviews of the relevant transplant literature, circulated to members of the PAC for comment and piloted with members of the public to ensure accessibility.
- *The workshop booklet*: A second, customized booklet was prepared for each panel before the workshop. This summarized their discussions on the options and definition of criteria. The booklet also described the key issue that the panel would raise at the workshop. A biography for each specialist was included, as well as his or her specific views on the organ gap to help citizens navigate the day.
- *Questions about options*: No other pre-prepared information on options was provided but panelists were encouraged to ask questions throughout the sessions. Panel members thus subsequently led the demand for information. One team member collated responses to these questions of fact from relevant experts and these were fed back in writing. Where it was not possible to provide a clear and unambiguous answer, panelists were advised to ask a specialist at the workshop.

Methods of analysis

DM produces both qualitative and quantitative outputs in relation to the appraisal of options, for both citizen and specialist strands. Table 3 shows the methods of analysis for each stage of the appraisal process.

Quantitative outputs were analyzed using *MC-Mapper*. All audio-taped materials were fully transcribed, and analyzed using Atlas-ti. This allowed analytical codes to be developed that complemented the quantitative analysis, through analyzing discussions around options, criteria, weighting and scoring. In addition, transcripts were coded for the wider analytical frameworks evident in panel and workshop discussions, for example around attitudes to transplantation, family contexts, and medical developments. Furthermore, sections of transcripts were analyzed to explore the deliberative interactions taking place within panels, and between specialists and citizens at the workshop. These deliberative sequences offer in-depth insight into the processes through which specialist and citizen participants position themselves in relation to each other, and to the options. Here, another set of codes was built up around specialist/citizen engagement, social learning and group processes. At all stages of the analysis, the research team worked using an iterative process comparing qualitative and quantitative outputs, across both specialist and citizen strands.

DM outputs: mapping option performance

The "bottom line" results show a remarkable degree of consistency in the overall ranking patterns for the different options. Overall, and despite quite radical differences in context and

Table 3 Analytical procedures for DM

Decision-making stage	Analysis of citizen strand	Analysis of specialist strand
Option definition and framing	<ul style="list-style-type: none"> • Qualitative in-depth transcript analysis of panel deliberations on options • Analysis of discussions recorded on flip charts • Qualitative transcript analysis of workshop deliberations 	<ul style="list-style-type: none"> • Analysis of initial scoping interview responses to inform definition of core and prompted options • Comparative analysis of which options appraised by individual specialists • Textual analysis of additional options using data entered into MCM software and interview transcripts of discussions around options from both interviews
Eliciting and weighting criteria	<ul style="list-style-type: none"> • Qualitative in-depth transcript analysis of panel deliberations and eliciting and weighting criteria • Analysis of criteria maps constructed by panels • Aggregation of criteria into criteria groupings by research team and the addition of new groupings not covered • Quantitative analysis of weightings by criteria grouping by panel 	<ul style="list-style-type: none"> • Textual analysis of criteria using data entered into MCM software and interview transcripts of discussions around criteria from both interviews • Aggregation of criteria into criteria groups (by research team on the basis of consultation with specialist participants). Ranking of criteria groupings by number of criteria and analysis of number and type of criteria by specialist participant • Qualitative in-depth transcript analysis of discussions around weighting • Quantitative analysis of criteria grouping by aggregate weightings of criteria by specialist panel and specialist sub-groups
Appraising option performance	<ul style="list-style-type: none"> • Qualitative in-depth transcript analysis of panel deliberations on scoring and options pre & post Joint Workshop • Quantitative analysis of scoring by option, by criteria grouping and by panel • Quantitative analysis of scoring shifts after workshop 	<ul style="list-style-type: none"> • Qualitative in-depth transcript analysis of pessimistic and optimistic conditions in scoring • Quantitative analysis of scoring by option by criteria grouping by participant grouping • Quantitative analysis of uncertainty by participant group, by criteria group and by option
Reviewing final option ranks	<ul style="list-style-type: none"> • Qualitative in-depth transcript analysis of key factors bearing on rankings including panel and workshop discussions • Quantitative analysis of rankings by option and by panel 	<ul style="list-style-type: none"> • Qualitative in-depth analysis of key factors bearing on rankings including Joint Workshop & Specialist Workshop • Quantitative analysis of rankings by option by participant grouping

perspective between the different groups, there appears to be a fairly clear basis for identifying important elements of common ground in the overall ranking picture. Illustrative results only are shown in Figures 2–4 (see Davies et al. 2003 for full results)

In short, the four “institutional” options tend to perform markedly better overall than do the others.

