# Commonsense, Trust and Biotechnology: Moving Beyond 'Corngate'

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## Abstract

This paper advocates for clearer distinctions to be drawn between school science and scientists' science, particularly with respect to the investigative processes that typify each. It draws on the findings of a recent survey of public attitudes to science in New Zealand, and on recent international research in science education. The paper explores the possibility that the images of science that appear to be carried from school into adult life are not helpful for democratic decision making that requires adults of engage with socio-scientifc issues such as genetic engineering. Recommendations for some changes in science teaching are outlined, and preliminary suggestions for support for teachers from professional scientists are made.

## Introduction

During the 2002 election campaign in New Zealand controversy erupted over the possibility that corn crops in several locations had been grown from a batch of seed that had tested positive for the presence of genetically engineered material, and that this situation had been deliberately suppressed for political reasons. The claims and counterclaims of the so-called 'Corngate' episode precipitated divisive debate that arguably spread beyond the immediate issue to inflame concerns about GE more generally, and perhaps, paradoxically, to actually hamper dialogue between scientists and the wider public about these concerns[1]. In such a climate of unhelpful confrontation it would appear to be critical to find ways to improve mutual communication between the science community and the interested and/or concerned public. This paper takes a long-term view of that broad aim. It is based on the premise that an important goal of science education is to prepare today's school students for active participation in socio-scientific decision-making in their adult lives[2].

The paper addresses issues of potential interest to those who teach science and those who practice professional science, as well as science education researchers. In the past tensions

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[1] This episode has been thoroughly documented elsewhere – see for example
Campbell, G. (2002) Planting the seeds of doubt. *New Zealand Listener*. 184, pp. 16-22

[2] This goal is clearly signalled in the aims of New Zealand's science curriculum document. However the curriculum is open to multiple possible interpretations, and such outcomes may not be foremost in teachers' minds.
Hipkins, R. & Barker, M. (2002). Science in the New Zealand Curriculum: present potential and future possibilities. *New Zealand Science Teacher, 100*, 10-16.2002 elaborates on these points).

between the scientific research community and the science education community have led to unhelpful power struggles and consequent flip-flopping over the nature and content of school science curricula (DeBoer 1991). I hope to demonstrate that scientists and science teachers have mutually interdependent but different roles to play in the education of our future citizens. I suggest that neither group can effect change without the active help and support of the other.

The case that is made draws on science education research as well as findings from recent research that investigated public attitudes to science in New Zealand. The latter research was funded by the MoRST, and carried out by NZCER in conjunction with ACNielsen. The quantitative component was a telephone survey that sought the views of eight hundred New Zealanders in areas that included their personal interest in science, their ideas about science, and their opinions about the work of scientists. The qualitative component used four focus groups chosen to represent diverse social groups: low waged; mothers of young children; young urban professionals; and teachers with an interest in science. Each group met twice to discuss the potential health effects of cell phone use. This topic was chosen to allow an exploration of ideas *about* science with less likelihood of ethical dilemmas and differing value positions dominating the discussion, as could happen in a context such as GE. In this first session each group discussed some short summaries of actual scientific research related to cell phone safety, and in the second session a range of published opinions about this topic.

The full research findings have been reported elsewhere (Hipkins, Stockwell, Bolstad & Baker 2002). This paper reports on ideas about scientific inquiry that emerged, and explores the possibility that some specific types of school science experiences could be contributing to the types of responses that are outlined. If that is indeed the case, specific courses of action that could address the issue can be relatively easily pinpointed. I hope to demonstrate that teachers and scientists have different but mutually interdependent roles to play if these actions are to be successful.

## Selected findings from New Zealand research

This section briefly outlines selected findings from the NZCER/ACNielsen research. First findings related to interest in and attitudes to controversial areas such as GM/GE are briefly outlined and compared with another recent telephone survey that probed people's awareness of and knowledge about genetic modification (Harsant & Kalafatelis 2001). Following that, findings related to socio-scientific decision making in general are introduced.

### *New Zealanders' interest in genetic modification*

Both research projects found a level of interest in, and concern about, aspects of GM within the New Zealand population. The Harsant and Kalafatelis survey reported a strong desire on the part of almost 80 percent of New Zealanders to know more about GM and how it is controlled. However the NZCER/ACNielsen research found less interest in the related area of cloning than in any of the other nine areas of research that were explicitly mentioned, with a similarly low level of perception that cloning can be beneficial.

