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Interaction between Citizens and Experts in Public Deliberation: A Case Study of Consensus Conferences in Taiwan

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Abstract Participatory technology assessment often holds sessions for experts to inform laypersons about scientific controversies. However, few studies examine how these laypersons perceive experts and make policy recommendations. The purpose of this study was to examine interactions between experts and laypersons in two consensus conferences in Taiwan to find illuminating illustrations. Quantitative and qualitative methods were employed to understand the cases. We found that in each of the two consensus conferences, on average the level of laypersons' science literacy in terms of content was improved and their attitudes toward scientific controversies changed. Expert lectures were perceived as the most important element in influencing participants' knowledge learning and attitude changes. However, in exchanging views with experts, laypersons could not only identify biases, normative positions, and personal preferences in experts' seemingly objective talks, but could also raise reflective, worthy viewpoints that were not articulated by the experts. Implications of the findings to research and practices of participatory technology assessment were discussed.

Chinese Abstract 科技相關的公共政策，經常落入科技專家或利益團體的獨斷控制，不利於民眾參與，明顯違背民主政治的基本理念　丹麥型的公民共識會議，以審議民主為本，針對有重大爭議的科技政策，提供專家和一般民眾較民主、較平等的對話機制，以聽取民眾於知情理性公開討論下，所形成的共識意見　本研究以2004年於台灣舉辦的代理孕母公民共識會議和產前篩檢與檢測公民共識會議為例，深入分析一般民眾和專家之間的互動，民眾科技知能和態度的變化，特別是專家歧見下，民眾如何看待這些意見並形成他們的看法　本研究關注專家和一般民眾之間的溝通權力和地位的不對等　本研

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究發現，民眾與專家對話後，不但能分辨專家的歧見和偏見，亦能提出超越專家盲點的見解　過程中，民眾對科技的理解，有明顯的轉變，民眾認為這些轉變受專家演講影響最大，而民眾的團體討論也有相當的影響力　此外，專家對科學的理解也需要並且也應該有機會被轉變，但事實如何，如何促進，值得後續研究努力

Keywords Consensus conference · Public understanding of science · Public participation · Taiwan

Introduction

Modern societies have long been criticized for a wide gap between the rapid growth of science and technology and a shortage of public participation in related policies (Laird 1993; Hennen 1999). The growing complexity of science and technology profoundly shapes new social identities and new types of control. The elite model of technology assessment is not sufficient to deal with unarticulated but discernible dimensions of issues that are embedded in controversial technology (Webler and Renn 1995). Recently, many innovations in participatory technology assessment have been developed to close the gap (Gastil and Levine 2005).[1] In these methods, it is often arranged for experts to provide laypersons with specialized knowledge and allegedly balanced opinions; and laypersons, after being informed, make considered recommendations to discussed issues. Experts are academics, government officials, representatives of related groups, or individual activists, while laypersons are nonexpert participants.

It is argued that public participation characterized by well-informed citizens engaged in a free, open, and rational dialogue can promote the power of the politically unorganized, reach a collective conclusion based on reasonable communication among equals, and enhance democratic legitimacy in public policies (Benhabib 1996; Einsiedel et al. 2001). But public participation cannot entirely eliminate the conditions of background power prevalent in a society (Cohen and Rogers 2003) and nor, often, do ideal public deliberations occur (Mansbridge 2003). It is thus important to understand how laypersons who learn from and enter into dialogue with experts discuss scientific controversies, and how they perceive experts and make recommendations under the circumstance in which different experts express competing reasons. But this regard is seldom a focus of studies of innovative techniques of participatory technology assessment (Guston 1999; Gastil and Levine 2005). To increase our understanding, this study examines interactions between experts and laypersons in two consensus conferences in Taiwan, focusing on the effects of the interactions on the dynamic of knowledge learning, attitudes formation, perception of expertise, and conclusion-making among lay participants. The purpose of this study is to find illuminating illustrations of consensus conferences to highlight critical issues for further research and applications of participatory technology assessment.

[1]Cases of innovations of participatory technology assessment include, for example, consensus conferences, planning cells, deliberative polling, citizens' juries, national issues forums, and these combined.

Laypersons and Technology Assessment

Participatory technology assessment concerning involvement of the general public in assessing advanced technologies has been a major issue since the 1960s (Webler and Renn 1995). Many strands of hard thinking are involved and they are reviewed below. Recent studies have raised at least three issues in support of civic engagement in science and technology policies.

The first issue is related to the growth of for-profit investment and government intervention in scientific research. In the past, scientific studies were initiated mainly by individual researchers to pursue the truth. This legacy, however, has been transformed into one in which a variety of stakeholders extensively control the production and use of research findings (Hennen 1999). Research projects are increasingly supported by more large pharmaceutical companies, defense contractors, and multi-national corporations than before. These stakeholders favor some research topics but neglect others. They have strong incentives to manipulate study findings, changing the purpose of research from truth-seeking to profit-making (Chopyak and Levesque 2002). In addition, the government can substantially influence the allocation of research resources. Many master plans about research are indeed made through joint efforts of political elites and academic leaders (Huijer 2003). In contrast, laypersons are still marginalized in the process of scientific knowledge production, which raises serious concerns about democratic control of science and technology development (Einsiedel et al. 2001).

The second issue is about the public perception of scientific risks. The general public has been seriously concerned with risks of science and technology after watching shocking news about nuclear disasters and environment pollution in mass media. The public perceives that scientific risks in a society have become more uncertain than before (Beck 1992; Perhac 1998). They often find that experts with different normative positions express conflicting opinions about science and technology (Otway 1992). Moreover, it is not surprising for the general public to find that an allegedly scientific truth is not as value-neutral and universally valid as claimed by the science community (Wynne 1992). Under such circumstances, many citizens begin to distrust the risk assessment done by scientific experts.

The third issue arises from criticisms about representative democracy. Public policies characterized by modern science and technology occur rapidly in contemporary societies. Citizens are entitled to have their voices heard in discussions of the policy that affects them; science policy is absolutely not an exception in this respect. The current representative mechanism is not sufficient to represent pluralistic opinions about complex policy issues in a democratic society. Moreover, as indicated by Cohen and Rogers (2003), "ordinary people are capable of reducing the political role of untamed power and arbitrary preference and, through the exercise of their common reason, jointly solving important collective problems". Consequently, the opportunity for public discussion should be provided to ordinary citizens in order to avoid the distortion of public opinions from representative democracy (Fishkin and Luskin 1999).

