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Public Perceptions of Genetic Engineering: Australia, 1994

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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This is a report of data collected for the Department of Industry, Science and Technology by the International Social Science Survey / Australia, Australia's leading academic survey, conducted by researchers at the Australian National University and the University of Melbourne. The results are based 1378 respondents from a large, representative national sample of all states and territories, drawn from the electoral roll. The survey was conducted in late 1994 and the early months of 1995. The conceptualization was based on a earlier developmental survey designed to explore a wide range of issues relating to genetic engineering

The author of this report is Senior Fellow in the Institute of Advanced Studies, Australian National University and Director of the International Social Science Survey. He has published widely in academic journals in Australia and overseas, including numerous publications in the world's best sociology and political science journals.

1.1 Scientific Research

A majority of Australians claim some basic understanding of science. Most also accept what we have called the 'scientific world-view' -- Darwin's theory of evolution and modern astronomy (the 'big bang' and the like). But many others, especially devout Christians, reject the scientific world-view.

A clear majority said they had heard of genetic engineering and a majority claimed a 'basic understanding' of it. About half were interested in it.

Australians are very strongly in favour of scientific research in medicine. They are also very strongly in favour of some agricultural goals (crops that would create an export market, healthier food) and of environmental protection. They are strongly -- but not as strongly -- in favour of scientific research that would increase farmers' incomes, provide cheaper food, or provide tastier food.

1.2 Approval

The Australian public is broadly supportive of a wide range of genetic engineering projects. The average Australian rates the average genetic engineering project as a "good idea".

Of the genetic engineering products we asked about in the survey, the most popular are a treatment for blood cancer, a drug that lowers blood pressure, and cotton that resists insect pests. More than 90% of Australians favour these. Then comes healthier cooking oil, genetically modified viruses to protect farm crops by attacking insect pests, viruses to control imported animal pests, and lean pork. Support is lowest for the genetically engineered tomato but even here a clear majority is in favour, 64% declaring them to be a "good idea" or a "very good idea" so long as they are clearly labeled.

1.3 Risks

The survey also asked about the potential risks associated with genetic engineering. The results can be expressed in the form of a worry scale, from zero ("No worry") to 100 ("Huge worry, terrible and very likely to happen"). The results showed Australians to be a worrying lot, even when the observed risks are quite low: fluorides -- which are added to drinking water to reduce tooth decay in most parts of Australia -- elicited 45 points on the worry scale. Concern with the use of chemical pesticides in farming elicited 65 points on the worry scale.

Concern that genetic engineering could accidentally create a new disease which could escape from the laboratory elicited 67 points on the worry scale, about as high as concern with chemical pesticides. Concerns about the possible long-term risks of eating genetically engineered food (59 points) and fears that genetically engineered plants might escape into the environment and become weeds (58 points) were lower.

Even people most concerned with potential risks generally believe that the benefits of genetic engineering will outweigh the risks in the long run. These results suggest that Australians have a balanced view about genetic engineering: they recognize that with any new technology there will always be risks but that these risks need to be, and can be, balanced against the prospective benefits.

1.4 Social Differences

Most Australians approve of genetic engineering, and there are few social differences in approval. They approve of genetic engineering mainly because they see it as serving goals that they value, not because they understand much about it. Opposition to genetic engineering is concentrated among people who put a low priority on improvements in health and agriculture as goals for Australians scientists, concentrated among supporters of the Greens, and concentrated among people who dissent from the scientific world-view.

1.5 Labeling

The public wants genetically engineered food products to be clearly labeled, so they can choose for themselves whether or not to use them. Even if genetically engineered foods are in fact entirely safe -- a scientific issue not to be settled by public opinion polling -- people nonetheless want to make the choice themselves. Voluntary labeling might meet most public concerns.

1.6 Use of Genetically Modified Products

The vast majority of Australians would wear clothes made from genetically engineered cotton (77%). The rest are mostly undecided (18%), with only 5% definitely unwilling. Clear majorities would eat genetically engineered cooking oil (60%), tomatoes (61%), and pork (56%) with most of the rest undecided rather than definitely unwilling.

Most willing to use genetically engineered products are those who generally support scientific research on agriculture, those less worried about the risks of genetic engineering, those more knowledgeable about it, and those who have a scientific rather than religious world-view.

1.7 Benefits and Risks

A clear majority of the Australian public think the benefits of genetic engineering will outweigh the risks. Most of the rest have mixed feelings and fewer than 10% think the risks will outweigh the benefits.

People who think the benefits will outweigh the risks tend to be those who:

- favour the goals, especially agricultural benefits;
- are less worried than the average about potential costs;
- do not particularly fear fluoridation;
- are relatively knowledgeable about genetic engineering; and

- have a scientific world-view.

Conversely, those who think the risks will outweigh the benefits -- the minority -- tend to be those who:

- are less keen on agricultural goals than most Australians;
- are more worried than the average about potential risks;
- fear fluoridation;
- know little about genetic engineering; and
- reject Darwin's theory of evolution and modern astronomy.

These results suggest that the Australian public will increasingly perceive genetic engineering's benefits as outwieghing its risks in the future as levels of knowledge increase.

2. INTRODUCTION

2.1 Public Perceptions of Biotechnology

As new biotechnologies are becoming available, what does the public think of them, and of their benefits and costs? In a democratic society, it is incumbent upon legislators and regulators to take into account the views of the populace on these matters. Genetic engineering is a particularly important area in which to assess public opinion, because it is a very new technology so that very few political choices about its uses and control have been made, let alone institutionalized. Systematically designed questionnaire data collected from large, nationwide representative samples are the only reliable method available for assessing public attitudes and social differences therein.

The 1994 International Social Science Survey/ Australia included a module on attitudes towards genetic engineering. The module began by asking people to rate a series of goals for Australian scientists, to get a general assessment of the desirability of different goals. We then introduced the concept of genetic engineering, and asked respondents to rate the desirability of a set of specific potential uses of genetic engineering. We also asked about the desirability of labeling genetically engineered products; about how much people worry about some potential risks of genetic engineering; about their personal preferences; whether they expect that they themselves would use genetically engineered products; and asked for a global evaluation of whether the benefits of genetic engineering are likely to outweigh the risks. We also asked people about their understanding of genetic engineering and of science and technology generally.

This report briefly summarizes a complex series of analyses. More detailed reports will appear in the academic literature in due course.

2.2 Conceptual Model

I propose that the public's views about genetic engineering can be understood with the aid of a simple model:

Attitudes to genetic engineering project X =
+ Worth of potential benefits offered by X
- Rational worries about potential costs of genetic engineering generally
- Irrational worries
+ Knowledge of genetic engineering
+ Scientific world-view
+/- Various minor factors [Eq. 1]

where the *potential benefits* are the medical, agricultural and other gains on offer; the *rational worries* are perceived risks of disease, environmental damage, and the like; *irrational worries* are fears of fluoridated drinking water or similar (surprisingly widespread) anxieties; *knowledge* is the public's level of information and understanding; and the *scientific world-view* is acceptance of Darwin's theory of evolution and modern astronomy (e.g. the 'big bang') rather than creationism and related pre-scientific views.