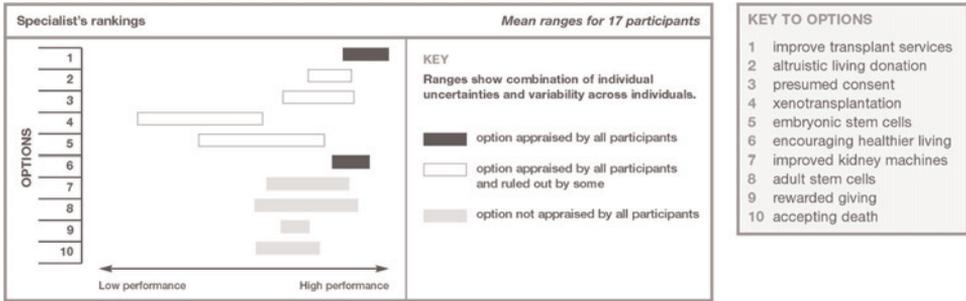


Figure 2. Mean ranges for the specialists' ranking

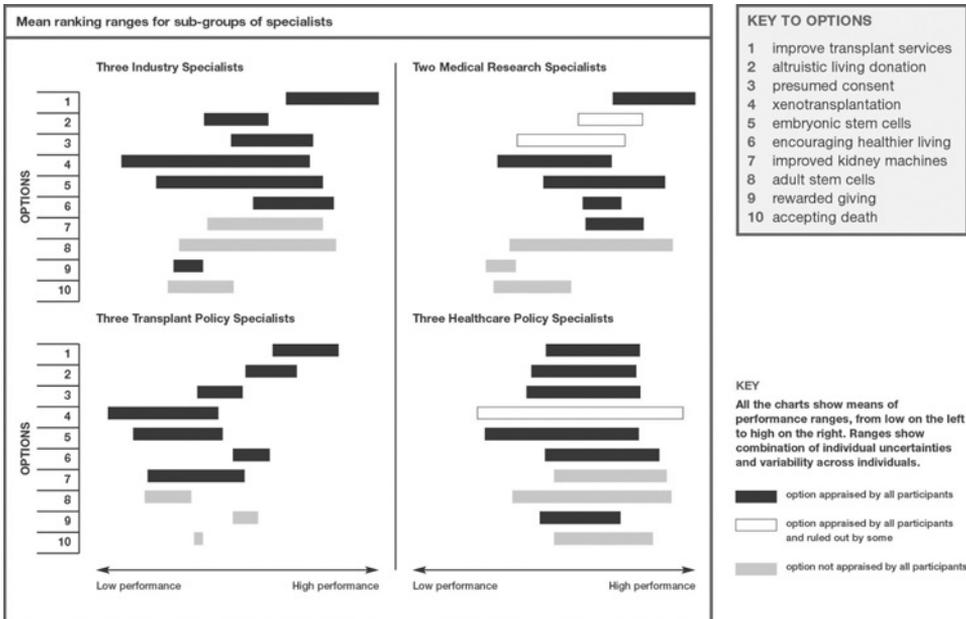
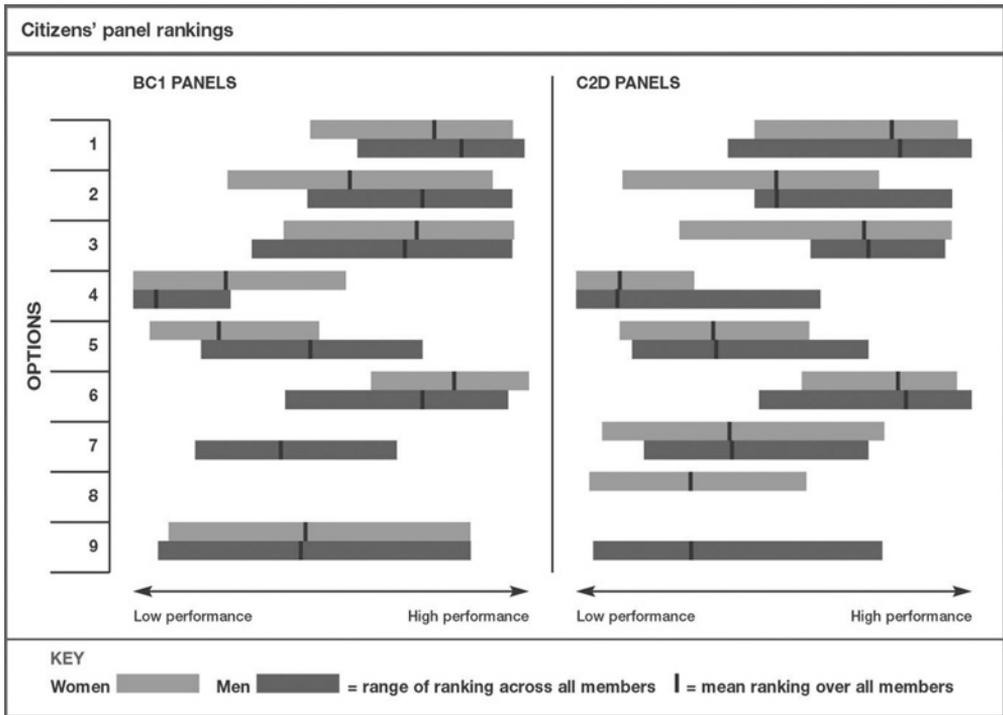