In contrast, many scientists worry about the public's ability to deliberate about scientific controversies. Many scientists criticize the self-interest and irrationality of the general public (Hamlett 2003), arguing that most laypersons would protect their

own benefits rather than stand for the public interest.[2] They also argue that laypersons frequently rely on intuition, common sense, or traditional beliefs, rather than on scientific evidence, to make their decisions. Given that beliefs in fortune telling, mythical experiences, or supernatural legend prevail among laypersons, many scientists have little trust in public participation in science and technology policy decisions (Joss and Durant 1995).

Furthermore, the process of public participation is criticized. Many minorities are excluded from equal participation, making it difficult for their concerns to be heard. When included, many people are not able to interact thoughtfully and effectively with experts. This is partly because socio-economic characteristics of individual citizens are associated with the way in which they perceive experts and capture scientific knowledge (Young 2000: pp. 52–80; Wynne 1995). For example, female senior citizens with low educational levels tend to show great respect for professional authority and follow expert instructions. People for whom perceived relevance of expert knowledge in their daily life is low are unlikely to participate actively in that deliberation (Mendelberg 2002).

Science communities argue for the necessity of promoting citizens' science literacy, partly because of the concerns about ability. They support civic scientists whose major task is to educate the general public about science (Greenwood and Riordan 2001; Clark and Illman 2001). In addition, the deficiency model argues that when citizens are more familiar with knowledge about science and technology, they become more supportive of related policies and feel more optimistic about the development of science and technology (Weigold 2001). But this hypothesis is not completely supported by empirical evidence. For example, it is found that an increase in public understanding of science and technology might enhance the support in some laypersons but raise doubts on the unlimited growth of science and technology among others who know both the positive and negative impacts of scientific and technological development (Clark and Illman 2001).

Moreover, social constructivism argues that the way people understand scientific knowledge is profoundly shaped by particular social, economic, and political conditions in a society (Pinch and Bijker 1987; Hamlett 2003). The process through which laypersons receive scientific information and transform it into knowledge is not one-way but interactive: They pick up some pieces of information and interpret the meaning according to interpersonal encounters or social contexts to which the information is referred (Winner 1993). Such a contingent and dynamic process will not guarantee a positive relationship between scientific knowledge and attitudes toward science and technology. In short, social constructivism highlights the contingency of public knowledge of science and technology.

Although critics have argued that external values, goals of science and technology, and uneven power relations do not necessarily lead to the social construction of science and technology (Hamlett 2003; Winner 1993), the constructivism literature provides many fruitful insights with implications for the topic of this study (Wynne 1995). For example, public participation can help discover significant social, political, and ethical controversies that underlie scientific

[2] A typical example is the NIMB (not-in-my-backyard) syndrome in which people are against sanitary landfills that are to be placed in their communities.

public policies, but that are seldom openly discussed among scientific experts who abide by the rigid positivist paradigm (Fiorino 1990; Fischer 2003: 206). Public discussion based on daily experiences of lay persons can offer practical solutions for controversies, new insights which might seldom occur to experts (Wynne 1992). In addition, some experts who have different opinions from their colleagues might represent a critical voice for ordinary citizens in a policy dialogue. It is possible for some experts in one field of science and technology to act as active citizens in discussions with experts in another field (Clark and Illman 2001; Fischer 2003). Under such a circumstance, civic engagement in technology assessment can make noteworthy contributions to scientific policies.

Democracy as Public Deliberation

Different models of democracy have developed different practices of public participation over recent decades (Huijer 2003; Laird 1993). In this study, deliberative democracy is taken as the fundamental model for further discussion. This is because deliberative democratic institutions are necessary for the general public to play an active and major role in policy discussion. Deliberative democracy practices emphasize the voice of the people and issue dimensions that tend to be ignored by experts (Fishkin and Luskin 1999). In addition, informed ordinary citizens involved in public deliberations need to follow the principles of engagement of rational discussion, fair treatment of other participants, and reciprocal understanding of different opinions (Gutman and Thompson 1996; Bohman 1996). Under such a circumstance, both the tyranny of the majority and the dominance of experts and political elite will be less likely to occur in scientific decision-making.

Among recently developed public deliberative inquiries (Chen and Lin 2004; Chopyak and Levesque 2002; Gastil and Levine 2005), the Danish consensus conference has been widely held in European countries, the United States, Canada, Australia, South Korea, Japan, and Taiwan (Hendriks 2005; Kim 2002; Nishizawa 2005).[3] Concisely described, the procedure essentially follows the principles of deliberative democracy. The conference consists of preparatory and formal sessions. All of the participants in the conference are lay citizens, considered to be moral and political equals. In preparatory sessions, participants are provided with balanced, comprehensible, and understandable background readings from experts. In formal sessions, participants are engaged in dialogues with experts and with other participants. The process of deliberative discussions is broadcast on television.

[3]The consensus conference that seeks reasoned opinions of lay people on socially controversial issues involving science and technology originated in Denmark in the late 1980s (Einsiedel and Eastlick 2000; Zurita 2006). Both South Korea and Japan were pioneers in conducting the consensus conference in eastern Asia in 1998 (Kim 2002; Nishizawa 2005). Most empirical studies about the consensus conference are single case studies that introduce the method and assess its effects (e.g., Joss 1998 in Denmark; Guston 1999 in the U.S.; Einsiedel and Eastlick 2000 in Canada; Kim 2002 in South Korea; Nishizawa 2005 in Japan). The technological issues debated vary from country to country. Einsiedel et al. (2001) compared three consensus conferences on food biotechnology in three countries. Hendriks (2005) made an extensive review of consensus conference studies. Loka Institute compiles and provides data about the consensus conferences in the world. See its webpage at http://www.loka.org/index.htm. For an introduction to the consensus conferences in Taiwan, see http://tsd.social.ntu.edu.tw/.

During the conference, participants are the major actors: They set the agenda of the public discussion, choose the experts with whom they seek to talk, and finally make policy recommendations (Zurita 2006; Fischer 2003: pp. 210–213; Guston 1999).