Note that the model of Eq. 1 implies that asking questions about genetic engineering generally, without naming the benefits, will bring up the negatives but not the positives, and so is misleading. I believe this is the cause of much of the confusion about the level of support for genetic engineering in the literature for other countries.

The things that influence genetic engineering have, in turn, their own causes. For example, holding a scientific world-view depends in part on being relatively knowledgeable about genetic engineering, which in turn depends in part on formal educational attainments. Explicating these

indirect links helps to reveal the deeper causes and complexities underlying public views about genetic engineering.

I assume that:

- Age, sex, education, occupation, religion and other background variables can be taken as fixed, causally prior to the other variables we consider here;
- Knowledge about science and genetic engineering is caused in part by background variables;
- Holding a scientific world-view depends on both background variables, and on knowledge of science and genetic engineering;
- What people think about the potential benefits of genetic engineering, and how much they worry about the costs and risks involved, depend in turn on background, knowledge, and whether they hold a scientific world-view; and
- all of these things in turn influence what they think of genetic engineering, and whether they would use its products.

Schematically, this is the model I will use in this report:

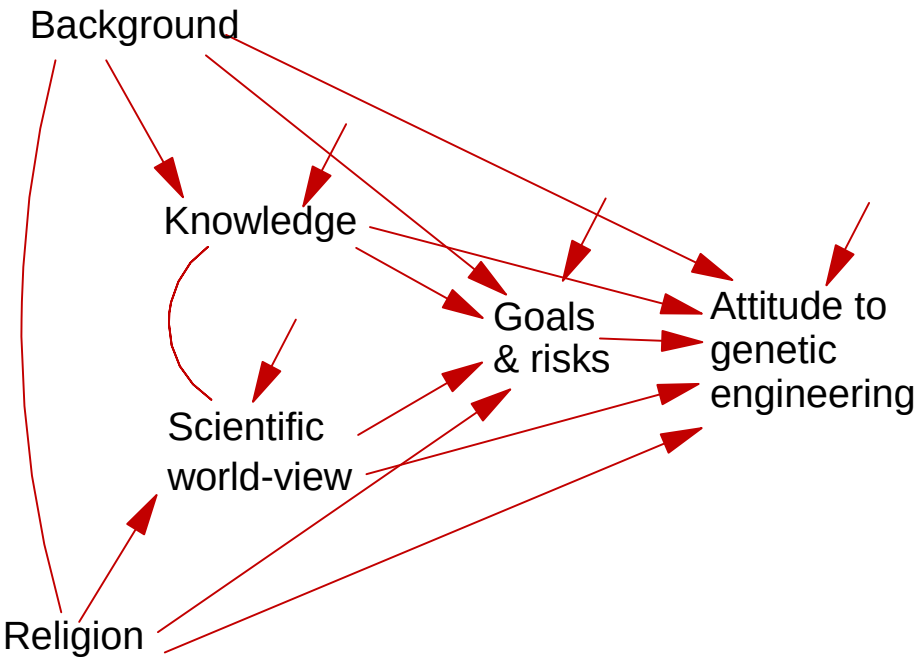

Figure 1. Theoretical model.

3. MEASUREMENT AND METHOD

3.1 The ISSS/A and the 1994 Survey.

The International Social Science Survey / Australia is a nation-wide survey conducted by researchers at the Australian National University and the University of Melbourne. Begun in 1984, it is Australia's leading academic survey and is devoted entirely to academic research in the social sciences, is non-profit, and is not connected with any business or political party. The survey's core sponsor is the Research School of Social Sciences at ANU.

The ISSS is a founding member of the International Social Survey Programme, sociology's leading cross-cultural survey project which conducts annual surveys in 22 nations throughout the world. The ISSS group recently founded the International Survey of Economic Attitudes, which is now conducted bi-annually in nine nations.

The ISSS group plans to establish a new **International Bioethics Survey** in 1996, hopefully with parallel surveys in Australia, the United States, and possibly other nations.

The ISSS is based on large, representative national samples of all states and territories, drawn from the electoral roll. Non-citizens are not surveyed but other evidence shows that they differ little from citizens, save only in length of residence in Australia (Evans, 1988).

The detailed and comprehensive ISSS survey takes about two hours to complete. It is conducted by mail. The first mailing includes a cover letter from the Australian National University and a postage-paid reply envelope, followed by a further letter about two weeks later. Anyone who did not respond within a month or so is then pursued by up to three more mailings over a six month period. Comparison with the census shows the samples collected in this way to be representative of the Australian population in age, sex, education, occupation, and other characteristics (Bean, 1991). Numerous academic papers based on ISSS data and written by the ISSS group have been published in the world's two top sociology journals (Kelley and Evans, 1993, 1995; Evans, Kelley, and Kolosi, 1992; Evans and Kelley, 1991).

Dr. Jonathan Kelley is Director and principal investigator of the ISSS; Dr. Clive Bean (Associate Director), Dr. M.D.R. Evans and Dr. Krzysztof Zagorski are co-principal investigators.

This report is based on 1378 respondents from the 1994/95 survey conducted in late 1994 and the early months of 1995.

3.1.1 Developmental Survey

The conceptualization of the ISSS survey was based on a developmental survey designed to explore a wide range of issues relating to genetic engineering. The purposes of the developmental survey are two: First to ascertain the broad outlines of public opinion on the matter. Second, to provide systematic evidence on which to base decisions about which topics warrant fuller investigation in the main survey.

The data for the developmental survey are from 318 randomly chosen ACT residents. They were interviewed by telephone in early May, 1994. Data collection was by Datacol, a highly regarded survey organization. With a sample of this size and the usual uncertainties of a developmental survey, percentages should be accurate to within 5 to 10 percent. Past experience suggests that ACT residents differ little from the rest of Australia, particularly on topics for which educational differences are modest. Genetic engineering is such a topic.

The developmental questionnaire provides broad coverage of genetic engineering topics, with over 75 individual questions. This is roughly twice the length of the final questionnaire.

The developmental data was analyzed extensively. Scales were conceptualized in advance (at the design stage); the items in each potential scale were factor analyzed; and concepts rethought if required. Multiple item scales were constructed on the basis of this work. The main analyses envisioned for the final data were then run on using the preliminary data and preliminary scales, mainly using ordinary least squares regression. This gave a fair idea of the broad outlines of public opinion about genetic engineering, in particular showing what concepts could be reliably measured and which helped to explain the Australian public's views on genetic engineering.

3.2 Topics Covered in the ISSS/A 1994 Survey

The 1994/95 International Social Science Survey covers a wide range of topics. It includes more than 1,000 questions and takes over two hours to complete. Topics covered in 1994 include

1. The International Social Survey Programme's module on the environment;
2. Questions about acceptance of a scientific world-view;
3. The genetic engineering module; and
4. An extensive inventory of background and demographic questions, and modules on many other topics ranging from attitudes on sex to attitudes on politics to educational and occupational careers.

The genetic engineering questions are one module in the ISSS, taking up about two and a half pages. Results from all the items in the module will be presented below. The complete text of the genetic engineering module is in an appendix.

3.2.1 Sequencing of modules

We located the module in the questionnaire following the five page "Attitudes towards the Environment" module of the International Social Survey Programme (ISSP) and the ISSS/A's "Scientific world-view" and "Technological Understanding" questions.