Figure 3. Mean ranking ranges for sub-group of specialists

- *Improved transplant services* consistently ranked either as the best performing option or as a very close second (to encouraging healthier living) for all four panels. It also performed markedly best among the specialists as a whole, and across most groups of specialists (except the “stakeholders” group).
- *Encouraging healthier living* was also among the two highest-ranking options for three of the panels (BC1 women, BC1/C2D men) and ranked a high third in the other case. Among the specialists, this option ranked among the top two overall, but somewhat behind improved transplant services. Ethicists and “wider stakeholders” were relatively more favorable overall, healthcare policy specialists relatively less so.



KEY TO OPTIONS

- 1 improve transplant services
- 2 altruistic living donation
- 3 presumed consent
- 4 xenotransplantation
- 5 embryonic stem cells
- 6 encouraging healthier living
- 7 improved kidney machines
- 8 adult stem cells
- 9 rewarded giving
- 10 accepting death

Figure 4. Mean ranking ranges for the citizen's panels

Altruistic living donation and presumed consent also perform well overall, although the picture here is slightly more qualified.

- *Presumed consent* ranked jointly highest for the C2D men's panel and for the "wider stakeholder" group of specialists. However, it performed less well than the leading options for the other panels, and tended only to be a mid-ranking option for the other specialist groups and for the specialists as a whole. One medical research specialist ruled it out on ethical grounds.
- *Altruistic living donation* ranked lower among the top four options, both among the panels and among the specialists. It was regarded relatively favorably by the transplantation policy and "wider stakeholder" specialists but again ruled out by one medical research specialist and approached in interestingly different ways by the men's and women's panels.

The two more “technology-based” common options tend clearly to perform most poorly overall, being variously ranked at the bottom end of the range, and/or ruled out entirely by certain specialist participants:

- *Xenotransplantation* performed unequivocally worst overall, both for the four citizens’ panels and amongst the specialists as a whole, being ruled out on ethical grounds especially by “health care policy” specialists. Always regarded relatively unfavorably by the citizens’ panels, its ranking further declined after the workshop.
- *Embryonic stem cells* perform less badly overall than xenotransplantation—both for the panels and for specialists. There was considerable variability between the panels and among specialists. One stakeholder specialist ruled this option out on ethical grounds, but this issue was not a prominent theme in citizens’ panel discussions. The option performed relatively well for ethical and medical research specialists.