Study Cases and Data Collection

The consensus conference has become one of the major methods of participatory technology assessment in Taiwan from its beginnings as a pilot operation in 2002. Up to now, more than 20 instances of the consensus conference have been conducted for controversial technologies at different political levels in Taiwan (Chen and Lin 2004). In this study, we focus on two consensus conferences held in Taiwan in 2004. One was on surrogate motherhood, and its central issue was whether surrogate motherhood should be legalized in Taiwan. This conference was organized by a team of university faculty and sponsored by the Bureau of Health Promotion, Department of Health. The Bureau announced that it would apply the consensus conference to understanding citizens' opinions of surrogate motherhood and would consider their policy recommendations seriously: A total of 20 participants were selected from among 92 ordinary citizens who self-enrolled after public recruitment through newspapers, the internet, and radio. Two dropped out later. The remaining 18 participants included a greater number of females and were slightly younger in proportion to the general population of Taiwan, but were much more educated because of characteristics of the self-enrollees.[4]

The other consensus conference was on prenatal testing and screening. It was organized by academics from the fields of sociology, law, political science, and medicine and was funded by the National Science Council in Taiwan.[5] Participant recruitment was very difficult, partly because citizens were not familiar with prenatal testing and screening.[6] In addition, because approximately 15% of newly married couples in Taiwan were made up of foreign wives and Taiwanese husbands, it was necessary to have some of these foreign females as participants. Through the considerable efforts of the organizing team, two foreign females agreed to attend the conference, but only one (from Vietnam) showed up at the very last minute. It was arranged for her to be accompanied by an interpreter who was a Vietnamese graduate student in sociology. Finally 14 participants joined the conference. The

[4]The participants were randomly selected from the enrollees by gender, age, education level, and geographic location, according to both the characteristics of the population in Taiwan and the characteristics of the enrollees. The purpose of doing so was to consider the population characteristics in Taiwan and provide equal opportunity of participation among the enrollees. Among the 18 participants, 12 were females. Six participants were between 20 and 34 years of age, 10 were between 35 and 54, and the other 2 were aged 57 and 62, respectively. Twelve had a college level education or above. The geographic distribution was similar to that of the population in Taiwan.

[5]This was the first consensus conference project approved by the National Science Council in Taiwan.

[6]A soap opera that presented an infertile woman who sought to borrow a womb for pregnancy was popular in Taiwan in 1997, allowing many people to hear about "surrogate motherhood." In addition, surrogacy issues were debated among social groups in the last two decades in Taiwan. The issues were occasionally reported in the media. In contrast, people in Taiwan paid little attention to issues of prenatal testing and screening.

group of participants included a greater number of females who were slightly younger in proportion to the population in Taiwan.[7]

Following the Danish model, these two consensus conferences were characterized by public reasoning by a small group of informed lay citizens for policy controversies involving science and technology. Each conference began with two-day preparatory sessions in which the participants listened to expert lectures on the conference topics. Two weeks later, formal sessions were held for three days on two successive weekends and mainly consisted of three sections of expert testimony on the issues determined by the participants. In each section, three or four experts answered questions posed by the participants and responded to panelists' comments. Most of the experts were doctors of reproductive medicine or academic professors while some were health officials, representatives of related non-governmental organizations (NGOs) or activists. Their professional backgrounds and issue positions were arranged according to the suggestions of the lay participants.

In these two conferences, the participants were encouraged to be open-minded, public-interest oriented, and reason-based in the dialogue process, rather than defending their self-interests based upon any predetermined positions. Although not representing the whole population well, the participants were expected to add the voices that were often not heard in Taiwan. Two experienced and impartial facilitators led group discussions with a rule of order that was approved in advance by the participants. The participants organized themselves into several units, each of which took notes about a broad issue under discussion in order to draft a conference report efficiently. At the end of the conferences, the participants presented their report in the presence of major health officials and representatives of leading health groups. The formal sessions were open to the public, covered by the media and the internet, and videotaped by Taiwan's public television station. A steering committee supervised the conducting of the consensus conference to ensure its administrative neutrality and competency.

Comparing these two consensus conferences provided us with an opportunity to study interactions between experts and laypersons. Before and after each of the conferences, self-administered questionnaires were employed to collect data about knowledge learning, attitudes toward science and technology, and social demographic characteristics of the participants. All of the activities of the conferences were recorded by digital video cameras with the consent of the participants. The exchange of opinions both among the participants and between the participants and the experts was fully transcribed. After each conference, two experienced research assistants in the organizing unit had an in-depth interview with each participant, and the interview information was completely transcribed. Both quantitative and qualitative methods were used to analyze the data.

[7]A total of 18 citizens was randomly selected from the enrollees by gender, age, education level, and geographic location, according to the characteristics of the population in Taiwan. Five dropped out later. Among the group of fourteen participants that included one foreign female from Vietnam, ten were females. Three were between 20 and 34 years of age, 8 were between 35 and 54, and the other 3 were between 56 and 73. Seven had a college level education or above. The geographic distribution of participants was similar to that of the population in Taiwan.

Results

Knowledge Learning and Attitudes Formation

To measure science literacy levels, the participants were asked questions about their knowledge of corresponding technologies.[8] It was found that, in the prenatal testing and screening conference, the mean of correctly answered questions rose from 2.43 (range from 0 to 5) before the conference to 4.07 (range from 1 to 7) after it. In the surrogate motherhood conference, the mean rose from 2.33 (range from 0 to 4) before the conference to 3.44 (range from 0 to 5) after it. The science literacy of participants appeared to have improved after the conferences.

Changes in attitudes toward related technology policies were analyzed. When asked whether they supported or opposed surrogate motherhood in Taiwan, before the conference 11 (61.1%) supported the practice, 6 (33.3%) opposed it, and one was indifferent. After the conference, 15 (83.3%) supported it, 2 (11.1%) opposed it, and 1 expressed indifference. As to the other conference, all of the participants "agreed definitely" or "agreed probably" that "governments should encourage pregnant women to have a prenatal examination in order to promote population quality in Taiwan" before the conference. But after the conference, only 4 (28.6%) "agreed definitely" or "agreed probably" with the statement.

The participants were categorized into two groups according to education levels, as more educated (having a college degree or above) or less educated (having less education than a college degree). After the conferences, on average science literacy levels appeared improved in each group, and the improvements were larger in the more educated group than in the less educated group.[9] It was noted, however, that before the prenatal testing and screening conference, the more educated group was not as good as the less educated group in the science literacy levels. These results seemed to suggest that more educated participants might not necessarily have better science literacy at the beginning of the conference, but they had more potential to learn scientific knowledge after the conference.