Similarities between the findings of the two surveys included:

- Four percent of the 603 respondents to Harsant and Kalafatelis survey mentioned GM/GE when initially asked an open question about issues they thought were of importance to New Zealand's future. In response to an open question about government controls of science, 6 percent of our respondents spontaneously mentioned GE as a specific concern (Hipkins *et al.* 2002, p. 15).
- In the Harsant and Kalafatelis survey, Maori (16%) were reported as 'significantly more likely than non-Maori (9%) to claim that genetic modification meant "playing with nature/playing with God". We found stronger levels of concern, arguably because we sought an agree/disagree response to the specific prompt that "people shouldn't interfere with nature". Maori (65%) and Pacific (67%) peoples agreed or strongly agreed compared to Europeans (59%) (Hipkins *et al.* 2002, p. 20).

The discrepancies between open and prompted responses in both surveys suggest that both the level and nature of that concern may be exaggerated by the very act of surveying. In her recent lecture series about trust in all areas of public life Onora O'Neill cautioned about this effect. She suggested that such findings are about *suspicion*, and that the daily actions/ decisions of most people actually suggest an largely unquestioning trust, at least in the products and applications of science[3]. It may be that controversies such as 'Corngate' create an exaggerated impression of trust issues and this would be an interesting question for further research. Nevertheless there does appear to be a level of concern about GM/GE in New Zealand, with the divisive responses to 'Corngate' suggesting there are communication gaps between the science community and the wider public that need to be addressed.

### *Trust in scientific research*

The quantitative component of the NZCER/ACNielsen research suggested that most New Zealanders hold strongly realist views of science. A considerable proportion of the population (18%) said they would not take any scientific claims on trust, with a quarter of this group

[3] The full text of the lecture series is available at www.bbc.co.uk/radio4/reith2002/.

saying they don't believe anything unless they see it for themselves. This poses considerable challenges when scientists are working with theoretical entities such as genes and it is not possible for them to directly demonstrate their research in a concrete manner. Some of the focus group participants tended to conflate science and business interests when issues of trust were being discussed. Past dishonest manipulation of research data by some scientists with commercial ties (as in the tobacco industry) was cited in support of such views, and those who held them were very suspicious of what they saw as 'PR spin' in the reporting of scientific research. While this issue arose in the discussions of all four groups, conflation of science and business interests was more evident in the 'low waged' and the 'young mothers' groups. Again this is an issue for areas such as biotechnology where commercial applications are often the primary focus of scientific research.

### *Commonsense judgements about the plausibility of research*

We found that focus group participants made 'commonsense' judgements about the plausibility of the brief reports of scientific research that they were given to discuss, based on their day-to-day ideas and experiences. However this type of reasoning is very likely to misrepresent the true complexity of actual scientific research, and so suspicions about science can result when research is judged not to be plausible. Limited knowledge about the actual processes of scientific investigation appears to contribute to these types of responses and it seems likely that personal experiences of learning in school science might be a significant source of 'commonsense' views about science (Hipkins *et al*. 2002, pp. 106-107). The next section of the paper explores this possibility by linking patterns of responses from the focus group participants to one recent comprehensive critique of the manner in which school science experiences represent scientific inquiry (Chinn & Malhotra 2002). The differences that are outlined collectively suggest that aspects of school science may need to change *if* teachers intend these to help students build views of the nature of actual scientific inquiry that they can usefully draw on in their adult lives.

## School science practical work and actual scientific inquiry

After carrying out a detailed analysis of differences between some examples of actual scientific research and some typical textbook examples of school practical work Chinn and Malhotra (2002)concluded that "textbook inquiry tasks assume an epistemology that is entirely at odds with the epistemology of real science" (p. 204). Some of the specific differences between school science and actual science that they describe have the potential to explain our findings of 'commonsense' decision making about scientific issues. Four areas of possible correlation are outlined next. The differences between real science and school science that are outlined collectively suggest some possible courses of remedial action that could be taken by both science teachers and scientists.

### *Commonsense thinking about scientific reasoning*

Chinn and Malhotra (2002)found a difference between the complexities and inherent uncertainties of the reasoning patterns employed by research scientists and those depicted in school science inquiry tasks. They suggest that school inquiry promotes straightforward, obvious patterns of reasoning that can be captured by “several simple, algorithmic rules” (Chinn & Malhotra 2002, p. 189). As a consequence “students may come to see science as compromising *certain* knowledge derived from *simple* logical rules of reasoning. They will not learn that science is uncertain, constantly undergoing scrutiny and revision, employing heuristics that fall short of certainty” (p. 190, emphasis in original). Our research findings suggest that such perceptions are likely to be implicated in personal judgements about issues of trustworthiness of science and scientists. The telephone survey probed responses to the statement that “when scientists say they can’t be really clear about the actual threat posed by something risky, they are telling the truth”(Hipkins *et al.* 2002, p.32-36). Fifteen percent of all the respondents were inclined to believe that scientists making such a claim would be hedging their bets, or protecting their backs. By contrast, just eight percent of respondents mentioned the complexities of scientific inquiry to support their view that scientists would be telling the truth when they admitted to uncertainties.