This degree of convergence is by no means to be assumed. As has been discussed, when compared to other consultation procedures, DM gives particular attention to the elicitation and documentation of divergent views (Davies, 2006a, 2006b). Given this emphasis, the strong picture of common ground across the perspectives of so many different participant backgrounds is a significant finding.

4. Participants’ reflections on DM

Reflections on the process

Each citizen’s panel had the opportunity to review their experiences of the process, and reflect on the outcomes, in the final session before a celebratory meal to mark the end of the process. Everyone agreed it had been an intensive and, at times, challenging process. However, most also felt it had been enjoyable and were satisfied with their achievements. Their ability to complete this complex process was seen as the result of the organization of the exercise into discrete and do-able tasks, the mixture of working in pairs and larger groups, and high quality facilitation. Participants also felt that they had supported each other effectively, and the development of ground rules at the outset provided a sound basis for group working. Overall, each panel felt the process had been a success, and the followed exchanges were typical.

Joe: Did every single panel work just as well as ours? Ours seems to work quite well, everyone seems to get on and gel I’d like to say how well it’s been chaired; I think it’s really good.

Bob: At the beginning you started off very well, in so much that we put some ground rules down, about respecting each other and I think that’s really important. I just think there’s sometimes other people who are better speakers than others, and it’s about listening. I think by starting off at that point, I certainly relaxed. I think that was a very good beginning, we knew where we were starting from. (session 6, BC1 men)

Aimee: It’s nice, I think, the way people have built the techniques that you’ve used. If we’d have started at week six, week one, I’d have been very intimidated with the actual technique you were using. Whereas by week five or six, it seemed ‘we can manage this, the things you’re asking us to do are not too hard’. It was staggered and I think that was very effective.

Anne: Multi-criteria analysis, I can do that in my sleep!

Loretta: Also, if things are very structured then you're very prepared to work hard. I think if you are focused and you're told you've got to work hard in this 20 minutes, then I think it's manageable, even though you might be tired, you'll do it. (session 6, BC1 women)

The participants were asked about the duration and timing of the sessions, and on the use of single-gender panels. Most thought the process would not have worked so well if it had been condensed into one or two long-weekends, arguing they needed time to think through their views. The sequential meetings developed commitment to the process and each other. Fortnightly sessions also fitted work and family commitments. However, some people would have preferred the process to be shorter, finding it difficult to remember all the details in the fortnight between meetings. There were mixed views about whether the groups should have included both men and women. Panelists did acknowledge that men and women might talk about the issues differently. This issue arose after the workshop, where panels had been able to meet together. Some thought this diversity of views would be a positive thing but others felt it would be intimidating. As Katelyn (session 6, C2D women) put it: "I would have felt uncomfortable if there were men. Men don't appreciate women's views; they always have to be right." It seemed that most were in favor of having separate men's and women's panels.

The specialists were asked for their reflections at several stages of the process. Overall, they expressed appreciation of the unique nature and ambitions of DM. Particularly appreciated was the strength of an approach that looked at several options, rather than being asked to pronounce on one alone.

I think overall it's been very positive, I've enjoyed taking part, I've found it very interesting and I particularly enjoyed the workshop, I thought that that was very good. (Medical ethicist, British Medical Association, second interview)

Some had found the specific MCM process difficult to grasp at first but were comfortable with the process and happy to follow the interviewer instructions.

I just couldn't get my head round it at the beginning ... But once I got into it, it did seem to start to make sense but I was thinking, 'I'm learning as I'm going along here'. (Manager, xenotransplantation company, Specialist workshop)

Specialists were concerned about their possible influence on citizens' deliberations. This was a particularly important issue for the Senior Medical Officer at the Department of Health, who requested the following comments were included in the evaluation of the process.