Levels of science literacy were classified as high or low. "High" referred to the participants who had 4 or more correct answers in the science literacy test about

[8]There were 7 questions regarding knowledge of prenatal testing and screening and 5 questions about the knowledge of surrogate motherhood. The questions were focused solely on content of science literacy. The information related was provided to participants in readable materials or expert lectures during the conferences. The levels of science literacy were measured as the number of the questions that were answered correctly by individual participants. The authors understand that this measure of science literacy levels is not complete and to many analysts, is not adequate (see Wynne 1995: pp. 365–370, 376–377). The authors agree with comments made by one of the referees of this article that "understanding of scientific concepts, etc., is only a part of science literacy. However, science literacy also requires understanding of the social organization and political economy of science. Citizens' knowledge of these factors appropriately will affect how they participate in deliberative fora like consensus conferences". See Appendix for these questions, which were translated into English for readers here.

[9]The mean of science literacy levels increased from 2 to 4.43 in the prenatal testing and screening conference and from 2.42 to 3.92 in the surrogate motherhood conference in the more educated group, and was elevated from 2.9 to 3.71 in the former conference and from 2.16 to 2.5 in the latter conference in the less educated group.

prenatal testing and screening, or those who had 3 or more correct answers in the science literacy test about surrogate motherhood. Others were classified as "low" science literacy. Our findings about the relationship between science literacy levels and attitudes toward related technology policies were mixed. Before the surrogate motherhood conference, the participants with high science literacy (66.7%, 6/9) seemed more likely than those with low science literacy (55.6%, 5/9) to support the practice of surrogate motherhood. But before the prenatal testing and screening conference, as described above, all the participants supported the prenatal examination regardless of their level of science literacy.

The relationship between improvements in science literacy and changes in attitudes toward related technology policies was also explored. After the prenatal testing and screening conference, 9 (81.8%) of the 11 participants with improvement in science literacy changed their attitudes from supporting to not supporting the statement that "governments should encourage pregnant women to have prenatal testing in order to promote population quality", while the other two continued to support that statement.[10] On average, the 9 people answered 6.42 (71.4%) science literacy questions correctly in the "after" test. Conversely, only 1 of the 3 participants without science literacy improvement had a change in attitude.[11] On average, these 3 answered 3 (42.9%) science literacy questions correctly in the "after" test only. In addition, after the surrogate motherhood conference, changes in the attitudes toward the practice occurred in 46% (6/13) of the participants whose science literacy was improved, but only changed in 20% (1/5) of those whose science literacy was not improved.[12] These results seemed to suggest that the participants with science literacy improvement tended to modify their attitudes toward related technology policies.

Four Functional Elements

The participants were asked to compare four functional elements, i.e., reading materials, expert lectures, expert testimony, and group discussion. Results are shown in Tables 1 and 2. According to Table 1, both the citizen panel in the prenatal testing and screening conference and the corresponding one in the surrogate motherhood conference perceived that expert lectures were the most important element in improving participants' understanding of science; reading materials ranked second, expert testimony third, and group discussions ranked least important. As to the relative significance in affecting participants' attitudes toward science, the ranking

[10]"Supporting" referred to those who "agreed definitely" or "agreed probably" with the statement. "Not supporting" referred to those who "disagreed definitely" or "disagreed probably" with the statement.

[11]Of these 3 participants, 2 had no change in science literacy and 1 had science literacy in degradation (i.e., from 4 to 3 questions answered correctly). The attitude of the participant with science literacy in degradation changed from supporting to being indifferent. The other 2 participants continued to support it.

[12]Of the 6 participants who improved their science literacy and changed their attitudes after the surrogate motherhood conference, 5 shifted their positions from opposing to supporting the practice and one became opposed to it. As to the participant who did not improve his science literacy but changed his attitude after the conference, he became indifferent to the practice.

Table 1 Self-perceived relative significance of functional elements in improving participants' understanding of science in the two consensus conferences[a]

Elements	Prenatal testing and screening (n=14)		Surrogate motherhood (n=18)	
	Ranking score	Mean	Ranking score	Mean
Expert lecture	52	3.7	60	3.3
Reading material	42	3.0	57	3.2
Expert testimony	38	2.7	44	2.4
Group discussion	29	2.1	41	2.3

[a] Ranking scores as self-perceived relative significance was measured as the sum of the scores that individual participants assigned to the elements. A score of 4 referred to the most important, 3 the second most important, 2 the third most important, 1 the least important. When a participant ranked each element as equally important, a score of 4 was given to each element in his or her case.

was slightly different. As shown in Table 2, in each conference, expert testimony became more important than reading materials, while expert lectures were still the most important element and group discussions still ranked the least important.

According to the above comparisons, it seemed to the participants that the knowledge provided by experts, in either oral or written form, was more important than group discussions in affecting their understanding of and attitudes toward scientific policy issues. In addition, one-way communication (i.e., expert lectures and reading materials) appeared more important in affecting knowledge learning than in affecting attitudes formation. In contrast, two-way communication between citizens and experts (i.e., expert testimony) appeared more important in influencing attitudes formation. The influence of experts appeared more significant than the influence of group discussions that were conducted among the participants themselves.

Perception of Expertise

In-depth interviews provided us with rich information about participants' perceptions of expertise. In the prenatal testing and screening conference, most of the participants respected professional knowledge highly and tended to follow expert opinions to some extent. One participant said that "because we did not understand these science and technology issues too much, we needed to consult experts for their opinions" (Interview PA). Another one agreed that "generally speaking, these

Table 2 Self-perceived relative significance of functional elements in influencing participants' attitudes toward science in the two consensus conferences[a]

Elements	Prenatal testing and screening (n=14)		Surrogate motherhood (n=18)	
	Ranking score	Mean	Ranking score	Mean
Expert lecture	46	3.3	55	3.1
Reading material	37	2.6	43	2.4
Expert testimony	41	2.9	54	3.0
Group discussion	37	2.6	30	1.7

[a] See footnote to Table 1.

experts were better than the general public and they had more specialized knowledge than us. We cannot surpass them in this dimension" (Interview PD). These reflections showed that the participants recognized the asymmetry between experts and themselves in professional knowledge and were willing to learn from experts.

From the in-depth interviews, we identified four images of experts about normative issues of scientific discussions. First, each expert was so specialized as to lack the broad view that was needed in understanding science in a society (Interview PI). Some experts studied science controversies from a very limited perspective and missed many critical points (Interview PF). Second, professional myths of experts might further crystallize their biases and prevent them from taking different experiences or positions into due consideration (Interview PN). Third, experts dominated science and technology policies. However, the general public was entitled to express their opinions about scientific policies because science and technology could benefit as well as jeopardize their lives (Interview PJ). Fourth, many experts had a strong bias about controversial issues. For example, one participant remembered that "some experts had a strong group identity and represented the position of their group instead of the general public" (Interview PB). It seemed to this participant that these experts were not impartial.