### *Commonsense and plausibility of research design*

When focus group participants made judgements about the plausibility of short reports of scientific research findings, they rejected those where the method did not make immediate sense to them (Hipkins *et al*. 2002, pp. 83-87). Inquiries with the potential to contribute carefully gathered evidence to the question of cell phone safety were rejected out of hand if the theoretical reasoning that underpinned their design was not readily evident. One participant challenged the use of the word ‘design’ within the scientific inquiry process, seemingly associating this with an expedient subjectivity that could lead research toward any set of desired outcomes. This invisibility of science theory in the design of research methodology has also been reported by other recent research of public attitudes to science (Tytler, Duggan & Gott 2001). In their analysis Chinn and Malhotra (2002) found no interdependence between theory and methods in the simple ‘textbook’ inquiry tasks. Contrasting this with the “theory-ladenness of methods” of actual scientific inquiry they point out that “students have no opportunity to develop an epistemology in which critical reflection on methods is important” (p. 189).

### *Seeing is believing*

Chinn and Malhotra do point out that science has different *purposes* to science education. Much school practical work is actually intended to support the learning of already known science ideas, and so they suggest that the goal of most simple inquiry is "a Baconian gathering of facts about the world" (p. 187). As already noted above, our research showed that some people expect the meaning of evidence to be immediately apparent – they want to *see* the proof for themselves (Hipkins *et al.* 2002, pp. 27-29). Although they were very sceptical about some written claims of 'evidence', most focus group participants initially took visual 'evidence' (in the form of a misleading computer simulation produced in support of a particular argument) at face value. Only once inconsistencies between what was claimed and what was represented were pointed out did they become more critical of what they could *see* (Hipkins *et al.* 2002, pp. 96-97). This commonsense view that evidence can be taken at face value will clearly not be challenged by the sorts of simple school science inquiry activities where face-value interpretation may actually be encouraged.

### *Images of the scientist as lone maverick*

Populist images of scientists often portray a solitary, eccentric individual, out of step with other people and 'real world' matters and concerns (Haynes 1996). We heard comment in this vein from the individual who was also suspicious that research might be 'designed' to achieve predetermined ends:

> ..it depends on who is funding the science projects, because they're loads of scientists that have been working things out in their garage and have got vehicles that can work on water, but it's not in the interests of the commercial field….the information is passed to a certain point where a company then goes 'that doesn't suit us so we'll do something about it'. And they're kind of bigger than the little home scientist in his garage figuring things for the benefit of human kind… so that's when a money mogul will come in and say 'no we don't want you to…we'll shut you up' (focus group one, first session).

Can experiences of school science contribute to the formation of such views, and hence as in the case cited here, indirectly contribute to suspicion of the motives of those who work at the science/commerce interface? Again Chinn and Malhotra's analysis supports this possibility:

> … scientists build on each others' work in a way that is absent in simple school science. Scientists start with a firm grounding in the methods, theories and empirical findings of science, which is acquired by studying other scientists' work. As we have noted, studying expert research is almost invariably absent from simple inquiry tasks. In addition, simple inquiry tasks typically lack certain institutionalized procedures found in science such as the review of articles by experts. Such procedures help create

> institutional norms that provide general guidelines for scientists (Chinn & Malhotra 2002, p. 190).

## What can be done about these commonsense views?

The general nature of commonsense thinking about science that has been outlined above suggests that better strategies to help today's students to learn *about* science while still at school could contribute to improved communication about socio-scientific issues with tomorrow's adult population. Specifically school students need to become more broadly aware of the complex web of relationships between evidence and theory, and the collaborative nature of scientific knowledge building, at both design and analysis stages. Such change implies different types of challenges for scientists and science teachers. These are outlined next.

### *What science teachers can do*

Clearly science teachers could address some of the issues raised in the analysis presented here by being more careful about the ways in which investigative work is represented to their students. Calls for changes related to this broad aim are increasing in frequency in the science education research literature. Specific changes being advocated include:

- providing experiences of a wider variety of types of inquiry so that students do not get the impression that there is only one valid 'scientific method' (Mayer & Kumano 1999; Watson, Goldsworthy & Wood-Robinson 1999);
- differentiating more clearly between practical experiences that serve as demonstrations of phenomena and actual investigations where some aspect of the outcome is genuinely not yet known (Millar 1998);
- drawing more overt links between theory and evidence in research design and interpretation (Solomon, Scott & Duveen 1996; Osborne, Erduran, Simon & Monk 2001);
- encouraging students to take part in more open inquiry, where possible exploring questions that they have posed, where they have an active interest in the outcome, and where some of the uncertainties and complexities of messy 'real' research can be experienced (Haigh & Hubbard 1997);
- making more use of simulation activities that have been designed to model aspects of real research while taking account of the constraints of science education settings. Twenty six such tasks are described by Chinn and Malhotra (2002).