Deliberative mapping is potentially a very powerful tool for establishing both the immediate public reaction to an issue, and also how public attitudes might change over time. However, the accuracy of any prediction is heavily dependent on providing a wide range of expert opinion that reflect the way opinions will be informed over time. Thus the selection of the expert advice may prove critical to the success of any particular project. I would be concerned if the tool was widely used without further assessment of the sensitivity of the quality of expert advice. (Senior Medical Officer, Department of Health, written communication, July 2003)

There were some reservations over the range of individual expertise required to participate in the process. For instance, several specialists acknowledged that, while they were an "expert" in some options, for others they could only offer a lay perspective in a similar way to the citizens. Some degree of difficulty with weighting, or at least articulating exactly what they

wanted to do, was common to many specialists, and often guidance was requested. Several specialists had specific conceptual difficulties with weighting, notably the rational of reviewing weightings at the end of interview when participants reviewed the results and adjusted weightings. Finally, it was felt that a less protracted process overall might have been preferable, given already overloaded schedules.

Reflections on personal learning

The citizens made many comments on what and how, they had learned about substantive issues, as well as more intangible benefits arising from their social interactions. Individuals expressed a sense of empowerment and strong feelings of ownership over the results: engaging with the issue and working through a structured decision-making process, were highly valued learning experiences. Many expressed pride in their ability to commit to and work through the whole process. For many in the C2D panels this was their first “formal” learning process since school, and their confidence developed through it. People also took away tangible knowledge about healthy living and, despite the often challenging discussions, some participants also actively expressed greater willingness to become organ donors.

A lot of it's to do with information. A lot of people don't understand what the gap is. We've been doing these groups and so far we've learned very much, and if we hadn't done these groups we really wouldn't have known much about it. So if he asks us about giving a kidney, about knowing certain numbers and that and about certain information. If I was someone who was dying, you wouldn't have time to tell me all this stuff. (Chatwood, session 6, C2D men)

Individuals particularly valued the opportunity to learn from each other whilst being supported by the facilitators in a small group. The sequential meetings gave panelists the opportunity to shape their deliberations, through mutual learning. Many also reflected on the issues between sessions, and recounted the difference it had made to the way they interacted with the media, or with other people. Some actively sought information, for example through the Internet; others felt they engaged differently with material they happened across. Overall, citizens felt they benefited enormously from the opportunity to engage with specialists at the workshop. However, whilst they felt there was both substantive learning about the options and more tacit learning about different kinds of expertise around organ transplantation, some found the workshop did not offer sufficient opportunities for dialogue.

All the panelists felt it important that their opinions had been valued from the outset. The emphasis on listening to people's views, and being guided by their needs through the process reinforced this. The honorarium payment was also important in this regard, indicating that their time and input were valuable. The scope of citizen learning was such that some reflected at the end they were no longer the “lay” participants they had been at the outset, so they were no longer “representative.” This perspective indicates both the scope for learning within deliberative processes, and perhaps something of the tensions for the citizen representatives within them.

If we're supposed to be a cross section of the general public of a London borough, we aren't anymore; we're more educated in the subject, so anything that we decide isn't going to be a normal cross section. (Susan, session 6, C2D women)

For the specialists, the nature of the learning was not so much technical, although some did change their views as a result of listening to other specialists at the workshop, but more about

the capacity of citizens to grapple with complex subjects. Reasons for taking part in the project were varied but many included an explicit interest in learning more about the processes and outcomes of engaging with publics.

Sometimes I think the public consultations that go on want the answer that they want to get, this seemed to be a project to look at other methods and I thought I'd get involved for that reason. (National Secretary, Guild of Catholic Doctors, Specialist workshop)

Generally, the specialists enjoyed interacting with the citizens at the Joint Workshop. Individuals were genuinely surprised at the competence of the lay participants, and people's willingness to engage with and challenge specialist views. Several commented explicitly that this element of DM should be expanded. At a time when tensions exist in policy circles about the ability of the public to be sufficiently informed to participate in scientific and technical decision-making, it was an important outcome.