The advantage of this placement was thematic continuity. A possible disadvantage is that the ISSP module asks people to rate the degree of danger from a long list of environmental hazards -- it is possible that this focus on hazard may slightly bias answers to the subsequent genetic engineering module **against** genetic engineering by making environmental dangers more salient. However, past ISSS experience suggests that the bias, if any, is probably small.

3.2.2 Attitude Formation

This is a baseline survey, conducted at a time when the commercial application of "genetically modified organisms" (GMOs) in Australia is in its infancy. The attitudes I describe here may or may not persist into the future: public attitudes towards some technologies have shifted in a clearly positive direction (for example, the moral qualms that some people felt during the pioneering stages of organ transplant procedures have vanished), while support has plummeted for others (for example, the growth of opposition to nuclear power in many countries).

Because this is so new, and hypothetical, it is possible that the public might not be able to form attitudes on the topic. Our developmental pre-test was designed, in part to assess this possibility, but it instead suggested clear opinions and pronounced social differences in them. This might

seem surprising, given how little people know about science in general, let alone about genetic engineering, but it is worth remembering that people often must think hypothetically and on the basis of very limited knowledge in their lives and in forming political opinions (for example in developing opinions about tariff policies -- an important and long-standing political issue -- or developing opinions about the likely consequences of various forms of government being mooted in the debate on an Australian republic).

We can tell whether the opinions offered are disorganized and random (indicating that there really is no underlying opinion) or whether they are real attitudes by assessing their correlations with one another and their correlations with "criterion variables" reflecting expected social differences using factor analysis and related maximum likelihood LISREL techniques. The results suggest that the Australian public in fact has well-formed attitudes in this domain.

3.3 Issues of Wording

Genetic engineering is not an easy concept and there are, as yet, no universally accepted question wording. We think our questions, developed after careful pretesting, are quite satisfactory but measurement is a difficult and potentially controversial issue. Details on question wording are in a later chapter. In this section, we consider some measurement issues that might be of interest to specialists.

Our introductory 'tomato' question is hypothetical, but hypothetical questions are common and pose few special problems -- citizens are quite accustomed to deciding about policies that do not exist and may never exist (for example, the GST). Our 'tomato' scenario actually paralleled events in the USA (Schibeci *et al.* 1994: 25-26): tomatoes were in fact carefully vetted by an appropriate government regulatory committee, met with little or no scientific opposition, and were labeled (although labeling was not legally required). Our genetic engineering questions followed a 15 minute International Social Survey Programme module which discussed an assortment of environmental risks, and so would, if anything, sensitize respondents to risk, not lull them into acquiescence. Moreover the tomato is the least popular genetically engineered product on our list. We might instead have introduced the subject with the leukemia cure, blood pressure treatment, or genetically engineered cotton. These are overwhelmingly popular and so sensible alternative wordings of our questions would surely also discover that.

3.4 Do Well-Formed Attitudes Exist?

Do ordinary Australians have coherent views on genetic engineering? To be sure, there are no hard and fast rules about the best way to measure difficult concepts but the standard procedure, and the one that usually works best, is to ask a number of specific, concrete questions and then average the answers. For example, to discover what voters think about government regulation of business, best practice is to ask a number of specific questions about regulation in particular industries (railways, steel manufacturing, cars, farms, etc.) and then construct a combined 'government regulation' scale from the answers (Kelley 1988; Headey, Kelley and Wearing, 1993). This is the strategy we followed for genetic engineering, choosing projects from among those already well into development in Australia and overseas (Australian Science and Technology Council, 1993).

This approach allows us to use standard multivariate statistical procedures to discover whether the public really does have coherent attitudes toward genetic engineering or whether the issue is so novel and complex that ordinary people as yet have no clear views. The evidence comes from the correlations among answers: if people have no clear views, their answers to different genetic engineering questions will be uncorrelated (and measurement reliability will be zero). But if they have well-defined views on genetic engineering, as they do on many political and economic issues, correlations will be positive, typically in the range of .20 to .60, and factor analysis will find a single factor. Table 1 gives the evidence.

Table 1: Genetic engineering questions: Correlations and factor analysis show that attitudes are well-formed. Australia, 1994.

Question	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Factor loading
1 Cure cancer	1.00									.72
2 Blood pressure	.79	1.00								.80
3 Cotton	.61	.67	1.00							.72
4 Cooking oil	.45	.51	.49	1.00						.73
5 Control animals	.35	.43	.46	.48	1.00					.66
6 Control insects	.40	.46	.50	.47	.72	1.00				.68
7 Lean pork	.39	.44	.44	.68	.53	.50	1.00			.74
8 Tomatoes	.31	.34	.32	.46	.31	.32	.53	1.00		.55
9 Benefit vs. risk	.36	.39	.35	.43	.34	.33	.45	.52	1.00	.56

Source: International Social Science Survey / Australia, N=1378. The questions are #4c, #4e to #4k, and #7a on pages 62 and 63 of the questionnaire.

These results clearly show that the Australian public has well-formed attitudes about genetic engineering. The correlations among questions average a substantial .46 and the factor analysis shows a single, clear factor. For comparison, correlations average .31 among items measuring attitudes toward government regulation, .42 among price control items, and .56 among trade union questions. Thus attitudes to genetic engineering are well within the normal range for Australian political and social attitudes (Evans and Kelley 1995; Kelley 1988:60-70; Kelley, Evans and Headey 1993).

3.5 Effects of Knowledge on Measurement

The public's (allegedly) low level of knowledge of genetic engineering worries many researchers, who wonder whether ill-informed citizens as yet have any well-formed views about genetic engineering at all. But in answer to one of our questions, 68% of Australians say they have "heard much about genetic engineering" and in answer to another, 63% claim to have "a basic understanding" of it (Kelley 1995b). So in fact there is a fair level of comprehension. Moreover, in a democracy voters routinely make decisions about policies about which they have no detailed academic understanding (Bean and Kelley 1995).

Importantly, even those who are less knowledgeable about genetic engineering nonetheless have reasonably coherent attitudes about it (table 2). Correlations among their answers (.39) are well within the normal range, although lower than correlations for more knowledgeable respondents (.50).

Table 2: Knowledge of genetic engineering. Australia, 1994.

	Less knowledgeable	More knowledgeable
Correlation among attitude questions (mean)	.39	.50
Support for genetic engineering:		
Cure cancer (% favour)	93%	94%
Blood pressure (% favour)	92%	93%
Cotton (% favour)	92%	93%
Cooking oil (% favour)	84%	82%
Control animals (% favour)	75%	74%
Control insects (% favour)	76%	72%
Lean pork (% favour)	75%	73%
Tomatoes (% favour)	57%	70%
Personally use products:		
Wear cotton (% yes)	68%	84%
Eat tomatoes (% yes)	51%	68%
Eat lean pork (% yes)	47%	63%
Use cooking oil (% yes)	59%	73%
Benefits outweigh risks (% yes)	55%	70%
(Number of cases)	(589)	(737)

Source: International Social Science Survey / Australia. The questions are #4c, #4e to #4k, and #7a on pages 62 and 63 of the questionnaire. The knowledge scale, based on items #7b and #7c, is described in the next chapter; it is dichotomized into high vs. low at the mean.