In the surrogate motherhood conference, most participants considered that expert lectures provided them with useful information and enhanced their understanding of the technical, ethical, and social implications of the practice. However, many participants emphasized that "Expert W had a very obvious personal attitudes toward surrogate motherhood" (Interview SJ). These participants were able to identify normative positions of experts and understand that experts might be as subjective as the general public in ethical controversies. This kind of perception of expertise was also noted in the prenatal testing and screening conference. But the participants in the surrogate motherhood conference seemed more critical. They highlighted the idea that it was more difficult for the experts than for the lay participants to change their attitudes at expert testimony. One vividly described that "There were only limited opinion exchanges between the experts and the participants because the experts brought in their perspective. We went to the conference with an empty mind and were prepared to bring something back home, but the experts came to us and dumped their opinions" (Interview SH).

In total, 12 participants said that the experts who opposed surrogate motherhood failed to provide strong evidence and persuasive arguments to win participants' support. In addition, some pointed out that some experts were too emotional in their speech or not sincere enough in a dialogue with the participants (Interviews SG, SH, SK, SN). It was found that the participants not only paid attention to information quality, but also expected to have a mutual exchange of empathy with the experts. From the participants' perspective, effective persuasion must combine evidence-based arguments and reflective life experiences. One participant reported that "some experts employed the strategy of emotional appeal. Although not decisive, the strategy did have some influence [on participants' attitudes toward surrogate motherhood]" (Interview SL). Appealing to the principle of altruism was also suggested. Because helping fellow citizens was socially approved, one said that "many participants were easily attracted by the argument of making some of our efforts to achieve the greatest happiness for other people" (Interview SF).

Group Dynamics and Informal Interaction

In the prenatal testing and screening conference, frequency of speaking that occurred was highly disproportionate: three of the most active participants together occupied 41% of the total of 202 talks in the formal sessions. The most active participant spoke 49 times. The second and the third did so 31 and 25 times, respectively. In group discussion, 2 or 3 participants led oral interactions, while 7 participants were quite silent. Each of the 3 most active participants had a college degree and 2 silent participants also had a degree.

In the surrogate motherhood conference, frequency of speaking occurred relatively evenly among all of the 18 participants as compared with those in the other conference. Ten talked above the average 17 times; the 3 most active ones together occupied 30% of the total of talks. This group discussion was not dominated by a few participants. Moreover, of the 10 most active participants, 4 opposed surrogate motherhood but 6 supported it; both proponents and opponents of surrogate motherhood were proportionally presented in group discussions. No significant difference in education levels was found between the active and inactive participants.

Indeed, group discussion was more reciprocal and more balanced among participants in the surrogate motherhood conference than among those in the prenatal testing and screening conference. The participants in the surrogate motherhood conference paid greater attention to the opinions of their fellow participants. It appeared that the participants with a relatively equal position of oral exchange were willing to consider others' opinions. For example, of the 6 participants who opposed surrogacy before the conference, 4 spoke far more often than the average number and 5 became supportive of the legalization after the conference. They had many opportunities to re-consider their positions because of fair and thoughtful dialogues between equals with different perspectives.

Group pressure appeared obvious in the surrogate motherhood conference. According to the in-depth interviews, one participant indicated that "it is not good for a member to insist on an opinion when many others agreed on another one, because conference members might think this person as one who sought to break a consensus of the majority" (Interview SO; see also Interviews SA , SF, SN). Another participant took a case as an example and said that "when speaking out her opinions against surrogate motherhood, she was surrounded by 4 participants who strongly persuaded her to change the mind" (Interview SN). It was reported that surrogacy proponents endeavored to persuade opponent participants by knocking on the door of their rooms and talking to them from late at night to very early in the morning.[13] There was a concern that informal interactions created strong group pressure upon some members and profoundly shaped the dynamics of group discussion, as reported in the in-depth interviews.

However, group pressure might not be a factor related to attitude change. According to our analysis, all of the 6 participants who became surrogate

[13]The participants of the surrogate motherhood conference had all arranged to stay at the same hotel during the conference.

motherhood proponents after the conference were very disappointed with the performance of the experts who argued against the practice. They recalled that these experts failed to provide strong arguments or express opinions as sincerely as expected. Four of these participants were actively involved in discussion and said in their in-depth interviews that they felt no group conformity pressure. Their efforts demonstrated that active participation could overcome group pressure.

In addition, many expert opponents spoke in jargon (e.g., commodification of the female, hegemony of the traditional culture), but neither explained technical words well nor provided sufficient arguments to support their positions. Conversely, an expert proponent told the participants of her hardship as an infertile wife who made every endeavor to become pregnant but failed. Moreover, an infertility specialist who was supposed to remind the participants of negative outcomes of surrogacy gave up his position and came to echo proponents' opinions at the testimony. Under such circumstances, the participants found that opponents' arguments were weak, incomplete, and unconvincing. Participants actively exchanged opinions with one another and, at the end of the conference, made a recommendation that the practice be "conditionally allowed": Surrogate motherhood should not be completely prohibited but should be legally allowed for certain infertile people in Taiwan.

Compared to those of the surrogate motherhood conference, the participants of the prenatal testing and screening conference were not engaged in persuasion during private time, although they exchanged opinions or feelings occasionally when outside the conference (Interview PB; see also PD, PE, PF, PI, PK). Only 2 participants reported that they felt some group pressure. They said that "when other members were in favor of one position, I would conceal my different opinions" (Interviews PD, PL). In addition, there was no complaint about expert performance and some participants gave positive comments on expert opinions. In their in-depth interviews, most of the participants agreed that more than 80% of their opinions were well incorporated into the final report (Interviews PA, PB, PD, PE, PF, PG).

Discussion

This study found four preliminary results about interactions between experts and citizens in consensus conferences in Taiwan. First, citizens' science literacy could be improved. Consistent with Hamlett (2003) and Hendriks (2005), this study found that, on average, participants' science literacy levels were improved after deliberative practices. In addition, after each conference, both the more and the less educated participants improved their science literacy, especially the more educated. These results might suggest that lay citizens could improve their scientific knowledge when they have an opportunity to learn from comprehensible and professional instructions. Indeed, Doble (1995), in his study comparing public opinions about scientific issues among 402 citizens before and after a video-education program and small group discussion, found that "the average person has the capability to digest rather quickly enough technical information to thoughtfully decide how to deal with very complex scientific issues".