10–15 years ago, public opinion was largely ignored. If doctors wanted to do something, they damned well did it. Nowadays it's completely the other way round, so in a sense your process impacts more and more. (Professor of Nephrology, University College London Medical School, Specialist workshop)

Has the citizens' panel changed my view? Probably not to be honest. But it has made me more aware of a different point of view, and not just a point of view but a point of view that comes from a different background, a different way of thinking, a different outlook on the subject. I guess it has made me more aware of the importance, if you want to move forward in any particular area, you need to get people's buy in. (Transplantation business manager, pharmaceutical company, second interview)

The specialists viewed DM's outcomes and the approach as offering something worthwhile. Several commented that they hoped the work would be used because of their confidence in the process. Others expressed more skepticism about the potential for engaging with national decision-making structures with such rich data sets. Many reflected on how issues of scale and locality influenced the public engagement processes more generally. One specialist, for example, felt that more citizens' panels were needed in order to produce valid findings to feed back into policy. Others explored the potential for DM to be scaled up, perhaps as part of a national public engagement exercise. Concerns about the validity of the panels also linked to issues about representation. While they accepted that the panels were not aiming to be statistically representative, some specialists felt running DM elsewhere might produce different outcomes. Overall, DM's contribution both to the case study of the organ gap, and to the development of new public engagement methods, was welcomed.

5. Issues for further research

DM has emerged in response to the challenge of creating A-D processes suitable for difficult and contentious science-policy problems, and a desire to address weaknesses in our previous methodologies. DM allows detailed deconstruction of analytic patterns in performance rankings, revealing rich diversity in the details of different perspectives. Were the analysis to have focused only on issues such as criteria choice, weighting, scoring, uncertainty, or only upon qualitative analysis of the divergent discursive styles of different citizen or specialist groupings,

then the picture generated would likely have been one that was more dominated by contrasts and tensions. The overlying concordance in the pictures of the overall performance of the different options seems to arise from a variety of different sources, and for different reasons in different contexts. The A-D design embracing an instrumental focus on option rankings, together with broader attention to diverse framings allows this phenomenon to be observed. But this is not to suggest that DM is a panacea and in this last section we turn to issues requiring more research.

Strategic behavior

One question is that of “strategic” behavior. To what extent should the findings be treated as positive reflections of real understanding of options and their associated issues or might they be affected by deliberate intent to contrive certain outcomes to the process as a whole? The question applies to any appraisal process in which the protagonists are social actors with particular interests and perspectives. Among specialists, some evidence of strategic behavior in scoring was found; it may also be evident in the post-workshop scoring by the citizens’ panels of one option (xenotransplantation). However, the very purpose of this kind of open-ended framework is to permit participants to frame the issues in whatever fashion best reflects their values and interests. Thus, discussion (and judgments) over what constitutes legitimate and illegitimate framings is a matter for the wider policy discourses that DM seeks to inform. The best response, perhaps, is to maximize opportunities to examine and challenge the legitimacy of others’ framings.

What does “weighting” signify?

The use of numerical weightings to reflect the relative prioritization and trade-offs among different issues is a central feature of many multi-criteria-analysis processes (Nijkamp et al., 1990; DETR et al., 2001). Essentially, numerical weightings allow performance under different criteria to be compared in a way that takes into account the crucial fact that, even where there is agreement over performance under any one criterion, different criteria may be of different importance under different perspectives. The formal basis for the weighting process in the specialist element of DM relies on an explicit comparison between the relative importance to the participant of the difference between best and worst option under one criterion, compared to the difference between best and worst option under another criterion. In the citizens’ panel process, the weighting was approached in a more discursive and less rigidly structured fashion, but was informed by the same general approach. In this way, the weightings elicited from participants may be held to be grounded in the specific scoring ranges, which they have in mind under each criterion. However, it became evident that participants do not actually approach the weighting process in this way. Even with explicit prompting, specialists typically conducted the weighting process with relatively little attention to the particular scoring ranges under each criterion. This is even truer of the citizens’ panels. Indeed, the weighting process was perhaps the least deliberative aspect in either strand. Either way, it seems that one pertinent finding is to raise serious questions over the degree to which numerical weightings may actually be interpreted in the formal sense that is implied and required by theory.