Moreover, knowledge of genetic engineering does not lead to opposition. Quite to the contrary (table 2), there is little systematic difference in support for most of the genetically modified products on our list. Knowledgeable respondents are actually **keener** on genetically modified tomatoes, **more** likely to say they would themselves use genetically modified cotton, pork and cooking oil, and **more** likely to believe that the benefits of genetic engineering will outweigh the risks,

These results suggest that Australian public will become more supportive of genetic engineering in the future as levels of knowledge increase.

3.6 Measurement of Background and Demographic Variables

Background and demographic variables come from the extensive battery of measures available elsewhere in the ISSS/A survey. They are measured conventionally:

***Gender**: Male = 1, female = 0*

***Age**: Years*

***Education**: Years of school and tertiary training*

***Status**: An approximation of Kelley's world-wide occupational status score, ranging from 0 to 100.*

*Politics: Sympathy for the **Liberal-National Coalition**: Average score for Liberal Party and National Party, on a conventional Michigan feeling thermometer. Range: 0 (very cold or unfavorable feeling). through 50 (no feeling either way), to 100 (very warm or favorable feeling).*

*Politics: Sympathy for **Labor**: Average score for the Labor Party on a conventional Michigan feeling thermometer. Range: 0 (very cold or unfavorable feeling). through 50 (no feeling either way), to 100 (very warm or favorable feeling).*

*Politics: Sympathy for **Environmentalists**. Average score for environmentalists on a conventional Michigan feeling thermometer. Range: 0 (very cold or unfavorable feeling). through 50 (no feeling either way), to 100 (very warm or favorable feeling).*

***Christian belief**: Average score on 5 items measuring belief in God, the devil, heaven, hell and life after death. Range: 0 (unbeliever) to 100 (devout).*

***Catholic** = 1, all others = 0.*

***Fearfulness**: A 4 item scale measuring fear of spiders, illness, etc. Range: 0 (not fearful) to 100 (highly fearful).*

3.7 Attitude Scales

Attitude and value measures (described in detail below) are almost all based on multiple item scales. The use of multiple item scales is a vast improvement over the more usual reliance on single questions. By including many measures of the same concept, it becomes possible to:

- (i) **Test** the assumption that they measure what you assume they do using factor analysis and other sophisticated statistical procedures;
- (ii) **Refine** the measurement by excluding items that show statistical or conceptual weaknesses;
- (iii) **Reduce arbitrariness** by relying on the average of several items rather than putting all your eggs in one basket by choosing a single question which may be unrepresentative in ways you could not anticipate; and
- (iv) **Reduce random measurement error** that inevitably arises from the statistical imprecision of any single item.

The cumulative impact of these advantages is so great that the use of single item measures of attitudes, values, or perceptions can rarely be justified in serious work.

3.8 Methods

3.8.1 Factor and Regression Analyses

Items in the developmental questionnaire were extensively factor analyzed (mainly principal axis factor analysis rotated to simple structure by the varimax criterion). Items in the final questionnaire were again factor analyzed and the scale construction based on those analyses and also on their correlations with demographic and other variables following the standard logic for multiple item indicators. Scale reliability was generally high.

Effects are estimated by ordinary least squares regression. No correction was made for attenuation due to random measurement error but this is likely to be small for the variables of main interest here, as our attitude measures are mostly quite reliable multiple item scales and demographic and background variables typically have little measurement error.

In the text, I report standardized partial regression coefficients (betas). These range from -1 (for a perfect negative relationship) to +1 (for a perfect positive relationship) but such extreme values are most unusual.. To give a sense of scale, note that a straightforward genetically inherited trait (like height, for example) produces a beta of .50, so that corresponds to a very strong effect indeed. In most circumstances -- and assuming that a reasonably large range of other relevant variables are included in the equation, as they are in this report, the following would be a reasonable practical guideline:

- A beta of .10 can be thought of as substantial;
- A beta of .20 as large;
- A beta of .30 as very large; and
- A beta of .40 or more is huge.

Unless otherwise noted, all betas reported are significantly different from zero at p<.01 or better.

3.8.2 Scoring: Points out of 100

For convenience in comparing questions with different answer categories, all are converted to range from a low of zero (for the lowest answer category, for example "definitely no") to a high of 100 (for the highest answer category, for example "definitely yes"). Intermediate answers are given scores at equal intervals in-between. For example answers to many questions are in standard yes/no categories:

```
Definitely yes                  [[scored 100 points]]
Yes                             [[scored 75 points]]
Hard to say, mixed feelings     [[scored 50 points]]
No                              [[scored 25 points]]
Definitely no                   [[scored 0 points]]
```

Means are then easy to compare. This scoring is purely cosmetic, and leads to the same conclusions as conventional scoring would (for example, scoring "definitely no" as 1 point, "no" as 2, and so on with "definitely yes" getting 5).

3.9 The Author

Jonathan Kelley is Senior Fellow in the Institute of Advanced Studies, Australian National University and Director of the National Social Science Survey. He is a graduate of Cambridge University (BA) and the University of California (Ph.D.). He is currently studying bioethics, inequality (with M. D. R. Evans), social mobility, and attitudes toward the economy (with Krzysztof Zagorski).

Many of these analyses are based on cross-national data from the International Social Survey Project, which he co-founded in 1984 . It is now conducted annually in 22 nations. Other analyses are from his new bi-annual International Survey of Economic Attitudes, founded a few years ago (with Evans and Zagorski) and now conducted in five nations. To date, he has been principal investigator for 16 large national surveys in three nations.

He has published widely in academic journals in Australia and overseas, including Australia (*Australian and New Zealand Journal of Sociology); Britain (Sociology; British Journal of Sociology*); Europe (*International Social Science Journal; Social Indicators Research*); and the USA (*American Journal of Sociology; American Sociological Review; American Political Science Review; American Journal of Political Science; Public Opinion Quarterly*). His publications include 4 major recent articles in the world's best sociology journals: Kelley and Evans, 1993, 1995; Evans and Kelley 1991; Evans, Kelley and Kolosi 1992). Indeed, over the five years to 1993

(the period evaluated for the upcoming ARC/ANU review of the Institute of Advanced Studies), he stands fourth in the world in amount published in the world's two leading sociology journals.

3.10 Summary: Measurement & Method

This is a report of data collected for the Department of Industry, Science and Technology by the International Social Science Survey / Australia. The ISSS, Australia's leading academic survey, is conducted by researchers at the Australian National University and the University of Melbourne. The results are based 1378 respondents from a large, representative national sample of all states and territories, drawn from the electoral roll. The survey was conducted in late 1994 and the early months of 1995. The conceptualization was based on a earlier developmental survey designed to explore a wide range of issues relating to genetic engineering

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4. SCIENTIFIC RESEARCH

4.1 Knowledge of Science

The ISSS measured knowledge of science by a straightforward self-evaluation. (The discussion here and subsequently goes topic by topic, not in the sequence questions were actually asked in the questionnaire. The module is given in full in an appendix.)

```
7e. Do you have a basic understanding of science and technology generally
              Yes, definitely                  12
              Yes, probably                    47
              Mixed feelings; yes and no       23
              No, probably not                 15
              No, definitely not                2
                                               ---
                                               100% (mean= 63)
```

Similar questions have been used in many previous surveys. They appear to provide a rough but serviceable measure of knowledge, well correlated with objective measures. But respondents clearly err on the optimistic side in evaluating their level of knowledge.