Second, this study found that citizens' attitudes toward technology policy issues could shift in public debate and confrontation, a result also found in Hendriks (2005)

and Doble (1995). In the current study, most participants shifted their attitudes to some extent after each conference. Many even changed their positions regarding a specific issue from support to opposition (or from opposition to support). Attitude changes appeared more likely to occur in participants with improvement in science literacy than in those without improvement. This might indicate that individual participants' attitudes toward an unfamiliar issue tend to change after they know more about it.

Third, this study found that, compared to group discussion, experts played a much more important role in affecting participants' understanding of and attitudes toward science in both conferences. Indeed, laypersons considered expert instructions seriously and most of them respected expert views highly. This result may be attributed to asymmetries of power and scientific knowledge between experts and lay participants or to a general inclination to favor expertise in dealing with scientific controversies in Taiwan. It may also exemplify communicative inequalities between citizens and experts: It is laypersons rather than experts who are supposed to need to be transformed and educated to discuss scientific controversies. In addition, experts acquire the authority to define the characteristics of issue complexity and technological uncertainty, set the boundaries of relevant knowledge, and explain the relationships between facts. Thus, there is concern that participation of experts in the consensus conferences might reinforce or even reproduce typical but asymmetric relationships between experts and citizens (Hendriks 2005: pp. 95–97).

In this regard, this study found mixed results. On the one hand, the experts profoundly shaped participants' understanding of scientific policy controversies and had an impact on their policy dialogues. The participants had to absorb and integrate new and abstruse information into their judgments. They were acknowledged to generate good ideas to solve complex issues. Many of them did that by marginally amending expert suggestions.

On the other hand, in exchanging ideas with the experts, the participants were able to discover inconsistency in certain scientific issues and very contradictory ethical positions among the experts. When the experts faced a dilemma, the participants had an opportunity to re-evaluate experts' suggestions and question the authority of experts in the policy process. In other words, the participants began to modify their submissive position toward the experts in terms of discussing scientific policies. The participants also began to look for opinions from their fellow participants and took their ideas into serious consideration.

Moreover, through the deliberative process, the participants could transcend and transform expert language. Gradually, the participants used their own language to discuss scientific controversies. They made comparisons and found contested or even contradictory ideas between expert opinions. They reflected concerns and raised worthy viewpoints unarticulated in expert presentations. As Einsiedel and Eastlick (2000) said, the evolution of their engagement showed "the increasing specificity of the question posed and the self-confidence in engaging the experts in a variety of areas". The participants continued to clarify their mission as generating the voices of the people and identifying themselves as the people. A few participants helped other members to question the experts and translate, acting as intermediates between the experts and the lay citizens. Their endeavors enabled the citizen panels to actively exchange views with the experts.

Fourth and more importantly, citizens could identify biases and stylized opinions in expert presentations. Many participants indicated that the experts tended to study an issue from a pre-determined, narrow, and technical perspective, neglecting, for example, moral and political consideration. They pointed out that some experts had such a strong preference for particular issues as to leave almost no room for further discussion. Too many specialized terms, low relevance to lay daily experiences, and sometimes shaky arguments were the characteristics of expert opinions mentioned in the in-depth interviews. Not surprisingly, some participants' trust in expert opinions was undermined under such a circumstance.

The finding that group discussion was the least important element did not mean that this element was not important at all. In fact, a total of 12 participants perceived that group discussions were as important as the other 3 elements in affecting knowledge learning and attitude formation. In addition, most participants participated heavily and relatively equally in group discussions in the surrogate motherhood conference. In that conference, disparity of opinion among the participants was obvious and dialogues with experts were not satisfying. It is believed that group discussion among equals with different perspectives can help find critical missing viewpoints earlier.

Whether or not the recommendation for conditionally-allowed surrogate motherhood met with the unanimous consent of the participants at the conference needs more investigation. One participant who was consistent in her opposition to surrogacy complained that a few proponents continued to persuade others even when discussion sections were over (Interview SE). She decided to boycott the conference by keeping silence afterwards. Another participant who later became opposed to surrogate motherhood recalled that the opposite side's urge "was somewhat threatening although it was a soft, emotion threat" (Interview SF). There were 2 participants who considered the conclusion to have been reached because of strategic compromise, instead of rational deliberations, among the participants (Interviews SL and SO). But another participant gave a positive remark about it (Interview SR). There were participants who neither approved of the deliberation process nor endorsed the advice in their in-depth interviews. It was likely that conformity, rational agreement, and self-detachment all played some roles in that conclusion. We therefore could not conclude that the surrogate motherhood conference was a complete success. Improvements in public deliberations are needed in further practices.

Conclusion

Since its beginnings in Denmark, the consensus conference has been characterized as putting the voices of laypersons at the center, having intensive dialogues between experts and citizens, and insulating experts from actively participating in lay deliberations (Einsiedel et al. 2001). This study found that in each of the two consensus conferences in Taiwan the level of laypersons' science literacy in the content perspective was improved on average and their attitudes toward scientific controversies changed. These results were also found in Doble's 1995 large-sample study. As to the direction of attitude change, one citizen panel became more supportive of surrogate motherhood but the other panel became opposed to the

statement that governments should encourage pregnant women to have a prenatal examination in order to promote population quality in Taiwan. Remember that the arrangement of the consensus conference has a significant normative position: the main purpose of enhancing participants' science literacy is to enable them to participate meaningfully in public deliberations about scientific policy controversies. Whether or not they will support science and technology development and why are open questions from the perspective of the practice.

A concern is that the group dynamic might shape knowledge learning, attitude formation, and finally conclusion making. For example, people will compare their opinions with the opinions of others' and tend to pick up those opinions similar to theirs to reinforce their own positions. Further studies are needed to specify conditions under which participants reinforce their positions or open their minds to consider experts' or other members' opinions, modify their own attitudes, and make conclusions collectively.

Ordinary citizens can identify biases, normative positions, and personal preferences expressed in talks by experts. They can be critical toward expert reasoning. More importantly, they are able and willing to have their voices heard in the policy process through public and informed deliberations. The consensus conference has the potential to make scientific policy dialogues between experts and laypersons more egalitarian and more democratic. In the process, experts are better to use language understandable to laypersons and to base their talks on solid arguments, with perceived persuasiveness, and with relevance to everyday experiences of laypersons. Also, experts are expected to allow changes like re-negotiation of knowledge construction or transformation of viewpoints to happen to themselves. Not only the public, but also experts, science, and the system that produces or reproduces them, need to be problematized in order to overcome communicative inequalities between experts and citizens in their interactions (Wynne 1995: pp. 370, 384–388).