Citizen and specialist learning

The effectiveness of communication and learning in DM varies between contexts. Participants and the evaluators commented on the high quality of facilitation in the citizens’ panels. There was sufficient time and appropriate space for members to become well acquainted with one

another, the tasks and the background to the issues. People expressed feelings of becoming more confident and well informed through the process. The workshop also proved an important arena for both specialists and citizens. The “specialist fair” session seems to have provided an opportunity for direct communication between citizens and specialists, but there were a few instances where this open, non-facilitated encounter was reported from the specialist side to have become quite challenging. The importance of face-to-face interaction in supporting learning (or in “influencing” individual judgments) was highlighted by the workshop in terms of subsequent shifts in the relative rankings of certain options. The technological options tended to be regarded discernibly less favorably by certain panel members after the workshop when compared with before. To the extent that this is a consequence of general cultural and discursive patterns, then it may be regarded as a robust reflection of joint deliberation. However, it may also have been a feature of the particular personalities of individual specialists (Davies and Burgess, 2004). The impact of inter-subjectivity in A-D processes more generally could usefully be addressed in future research. Important issues about power-relations external to the process also require further research. For example, Goven (2003) notes how policy actors were able to subsume critical citizen perspectives within scientific and economic rationalities (also Levidow and Marris, 2001). Expert participation in processes clearly gives insight into ways in which potential dissent may be “managed” and manipulated. But at the same time, experts also run the risk of having their expertise de-constructed and publicly exposed (Nowotny, 2000; Jasanoff, 2005).

Creating a fair process

Although DM allows a relatively high degree of sensitivity and breadth, it is relatively complicated and quite highly structured. It was clear in both citizen and specialist strands that certain individuals empathized with DM’s rational framework more readily than did others. The use of an explicitly quantitative idiom in scoring and weighting in the specialists’ interviews and, to a lesser extent, in the citizen panels, further compounds asymmetries in the accessibility and agency experienced by participants. Although the specialists were given the opportunity to identify issues of principle under which performance is not subject to trade-offs, the same was not true of the panels. To this extent, the latter strand of the process might reasonably be seen as “utilitarian,” presuming that the majority of salient issues can reasonably be traded off against one another. Although not without exceptions, there are also indications, arising from our practical experiences of facilitation as much as in the transcripts, that the multi-criteria analytic embodies a gendered rational which may under-privilege women’s understandings and merits further research.

6. Policy relevance of DM

Convergence and the understanding of diversity

Much policy appraisal focuses on averaging variability, marginalizing uncertainty and aggregating different viewpoints. By contrast, DM systematically documents the effects of sensitivities, contingencies and differences of perspective on appraisal. The methodology explores the degree of *variability* displayed between different citizen panels, the nature of the different *uncertainties* entertained under different specialist perspectives and certain patterns of *convergence* and *divergence* through the process over time, in particular in relation to the joint workshop. The result is an unusually comprehensive analysis of the forms and sources of

divergence in the appraisal of key policy options. In this regard, a contrast may be drawn between DM and other exercises exploring the interaction between divergent socio-political perspectives and the technical appraisal of policy options. Although individual technical analyses may often result in highly precise and prescriptive recommendations, it is typically the case that meta analysis of the results obtained by different studies reveals far greater divergence (Shackley and Wynne, 1996; Levidow et al., 1997; Saltelli, 2001). DM shows how an emphasis from the outset on the open-ended accommodation and understanding of divergent views need not preclude the identification of important areas of common ground. In discussions of option definitions, criteria choice and technical appraisal DM explores a number of highly nuanced characteristics associated with the perspectives of different socio-demographic groupings and diverse professional and institutional viewpoints. Yet, against this rich background of variety and complexity, the “bottom line” representation of option rankings conveys clear practical policy implications.

Transparency and auditability

One measure of usefulness to policy makers, especially in contested problems is the extent to which A-D processes are transparent (to participants) and auditable (to third parties). The clear architecture for DM and its relatively straightforward framework provide a fairly high degree of transparency for participants. The fact that many of the key framing elements in this exercise (additional options, criteria, weightings, scores, uncertainties) are all generated by the participants themselves also contributes to this transparency. The position is rather similar with respect to external audit. A key aim of DM is to make explicit many crucial parameters in appraisal, of a kind that sometimes remain implicit even to participants, and are often entirely opaque to third parties. However, caution is necessary in interpreting the explicit parameters as fully authentic renderings of the “reasons” underlying the different perspectives. For instance, even in an intensive interview setting such as specialist scoring, it is possible only to develop an incomplete and stylized documentation of the full range of reasoning processes contributing to the explicit quantification of performance. Likewise, the highly structured appraisal framework, especially in the specialists’ interviews, can conceal cross-cutting issues and sentiments that might otherwise have been documented in a more discursive approach. This latter factor is better addressed in the citizens’ panels but the ability to document the detailed underpinnings of appraisal judgments or to illuminate individual diversity underlying the group picture is less pronounced.