Some 12% of the Australian population say they definitely have a basic understanding and 47% that they probably do -- so a clear majority claim a "basic understanding". Some 23% have mixed feelings on the question; 15% admit they probably don't have a basic understanding and 2% admit they definitely do not. This gives an average of 63 points on our usual points out of 100 basis, part way between "yes, probably" and "mixed feelings".

Knowledge of science is much more widespread among the well educated (beta= .28), among the young rather than the old (beta=-.16), and among men rather than women (beta=.13).

4.2 The Scientific World-View

Earlier in the questionnaire, we measured respondents' general acceptance of a scientific world-view, specifically their acceptance of the theory of evolution and modern astronomy (these questions are not part of the genetic engineering project but are from another ISSS module, and are used here by permission):

```
1. Would you say these are true or false...
a. The universe began with a
huge explosion . . . . . .  True!!  True  ??  False  False!!

b. Elsewhere in the universe, there
are probably thousands of planets
much like our own. . . . . .  True!!  True  ??  False  False!!

c. There is probably life on other
planets elsewhere in the universe. . . . .  True!!  True  ??  False  False!!

d. Modern animals and plants evolved
over millions of years, through
survival of the fittest. . . . . .  True!!  True  ??  False  False!!

e. Mankind evolved by natural selection
from lower animals, as Darwin's theory
of evolution says. . . . . .  True!!  True  ??  False  False!!

f. The earliest humans appeared
millions of years ago in Africa. . . . . .  True!!  True  ??  False  False!!

g. Mankind's ancestors were apes . . . . .  True!!  True  ??  False  False!!
```

Belief in Darwin's theory of evolution and acceptance of modern astronomy are far from universal in Australia. On our usual points out of 100 scoring, the Australians average only 62 -- about half-way between 'true' and 'uncertain'.

Factor analysis shows a strong single factor underlying the several questions on evolution, and another -- possibly somewhat separate, possibly not -- underlying the astronomy questions. For simplicity, we here take them as a single factor and measure them by a single multiple item scale:

[Definition] ***Scientific world-view*** *= mean(All 7 evolution and astronomy items)*

The scientific world-view is enormously less common among devout Christians (beta= -.48). Men hold it somewhat more often than women (beta= .10), and the young rather more than the old (beta= -.10). Surprisingly, the well educated are no more scientifically inclined than the poorly educated.

4.3 Interest and Knowledge of Genetic Engineering

4.3.1 Level of Knowledge and Interest

To measure interest and knowledge of genetic engineering we asked, towards the end of the module:

```
b. Before reading about it in this questionnaire, had you heard much about
genetic engineering?
              Yes, definitely                  19
              Yes, probably                    49
              Mixed feelings; yes and no        9
              No, probably not                 19
              No, definitely not                4
                                               ---
                                               100% (mean= 65)

c. Would you say you have a basic understanding of genetic engineering?
              Yes, definitely                  14
              Yes, probably                    49
              Mixed feelings; yes and no       16
              No, probably not                 16
              No, definitely not                4
                                               ---
                                               100% (mean= 63)

d. Are you interested in genetic engineering?
              Yes, definitely                  10
              Yes, probably                    41
              Mixed feelings; yes and no       27
              No, probably not                 19
              No, definitely not                4
                                               ---
                                               100% (mean= 59)
```

About 19% said "Yes, they had definitely" heard of genetic engineering, 48% said "Probably", 9% had "Mixed feelings, yes and no"; 19% "No, they heard about it", and 4% "Definitely not". So the majority of the population claimed that they had heard about it, but a substantial number were not sure, or thought that they had not heard of it. This comes to 65 points out of 100.

On the question about understanding genetic engineering a majority claim some "basic understanding". Some 14% said "Definitely yes", 49% "Yes", 16% were not sure, 18% thought not, and 4% said no, they definitely did not.. The mean level of knowledge, on our usual points out of 100 basis, is 63.

This is not, of course, anything like a definitive measure but similar questions in other surveys that include knowledge tests suggest that it provides a reasonable approximate measure of knowledge (U.S. Congress, Office of Technology Assessment, 1987: Chapter 6).

Of course, people surely take an optimistic view of their knowledge and a university lecturer in biology would rarely be impressed with the knowledge of even the best informed of the general public. But, equally, few in the general public would impress a university lecturer in economics with their knowledge of economics, nor impress a university lecturer in political science with their knowledge of politics. But such modest levels of knowledge as the public has quite suffice for them to evaluate the economic performance of the government of the day and, at the ballot box, to retain or dismiss the government from office. So it would be quite mistaken to discount the public's views on the grounds that they lack a deep understanding of the issue: that is the normal way things operate in a democracy, for better or for worse.

Levels of interest in genetic engineering were also moderately high. Some 10% said they definitely are interested, 40% are interested, 27% have mixed feelings, 19% not interested, and only 4% definitely not interested. The average is 59 points out of 100.

The questions on hearing about genetic engineering and understanding it are highly correlated and make a satisfactory summary measure of knowledge:

[Definition] ***Knowledge of genetic engineering*** *= mean(Heard about G-E, Understand G-E)*

4.3.2 Who is Most Knowledgeable about Genetic Engineering?

Those knowledgeable about science in general are very much more knowledgeable about genetic engineering (beta= .55). Those with a scientific world-view are somewhat more knowledgeable (beta= .15). The old are a bit more knowledgeable than the young (beta= .08), once their generally modest level of knowledge about science in general is taken into account.

4.4 Goals for Scientific Research

Before any discussion of genetic engineering, the ISSS survey asked about general goals for scientific research on food and medicine. The aim was to discover what goals are uppermost in the public's mind and only then to discuss genetic engineering as a means of achieving some of those goals. The questions:

```
3.  Australian scientists do a lot of research on food and medicine. Here are some
things they could try to do, some goals for the future. How do you feel about
developing...

                                  Delighted                          Terrible
a. New medicines to cure
serious diseases like cancer?. . . . . 1   2   3   4   5   6   7   8   9
        (Mean 96 points out of 100)
b. Tastier, fresher food?. . . . . 1   2   3   4   5   6   7   8   9
        (Mean 80 points out of 100)

c. Cheaper food? . . . . . 1   2   3   4   5   6   7   8   9
        (Mean 82 points out of 100)

d. Healthier, more nutritious foods. . . . 1   2   3   4   5   6   7   8   9
        (Mean 90 points out of 100)

e. Higher yielding crops, which would
increase farmers' earnings . . . . . 1   2   3   4   5   6   7   8   9
        (Mean 85 points out of 100)

f. Crops that would create a new
export market for Australian farmers . . . 1   2   3   4   5   6   7   8   9
        (Mean 90 points out of 100)

g. Reducing the use of chemicals
and pesticides in farming. . . . . 1   2   3   4   5   6   7   8   9
        (Mean 92 points out of 100)

h. Protecting the environment. . . . . 1   2   3   4   5   6   7   8   9
        (Mean 92 points out of 100)
```

We offered respondents a choice of 9 answers (numbered 1 to 9) with one end labeled "Delighted" and the other end labeled "Terrible". This is a standard question format with very satisfactory measurement properties.