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Appendix: The Science Literacy Questions Asked of Participants in Each of the Consensus Conferences

I. In the consensus conference on surrogate motherhood

1. Which of the following conditions of infertility is most likely to need to pursue a surrogacy arrangement?

   (1) Ovulation anomalies
   (2) Poor quality of sexual life
   (3) Poor quality of sperm
   (4) Uterus anomalies
   (5) Don't know

2. In Taiwan, what is the average success rate of having a baby through in vitro fertilization?

   (1) One out of four
   (2) One out of three
   (3) One out of two
   (4) Two out of three
   (5) Don't know

3. The regulation of surrogacy in United Kingdom is often discussed. Which of the following best describes the regulation of surrogacy in United Kingdom?

   (1) All forms of surrogacy are prohibited in United Kingdom
   (2) Non-commercial surrogacy is allowed in United Kingdom
   (3) Commercial surrogacy is allowed in United Kingdom
   (4) There is no regulation of surrogacy in United Kingdom
   (5) Don't know

4. Which of the following best describes the current status of Taiwan's regulation of assisted human reproductive technology?

   (1) The Assisted Human Reproduction Act has been promulgated for many years and it prohibits surrogacy
   (2) The Assisted Human Reproduction Act has been promulgated for many years but it does not regulate surrogacy
   (3) The bill of Assisted Human Reproduction Act is currently being drafted
   (4) There will be no separate act that regulates assisted human reproductive technology because the issue is covered by other Acts
   (5) Don't know

5. According to current law in Taiwan, who will be defined as the mother of a baby?

   (1) The woman who provides the egg
   (2) The woman who conceives and give birth to the baby
   (3) The woman who raises and nurtures the baby
   (4) The woman who provides the baby with necessities and money for life
   (5) Don't know

II. In the consensus conference on prenatal screening and testing

1. Which of the following can be diagnosed by fetus ultrasound in prenatal care?

   (1) Fetuses with anomalies of the limbs
   (2) Fetuses with thalassemia
   (3) Fetuses who are HIV positive or have AIDS
   (4) Fetuses with hypertension
   (5) Don't know

2. Which of the following pregnant women are most likely to need to have prenatal screening services?

   (1) All of them
   (2) Those with a family history of hereditary diseases
   (3) Those with histories of fetal anomalies
   (4) Those diagnosed by prenatal testing to have a fetus with anomalies
   (5) Don't know

3. Which of the following pregnant women are most likely to need to have prenatal testing services? Please choose one or more answers.

   (1) All of them
   (2) Those with a family history of hereditary diseases
   (3) Those with a history of fetal anomalies
   (4) Those diagnosed by prenatal testing to have a fetus with anomalies
   (5) Don't know

4. Which of the following is included in prenatal screening services for pregnant women? Please choose one or more answers.

   (1) AIDS screening
   (2) Family history of hereditary diseases
   (3) History of fetal anomalies
   (4) Amniocentesis
   (5) Umbilical cord blood test

5. Which of the following is included in prenatal testing services for pregnant women? Please choose one or more answers.

   (1) AIDS screening
   (2) Family history of hereditary diseases
   (3) History of fetal anomalies
   (4) Amniocentesis
   (5) Umbilical cord blood test

6. For each pregnant woman in Taiwan, how many times are prenatal screening services currently subsidized by the national health insurance program?

   (1) 15
   (2) 12
   (3) 10
   (4) 8
   (5) Don't know

7. According to Genetic Health Act, which of the following is not subsidized by the government in prenatal testing services?

   (1) For all pregnant women
   (2) For pregnant women of age 34 or above
   (3) For pregnant women with a family history of hereditary diseases
   (4) For pregnant women with anomalies of the fetus found in prenatal screening services
   (5) Don't know

References

Beck, U. (1992). *Risk society: Toward a new modernity.* London: Sage.

Benhabib, S. (1996). Toward a deliberative mode of democratic legitimacy. In S. Benhabib (Ed.), *Democracy and difference: Contesting the boundary of the political* (pp. 67–94). Princeton: Princeton University Press.

Bohman, J. (1996). *Public deliberation: Pluralism, complexity, and democracy.* Cambridge: MIT Press.

Chen, D.-S., & Lin, K. (2004). The prospect of deliberative democracy in Taiwan. *Paper presented at the international symposium on Asia's new democracies: Taiwan, the Philippines and South Korea compared*. Taipei: Academia Sinica.

Chopyak, J., & Levesque, P. (2002). Public participation in science and technology decision making: Trends for the future. *Technology in Society*, *24*, 155–166.

Clark, F., & Illman, D. L. (2001). Dimensions of civic science. *Science Communication*, *23*(1), 5–27.

Cohen, J. (1996). Procedure and substance in deliberative democracy. In S. Benhabib (Ed.), *Democracy and difference* (pp. 95–119). Princeton: Princeton University Press.

Cohen, J. (1999). Deliberation and democratic legitimacy. In J. Bohman & W. Rehg (Eds.), *Deliberative democracy* (pp. 67–92). Cambridge, MA: MIT Press.

Cohen, J., & Rogers, J. (2003). Power and reason. In A. Fung & E. O. Wright (Eds.), *Deepening democracy: Institutional innovations in empowered participatory governance* (pp. 237–258). London: Verso.

Doble, J. (1995). Public opinion about issues characterized by technological complexity and scientific uncertainty. *Public Understanding of Science*, *4*, 95–118.

Einsiedel, E. F., & Eastlick, D. L. (2000). Consensus conferences as deliberative democracy: A communications perspective. *Science Communication*, *21*(4), 323–343.

Einsiedel, E. F., Jelsøe, E., & Breck, T. (2001). Publics at the technology table: The consensus conference in Denmark, Canada, and Australia. *Public Understanding of Science*, *10*, 83–98.

Elster, J. (1989). The market and the forum: Three varieties of political theory. In J. Elster & A. Hylland (Eds.), *Foundations of social choice theory* (pp. 103–132). Cambridge: Cambridge University Press.

Fiorino, D. J. (1990). Citizen participation and environmental risk: A survey of institutional mechanisms. *Science, Technology, and Human Values*, *15*, 226–243.

Fischer, F. (2003). Citizens and experts: Democratizing policy deliberation. In *Reframing public policy: Discursive politics and deliberative practices* (pp. 205–237). Oxford: Oxford University Press.

Fishkin, J. S. (1995). *The voice of the people.* New Haven: Yale University Press.