Timeliness and cost

The project took just over 21 months to complete, a leisurely timeframe for live policy issues. In 2004, the process was adapted for a more high-pressured trial to consider radioactive waste disposal options by bringing citizens together for two residential weekends, and integrating specialists with them for part of that time (Burgess et al., 2004). But the time required for full analysis of the data produced from DM, in either format, is considerable and the process is also relatively costly. Questions about “scaling up” and/or “scaling down” DM are addressed in the Final Report of the project (Davies et al., 2003). In principle, DM is applicable where clear high-profile policy decisions are required, where there is active contention between different socio-political interests and/or specialist perspectives concerning choices among a relatively well-defined range of policy options and where the issues in contention include technical uncertainties and variabilities, as well as divergent ethical and evaluative positions.

7. Conclusion

We have placed DM in an historical narrative of process development and sought to substantiate our claim that it is an innovative A-D process. The research demonstrates that quantitative expert-driven methods in policy appraisal can be reconciled with more participatory deliberative approaches to public engagement. DM has achieved an unusually intimate integration of quantitative and qualitative, and individual- and group-based methods in a framework encompassing balanced attention to a wide variety of specialist, stakeholder and citizen perspectives. In the process, particular attention has been given to the documenting of uncertainties, the exploring of contingencies and the mapping of diversity, as well as to checking for volatilities that may occur over the passage of time.

DM provides a rich picture of the key drivers and consequences associated with contending perspectives, often identifying important elements of common ground. Where this is the case, the results are all the more robust for being based on a process that is designed to reveal diversity, rather than engineer consensus. The aim is therefore to provide a stronger basis for subsequent decision-making, rather than to prescribe it. Certain options may quite clearly be identified as of lower overall performance, but choices among relatively high-ranking options will typically require explicit further justification in terms of the political, economic or ethical priorities bearing on decision-making. As such, DM is not well suited to situations in which the priority lies in constructing unequivocal justification for policy decisions. The focus lies on rendering the key determinants of policy decisions more explicit and accountable, rather than on providing a means to invoke legitimation or manage blame. In the right circumstances, DM may enhance the quality of the “social intelligence” bearing on policy decisions, thereby assisting in better-informed and more technically robust, as well as more democratically accountable, science-policy outcomes.

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Authors

Jacque Burgess left University College London (UCL) in August 2006 to become Director of the Centre for Environmental Risk in the University of East Anglia where she is leading research into the design and implementation of A-D processes to support environmental and energy policy decision-making. Correspondence: Centre for Environmental Risk, School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK; e-mail: jacque.burgess@uea.ac.uk

Andrew Stirling is at the Science Policy Research Unit at the University of Sussex. His research focuses on the opportunities and tensions arising in linkages between science, technology and innovation systems on the one hand and sustainability, precaution and participatory governance on the other.

Judy Clark retired from UCL in April 2006 to tend her garden but she still works as a consultant on the design and implementation of participatory and deliberative processes to support environmental decision-making and as an Open University Associate lecturer in the same field.

Gail Davies is a lecturer in human geography at UCL. Her research is directed to investigating and intervening in the cultures of nature, expertise and ethical debate which accompany changing practices in the life sciences.

Malcolm Eames is Research Professor in Innovation and Sustainable Development at Brunel University, specializing in science-policy issues. His current research includes projects on the role that hydrogen could play in future energy supply mixes, and how citizens' environmental knowledge can be mobilized for sustainability.

Kristina Staley is Co-Director of TwoCan Associates, a small company specializing in researching, promoting and supporting user and carer involvement in the voluntary and statutory sectors.

Suzanne Williamson worked at UCL on the DM project from 2001 to 2003. She has a background in medical geography and participatory methods in health care. She currently lives in Norfolk, teaching medical sociology and developing her career in photography.