To provide a clear and compact summary of answers, we score these answers conventionally at equal intervals from 0 (terrible) to 100 (delighted) and report the average score. This scoring is purely cosmetic and any other equal interval scoring (e.g. 1 through 9) would leave standardized coefficients unchanged:

```
Delighted = 1 -- Scored 100 points
2             -- Scored 87.5 points
3             -- Scored 75 points
4             -- Scored 62.5 points
5             -- Scored 50 points
6             -- Scored 37.5 points
7             -- Scored 25 points
8             -- Scored 12.5 points
Terrible=9     -- Scored 0 points
```

4.4.1 Medical Goals

For the average Australian, the greatest benefits from scientific research come from health and agriculture. On "new medicines to cure serious diseases like cancer", 85% of the populace chose the most favorable option, saying that they are delighted for Australian scientists to pursue research that might lead to new medicines for serious diseases. Another 7% chose the second most favorable answer, 3% chose the third, 2% the fourth, and another 2% chose the neutral point, the remaining 1% chose more negative answers. In sum, the huge majority are very enthusiastic and nearly all the rest are supportive.

The average desirability rating for "new medicines to cure serious diseases like cancer" -- using the points out of 100 scoring -- is a very high 96.

4.4.2 Agricultural and Food Goals

- "Reducing the use of chemicals and pesticides in farming" is also a highly desirable goal, in the eyes of Australians, who give it a desirability rating of 92 out of 100 on average.

- "Protecting the environment" is also seen as an urgent task for scientists: the public gives this goals a desirability rating of 92 out of 100, on average.

- The goal "Crops that would create a new export market for Australian farmers" is a highly desirable one for Australian scientists, according to our respondents who accord it a desirability rating of 90.

- "Healthier, more nutritious foods": Australians feel that this, too, is a laudable goal for scientists. They give it a desirability rating of 90, on average.

In sum, these 4 goals were rated, on average, a very favorable 90 or more points out of 100.

The public is also strongly in favour of several other goals, rating them over 80 points on the average:

- "Higher yielding crops, which would increase farmers' earnings" -- this goal attracted a desirability rating of 85 points out of 100, on average.

- "Cheaper food" -- the public rates this goal at 82 points out of 100.

- "Tastier, fresher food" -- the citizenry gives a desirability rating of 80 to having scientists pursue the goal of tastier, fresher food.

These last few questions show widespread sympathy for farmers' economic situation, a pattern found throughout the developed world and in the emerging economies of Eastern Europe.

4.4.3 The Structure of Opinion on Goals

Support for agricultural and food goals tends to go together, with those who favour one tending to favour all. Support for environmental protection and for reducing the use of chemical pesticides tend to go with each other and are somewhat separate from other agricultural and

food goals. Finally, medical goals are somewhat different than either of these. These patterns are clearly shown in a factor analysis.

Reflecting this structure, we distinguish three separate aspects of goals, measuring them by two multiple item scales and a single item:

[Definition] ***Agricultural goals*** *= mean(Export market, Healthier food, Higher yielding crops, Cheaper food, Tastier food)*

[Definition] ***Medical goals*** *= Single item on new medicines*

[Definition] ***Environmental goals*** *= mean(Reduce chemical pesticides, Protect environment)*

4.4.4 Who Holds Which Goals?

Social differences about scientific goals are few. Generally men and women, the well educated and the poorly educated, devout Christians and unbelievers, Catholic and Protestant, share much the same goals. Political differences are few as well, although Coalition supporters are a little more sympathetic to agricultural goals (beta= .10), as are older respondents (beta= .15). Environmentalists are, of course, more sympathetic to environmental goals.

4.5 Summary: Scientific Research

A majority of Australians claim some basic understanding of science. Most also accept what we have called the 'scientific world-view' -- Darwin's theory of evolution and modern astronomy (the 'big bang' and the like). But many others, especially devout Christians, reject the scientific world-view. A clear majority said they had heard of genetic engineering and a majority claimed a 'basic understanding' of it. About half were interested in it.

Australians are very strongly in favour of scientific research in medicine. They are also very strongly in favour of some agricultural goals (crops that would create an export market, healthier food) and of environmental protection. They are strongly -- but not very strongly -- in favour of scientific research that would increase farmers' incomes, provide cheaper food, or provide tastier food.

5. APPROVAL OF GENETICALLY ENGINEERED PRODUCTS

5.1 Measuring Opinions on Complex Issues

In survey research there are no hard and fast rules about the best way to measure difficult concepts -- doing so is an art in itself. But the standard procedure, and the one that usually works best, is to ask a number of relatively specific, concrete questions and then average the answers. For example in a study of voting behaviour, to discover what voters think about government ownership, best practice is to ask a number of specific questions about ownership of particular industries (electricity generation, railways, steel manufacturing, cars, shops, farms, etc.) and then construct a combined 'government ownership' scale from the answers. Analogously, in a study of psychiatric depression, standard practice is to ask about a long list of specific symptoms and then construct a summary scale from the answers (Headey, Kelley and Wearing, 1993). Asking people a single, direct question is rarely the optimal approach, save occasionally in areas where people have firm, long-standing views on a simple black-and-white topic (for example, whether they support the Labor Party or the Coalition). Genetic engineering is not such a topic.

An example may make the logic of the standard 'multiple item indicator' approach clearer. Suppose you want to know how much people like French Post-Impressionist paintings. The ways you can ask the question depend on the knowledge and sophistication of the respondents

- (1) If you were dealing with people who know a lot about art -- for example, people with a BA degree in art history -- a single, general question would suffice: "How much do you like French Post-Impressionists?" To answer this, respondents need to recall just who the Post-Impressionist painters were, recall what their paintings look like, and decide how much they like the paintings.

- (2) But most non-specialist university graduates have at best only a vague idea about who the Post-Impressionists were, so it would be better to ask them a number of more specific questions naming the particular painters you are asking about: "How much do you like Bonnard's paintings?" "How about Derain?" Etc. Then one can get a good idea of what respondents think of Post-Impressionists by averaging their answers to the several questions. To answer these questions, respondents need to recall what Bonnard and Derain's paintings look like, and decide how much they like them.

- (3) But even these questions assume a fair level of knowledge, specifically that respondents are familiar with (for example) a reasonable selection of Bonnard's paintings and so can say whether they generally like them or not; that they are familiar with a selection of Derain's paintings, and so can rate them; and so forth. This may (or may not!) be reasonable for the general run of university graduates. But for a normal, population with only year 9 or year 12 schooling, it is not reasonable. For most people, it would be much better to show several of Bonnard's paintings and ask how much they liked each of them; then show some Derains, and ask about them, and so forth. This does not require respondents to know which artists are Post-Impressionists, nor to recall any of their pictures. Instead it only requires them to look at pictures and decide how much they like them -- a far easier task.

We have therefore adopted the third style -- the conventional multiple indicator research -- in asking about genetic engineering. To answer these questions, respondents do **not** have to know which scientific developments they have heard about over the past few years involve genetic engineering, **nor** do they have to recall unaided particular genetic engineering projects that have been in the news over the past few years. They have only to read the questions and respond to the particular, concrete proposals in them -- a far easier task. In addition to clarity, asking questions in this third style has several important analytic advantages:

- First, it works perfectly well for sophisticated respondents as well as unsophisticated respondents -- the art BAs in our example can perfectly well answer a number 3 style question.