### *What scientists can do*

All those people who communicate ideas about science to others are constrained to work with materials that are available to them. Science teachers (and science reporters) can only access the details of authentic scientific inquiries if the scientists who know the ‘real story’ of the research are prepared to put effort into shaping richer ‘discovery stories’ than they currently usually tell – at least in formal settings. For example, the invisibility of theory/evidence links in both research design and interpretation can only be reversed if scientists are prepared to change or add to their institutionalised reporting practices to produce more contextual accounts of their work for audiences other than their peers. An encouraging start in this direction has already been made in at least one New Zealand collection of essays (Hogan & Williamson 1999). Although the specific issues raised in this paper are not necessarily addressed by each of the essays in this book, they easily could have been, given an explicit intention to do so, and to write more discursively for a wider audience.

## Challenges upon challenges

This paper has explored the manner in which commonsense interpretations of scientific research can impact on public attitudes to science. As in the focus group component of the NZCER/ACNielsen research itself, the focus of the discussion has been largely restricted to the actual processes of scientific investigation. However all scientific research takes place within wider frameworks of societal structures. Beliefs, attitudes and values of social groups all potentially impact on the work of scientists. Biotechnology is one area of research where the impact of these wider frames of reference is most keenly felt, since it is an area where some research raises considerable ethical issues. The challenges of exploring and elucidating those influences will doubtless be at least as complex as the aspects of public thinking reported here. That challenge awaits further attention from New Zealand’s researchers, teachers and scientists. As in this project, doubtless all three groups will prove to have critical, complementary roles to play in establishing more effective education and communication about scientific research and its applications.

## References

Campbell, G. (2002) Planting the seeds of doubt. *New Zealand Listener*. 184, pp. 16-22

Chinn, C. & Malhotra, B. (2002). Epistemologically authentic inquiry in schools: a theoretical framework for evaluating inquiry tasks. *Science Education, 86*(2), 175-218.

DeBoer, G. (1991). *A History of Ideas in Science Education: Implications for Practice*. New York: Teachers College Press.

Haigh, M. & Hubbard, D. (1997). 'I really know I have learned something': investigative work in science education. In B. Bell and R. Baker (Eds.) *Developing the Science Curriculum in Aotearoa New Zealand*. Auckland: Longman.

Harsant, M. & Kalafatelis, E. (2001). *Genetic modification: public awareness and knowledge benchmark survey.* Report prepared for the Ministry for the Environment. Wellington: BRC Marketing & Social Research.

Haynes, R. (1996). Mad, bad and dangerous to know: what fiction writers think of scientists. *Australian Science, 17*(3), 2-4.

Hipkins, R. & Barker, M. (2002). Science in the New Zealand Curriculum: present potential and future possibilities. *New Zealand Science Teacher, 100*, 10-16.

Hipkins, R., Stockwell, W., Bolstad, R. & Baker, R. (2002). *Commonsense, trust and science: How patterns of beliefs and attitudes to science pose challenges for effective communication.* Report to the Ministry of Research, Science and Technology. Wellington: New Zealand Council for Educational Research.

Hogan, D. & Williamson, B., (Eds.) (1999) *New Zealand is different: chemical milestones in New Zealand history.* Christchurch,: Clerestory Press.

Mayer, V. & Kumano, Y. (1999). The role of system science in future school science curricula. *Studies in Science Education, 34*, 71 - 91.

Millar, R. (1998). Rhetoric and Reality: What practical work in science education is *really* for In J. Wellington (Ed.) *Practical work in Schoool Science: Which Way Now?* London: Routledge, pp. 16 - 31.

Osborne, J., Erduran, S., Simon, S. & Monk, M. (2001). Enhancing the quality of argument in school science. *School Science Review, 82*(301), 63-70.

Solomon, J., Scott, L. & Duveen, J. (1996). Large-Scale Exploration of Pupils' Understanding of the Nature of Science. *Science Education, 80*(5), 493 - 508.

Tytler, R., Duggan, S. & Gott, R. (2001). Public participation in an environmental dispute: implications for science education. *Public Understanding of Science, 10*(4), 343 - 364.

Watson, R., Goldsworthy, A. & Wood-Robinson, V. (1999). What is not fair with investigations? *School Science Review, 80*(292), 101-106.