Fishkin, J. S., & Luskin, R. C. (1999). The quest for deliberative democracy. *The Good Society*, *9*(1), 1–14.

Fung, A. (2003). Recipes for public spheres: Eight institutional design choices and their consequences. *Journal of Political Philosophy*, *11*, 1–30.

Gastil, J., & Levine, P. (Eds.) (2005). *The deliberative democracy handbook: Strategies for effective civic engagement in the 21th century.* San Francisco: Jossey-Bass.

Greenwood, M. R. C., & Riordan, D. G. (2001). Civic scientist/civic duty. *Science Communication*, *20*, 28–40.

Guston, D. H. (1999). Evaluating the first U.S. consensus conference: The impact of the citizens' panel on telecommunications and the future of democracy. *Science, Technology, & Human Values*, *24*(4), 451–482.

Gutmann, A., & Thompson, D. (1996). *Democracy and disagreement.* Cambridge: Harvard University Press.

Hagendijk, R. P. (2004). The public understanding of science and public participation in regulated worlds. *Minerva*, *42*, 41–59.

Hamlett, P. W. (2003). Technology theory and deliberative democracy. *Science, Technology, & Human Values*, *28*, 112–140.

Hendriks, C. M. (2005). Consensus conferences and planning cells: Lay citizen deliberations. In J. Gastil & P. Levine (Eds.), *The deliberative democracy handbook: Strategies for effective civic engagement in the 21th century* (pp. 80–110). San Francisco: Jossey-Bass.

Hennen, L. (1999). Participatory technology assessment: A response to technical modernity? *Science and Public Policy*, *26*(5), 303–312.

Huijer, M. (2003). Reconsidering democracy: History of the human genome project. *Science Communication*, *24*, 479–502.

Jasanoff, S. (2003). (No?) accounting for expertise. *Science and Public Policy*, *30*(3), 157–162.

Joss, S. (1998). Danish consensus conference as a model of participatory technology assessment: An impact study of consensus conference on Danish parliament and Danish public debate. *Science and Public Policy*, *25*(1), 2–22.

Joss, S., & Durant, J. (1995). The UK national consensus conference on plant biotechnology. *Public Understanding of Science*, *4*, 195–204.

Kim, M.-S. (2002). Cloning and deliberation: Korean consensus conference. *Developing World Bioethics*, *2*, 159–172.

Laird, F. N. (1993). Participatory analysis, democracy, and technological decision making. *Science, Technology, and Human Values*, *18*, 341–361.

Lee, C.-J., Scheuffle, D. A., & Lewenstein, B. V. (2005). Public attitudes toward emerging technologies. *Science Communication*, *27*(2), 240–267.

Lenaghan, J. (1999). Involving the public in rationing decisions: The experience of citizens juries. *Health Policy*, *49*, 45–61.

Mansbridge, J. (2003). Practice-thought-practice. In A. Fung & E. O. Wright (Eds.), *Deepening democracy*: *Institutional innovations in empowered participatory governance* (pp. 175–199). London: Verso.

Mendelberg, T. (2002). The deliberative citizen: Theory and evidence. *Political Decision Making*, *Deliberation and Participation*, *6*, 151–193.

Montpetit, E., Scala, F., & Fortier, I. (2004). The paradox of deliberative democracy: The National Action Committee on the Status of Women and Canada's policy on reproductive technology. *Policy Sciences*, *37*, 137–157.

Nelkin, D., & Pollak, M. (1979). Public participation in technological decisions: Reality or grand illusion? *Technology Review*, 55–64, August/September.

Nishizawa, M. (2005). Citizen deliberations on science and technology and their social environments: Case study on the Japanese consensus conference on GM crops. *Science and Public Policy*, *32*, 479–489.

Nowotny, H. (2003). Democratising expertise and socially robust knowledge. *Science and Public Policy*, *30*(3), 151–156.

Otway, H. (1992). Public wisdom, expert fallibility: Toward a contextual theory of risk. In S. Krimsky & D. Golding (Eds.), *Social theories of risk* (pp. 215–228). Westport: Praeger.

Otway, H., & Wynne, B. (1989). Risk communication: Paradigm and paradox. *Risk Analysis*, *9*(2), 141–145.

Perhac, R. M. Jr. (1998). Comparative risk assessment: Where does the public fit in?" *Science, Technology, and Human Values*, *23*(2), 221–241.

Pinch, T., & Bijker, W. E. (1987). The social construction of facts and artifacts. In W. E. Bijker, T. P. Hughes & T. J. Pinch (Eds.), *The social construction of technological systems* (pp. 17–50). Cambridge: MIT Press.

Rayner, S. (2003). Democracy in the age of assessment: Reflections on the roles of expertise and democracy in public-sector decision making. *Science and Public Policy*, *30*(3), 163–170.

Renn, O., Webler, T., & Wiedemann, P. (1995). *Fairness and competence in citizen participation*. London: Kluwer Academic Publishers.

Salomon, J.-J. (2000). Science, technology and democracy. *Minerva*, *38*, 33–51.

Smith, G. (2000). Toward deliberative institutions. In M. Saward (Ed.), *Democratic innovation* (pp. 29–39). New York: Routledge.

Thurston, W. E., MacKean, G., Vollman, A., Casebeer, A., Weber, M., Maloff, B., et al. (2005). Public participation in regional health policy: A theoretical framework. *Health Policy*, *73*, 237–252.

Webler, T., & Renn, O. (1995). A brief primer on participation: Philosophy and practice. In O. Renn, T. Webler & P. Wiedemann (Eds.), *Fairness and competence in citizen participation* (pp. 17–34). London: Kluwer Academic Publishers.

Weigold, M. (2001). Communicating science: A review of the literature. *Science Communication*, *21*, 164–193.

Winner, L. (1993). Upon opening the black box and finding its empty: Social constructivism and the philosophy of technology. *Science, Technology, & Human Values*, *18*, 362–378.

Wynne, B. (1992). Risk and social learning: Reification and engagement. In S. Krimsky & D. Golding (Eds.), *Social theories of risk* (pp. 257–297). Westport: Praeger.

Wynne, B. (1995). Public understanding of science. In S. Jasanoff et al. (Eds.), *Handbook of science and technology studies* (pp. 361–388). London: Sage Publications.

Young, I. M. (2000). Inclusive political communication. In *Inclusion and democracy* (pp. 52–80). Oxford: Oxford University Press.

Zurita, L. (2006). Consensus conference method in environmental issues: Relevance and strengths. *Land Use Policy*, *23*, 18–25.