- Second, it allows us to use sophisticated multivariate statistical procedures to discover whether the concept 'liking Post-Impressionists" is empirically a sensible one. For example, if (I) liking Bonard's "Landscape with Olive Trees and a Chapel" is closely correlated with liking with his "The Blue Balcony", correlated with liking Derain's "Trees by a Lake", and correlated with liking other Post-Impressionist paintings, while at the same time (ii) liking these paintings is **not** so highly correlated with liking Impressionist paintings, nor with lining Old Masters or Modern Art, then (iii) the concept seems sensible. But if liking the Post-impressionist paintings is equally highly correlated with liking Impressionist paintings and also with liking Modern Art, then the concept is too narrow -- it should be 'Impressionist, Post-Impressionist and Modern Art, perhaps. Or, analogously, if liking Post-Impressionist landscapes is highly correlated with liking landscapes from other periods but not with liking portraits of any period, the whole concept needs re-thinking.

- Third, using a multiplicity of questions reduces measurement error. If we had asked only after "Landscape with Olive Trees and a Chapel" we would be at the mercy of the myriad idiosyncratic factors that lead people to like, or dislike, a particular painting. By asking about many paintings from many artists, we average out these individual idiosyncrasies and get more reliable measurement.

We have therefore adopted the usual -- and generally correct -- multiple indicator strategy of asking about a number of particular, concrete instances of genetic engineering. The particular instances are among those already well into development in Australia and overseas (Australian Science and Technology Council, 1993).

5.2 Introduction to Genetic Engineering

The genetic engineering module required a lengthy introduction, because our pre-test suggested that many people had not heard of it, and for many others, a bit of reminding of what genetic engineering is about is useful to focus their thoughts, to remind them of things they may have already heard about (as most had), and to explain the topic to those previously unacquainted with it. The introduction:

> *Genetic engineering is a new way to create new products. Scientists can use genetic engineering on plants or animals to change things like their size, colour, or taste. They do this by moving a gene from one kind of animal or plant to another, or by turning a gene off.*

Our double goal with this introduction was to maintain scientific accuracy but also to make it readily accessible to respondents with little education. We began with this general sketch of the technique, and then proceeded to a particular concrete example, because people can always think better with a concrete example to hand:

> *Recently, scientists have made an improved variety of tomato that has a better texture, costs less, and might make a valuable export. They turned off one of its genes, which would otherwise have made the tomato go mushy.*

After introducing the example, the introduction raises the key theme of safety and danger that will echo through the rest of the examples in the module:

```
After careful study, a government regulatory committee believes that the new
tomatoes are safe. Most scientists agree. But a few are worried and some
nation-wide environmental groups say the tomatoes might be dangerous and
should be banned.
```

This scenario sets up the actual situation in the recent U.S. introduction of genetically engineered tomatoes, a scenario likely to be repeated in Australia in coming years. At this stage the question is hypothetical -- the tomatoes are not yet on the Australian market and Australian regulatory bodies have not been asked to evaluate them -- but hypothetical questions are perfectly normal in politics and elsewhere, and usually pose respondents no particular problems -- citizens are quite accustomed to deciding about policies that do not exist and may never exist (for example, the GST).

We closed the introduction with a reassuring sentence to re-affirm that we were seeking everyone's opinion, not just the opinions of people who consider themselves experts: "

```
 >> Most people have not heard much about genetic engineering. We just want
your opinion, your best guess.
```

5.3 Levels of Approval

After introducing the topic of genetic engineering in this way, we then asked several questions (described later) about genetically engineered tomatoes, and concluded with a summary evaluation:

```
c. If clearly labeled, are these new tomatoes a good idea or a bad idea
             Very good idea                    17
             Good idea                         47
             Mixed feelings, hard to say       28
             Bad idea                           5
             Very bad idea                      3
                                               ---
                                               100% (mean= 63)
```

We went on to ask about 7 other genetic engineering projects that are underway in Australia or overseas, or likely to be underway in the relatively near future. We began with a general introductory phrase "Here are some other things that scientists might make with genetic engineering...", and then asked people to rate the desirability of a list of possible genetically engineered products:

```
Here are some other things scientists might make with genetic engineering...
e. A treatment that would save the lives of people who have blood cancer—
             Very good idea                    65
             Good idea                         29
             Mixed feelings, hard to say        5
             Bad idea                           1
             Very bad idea                      1
                                               ---
                                               100% (mean= 89)

f. A genetically engineered drug that lowers blood pressure better than
other drugs, reducing the risk of heart attack
                    Very good idea  ...etc...
                           (mean 87)

g. Genetically engineered cotton that resists insect pests -- this could
greatly reduce the use of chemical pesticides
                    Very good idea  ...etc...
                           (mean 87 )

h. Genetically modified viruses to protect farm crops by attacking insect
pests, such as beetles and locusts
                    Very good idea  ...etc...
                           (mean 76 )
i. Modified viruses to control imported animal pests (such as rabbits or
feral pigs) by preventing them from breeding
                    Very good idea  ...etc...
                           (mean 76 )

j. Leaner, healthier pork (assuming it is clearly labeled, so you can decide
for yourself whether or not to buy it)
                    Very good idea  ...etc...
                           (mean 73 )

k. Healthier cooking oil and margarine, with more of the desirable
unsaturated fats and fewer of the undesirable fats
                    Very good idea  ...etc...
                           (mean 79 )
```

Very few people were unable to form an opinion: only 3% of the sample declined to answer these questions, on the average. That is about average for the questionnaire -- perhaps rather lower than average -- and well below the levels of "missing data" that occur on obscure topics (for example, in another ISSS, we asked people to rate their feelings towards the Chinese leader, Mr. Deng, and 25% declined to answer the question: Kelley, 1995). In a paper-and-pencil format, there is no social pressure to answer any question one would prefer to skip, so the low level of missing data offers another sign that real public opinion on the topic exists.

5.3.1 Genetically engineered medicines

The public overwhelmingly supports trying to use genetic engineering to make "A treatment that would save the lives of people who have blood cancer." We offered five answer categories, and 64% of respondents declared that trying to use genetic engineering to make a treatment for blood cancer was a "Very good idea", and another 29% said a "Good idea". That makes 93% in favour. 5% had mixed feelings on the subject, 1% thought it "A bad idea" and another 1% thought it a "Very bad idea". Scoring these answer categories from 0 (a very bad idea) to 100 (a very good idea) gives us a summary "desirability rating". Australians, on average, rate trying to use genetic engineering to make a treatment for blood cancer at 89 points out of 100.

There is also overwhelming support for trying to make "A genetically engineered drug that lowers blood pressure better than other drugs, reducing the risk of heart attack". 59% of the public found this a "Very good idea", and 33% said a "Good idea". That makes 93% in favour. 6%

had mixed feelings. 1% said a "Bad idea" and another 1% said a "Very bad idea". On average, Australians rate a genetically-engineered blood-pressure drug at 87 points out of 100.

5.3.2 Genetically Engineered Food

Using genetic engineering to make new foods also attracted substantial support, provided that the new foods would be clearly labeled.

The public, on average, rated at 79 points out of 100 "Healthier cooking oil and margarine, with more of the desirable unsaturated fats and fewer of the undesirable fats." This is a high rating, although not so outstandingly high as for the genetically engineered medicines. 40% said it was a "Very good idea", another 42% said a "Good idea", 13% have mixed feelings, 2% think its a bad idea, and 2% think its a "Very bad idea".

With a desirability rating of 73, "Leaner, healthier pork (assuming that it is clearly labeled, so you can decide for yourself whether or not to buy it)" is about three-quarters of the way towards being thought a "very good idea". 29% think it is a "very good idea", and another 42% think it is a "good idea". 19% have mixed feelings. 4% think it is a "Bad idea" and 3% say a "Very bad idea".

The genetically engineered tomatoes that served as the example in the introduction elicit a desirability rating of 67, still strongly favorable but noticeably lower than other foods. "If clearly labeled, are these new tomatoes a good idea or a bad idea?" 17% said a "Very good idea", 47% said a "Good idea". 28% had mixed feelings. 6% thought these tomatoes a "Bad idea" and 3% thought them a "Very bad idea".

5.3.3 Genetically Engineered Agricultural Products

"Genetically engineered cotton that resists insect pests -- this could greatly reduce the use of chemical pesticides" attract a desirability rating of 87 points out of 100. That is overwhelming support. Fully 59% of the populace endorsed them as a "Very good idea" and another 34% found them a "Good idea". 6% reported mixed feelings on genetically engineered cotton. 1% thought it a "Bad idea" and another 1% thought it a "Very bad idea".

The citizenry accords "Genetically modified viruses to protect farm crops by attacking insect pests, such as beetles and locusts" a desirability rating of 76 points out of 100. This is substantial support, although clearly lower than for the pest-resistant cotton. 41% thought these viruses a "Very good idea", and another 33% thought them a "Good idea". 18% had mixed feelings. 5% thought them a "Bad idea" and 3% thought them a "Very bad idea".

Australians have very similar views about "Modified viruses to control imported animal pests (such as rabbits or feral pigs) by preventing them from breeding": they give these contraceptive viruses, too, a desirability rating of 76 points out of 100. 40% say these contraceptive viruses are a "Very good idea", 34% think them a "Good idea". 17% had mixed feelings. 5% said these contraceptive viruses were a "Bad idea", and another 3% said a "Very bad idea".

5.3.4 Summary: Desirability Ratings

Thus, the citizenry holds positive attitudes towards this entire array of potential genetic engineering products: they range from moderately positive to overwhelmingly positive. At the top are "A treatment that would save the lives of people who have blood cancer" (89 points out of 100), "A genetically engineered drug that lowers blood pressure better than other drugs, reducing the risk of heart attack" (87 points), and "Genetically engineered cotton that resists insect pests -- this could greatly reduce the use of chemical pesticides" (87 points). A bit less popular, although still highly desirable in the public mind are "Healthier cooking oil and margarine, with more of the desirable, unsaturated fats and fewer of the undesirable fats" (79 points out of 100) "Genetically modified viruses to protect farm crops by attacking insect pests, such as beetles and locusts" (76 points), and "Modified viruses to control imported animal pests (such as rabbits or

feral pigs) by preventing them from breeding" (76 points). The populace was a little less favorable towards "Leaner, healthier pork (assuming it is clearly labeled, so you can decide for yourself whether or not to buy it)", granting it a desirability rating of 73 points. There is still a substantial majority support for the modified pork, with 73% thinking it a "Good idea" or a "Very good idea". Support is lowest for the genetically engineered tomato: Australians accord it a desirability rating of 67 points out of 100. Even in this case, a clear majority are in favour, with 64% declaring genetically engineered tomatoes to be a "Good idea" or a "Very good idea".

It is clear the Australian public is broadly supportive of a wide range of genetic engineering projects. The average level of support is 79 points out of 100 -- so the average Australian rates the average genetic engineering project just a shade more favorable than a “good idea”.

5.3.5 Potential Bias in These Questions?

It is clear that there is substantial variation in the public’s views about different genetically engineered products. As in overseas studies, support is overwhelming for medical uses, high for general agricultural uses, and least for genetically modified foods. As a consequence, there is no entirely unambiguous answer to the question “how supportive of genetic engineering is the Australian public” -- it depends, in part, on which product you have in mind.

This ambiguity is quite normal for public policy issues. For example, there is no unambiguous answer to the question “how supportive of government spending is the Australian public?”. Instead the answer depends on what the spending is for -- for example support is high for spending on education, moderate for spending on unemployment benefits, and low for spending on foreign aid.

Because of this variability, someone who wanted to paint an overly optimistic picture of public reaction to genetic engineering could concentrate entirely on medical uses and (correctly) report overwhelming support. But someone who wished to paint an overly pessimistic picture could concentrate entirely on food for human consumption, and (correctly) report only majority support, with a substantial minority uncertain. And in the extreme, someone could imagine a genetic engineering project with dubious goals, ask about it in a survey, and report widespread opposition.

We have chosen a middle road, reporting the average for a range of realistic projects which are already underway in Australia or overseas, eschewing the wild dreams of genetic engineering visionaries but also the dark scenarios of genetic engineering’s most imaginative foes.

There is, however, one way in which our choice of questions has perhaps slightly tipped the scales **against** genetic engineering: our principal example, the genetically engineered tomato, is the least popular product on our list, and so, if anything, gives a slightly unfavourable introduction to the topic. A more neutral choice would have been one of the agricultural products , and a more favorable choice would be one of the medical products. We thought the simplicity and familiarity of tomatoes (and the fact that they are among the first genetically engineered products to reach the market overseas) outweighed this slight disadvantage.

5.4 Structure of Opinion on Genetic Engineering

A factor analysis shows that people who favour one genetic engineering product tend strongly to favour all of them, and conversely those who are dubious about one tend to be dubious about all. This justifies combining them into a single scale for subsequent analysis:

> *[Definition]* ***Attitudes to Genetic Engineering*** *= mean(Good vs. bad rating for: cancer treatment, blood pressure medicine, pest resistant cotton, viruses to protect crops, viruses against animal pests, new tomatoes, leaner pork, cooking oil with unsaturated fats)*

There is some evidence of modest differences among these, particularly between medical products on the one hand and agricultural and food products on the other. But in the interest of simplicity, we ignore these differences here.

5.5 Summary: Approval

The Australian public is broadly supportive of a wide range of genetic engineering projects. The average Australian rates the average genetic engineering project as a “good idea”.

The most popular genetic engineering products are a treatment for blood cancer, a drug that lowers blood pressure, and cotton that resists insect pests. More than 90% of Australians favour these. Then comes healthier cooking oil, genetically modified viruses to protect farm crops by attacking insect pests, and viruses to control imported animal pests and lean pork. Support is lowest for the genetically engineered tomato but even here a clear majority is in favour, 64% declaring them to be a "good idea" or a "very good idea" so long as they are clearly labeled.

6. POSSIBLE RISKS IN GENETIC ENGINEERING

6.1 Amount of Risk

The ISSS survey asked about a number of possible risks associated with genetic engineering, focusing on the worries that seem to have come up often in previous research. The questions were:

```
5.  Genetic engineering might have some risks as well as benefits. Here are
some possible worries, things that some people think might happen...

a. That medical genetic engineering accidentally create a new disease,
something that might escape from the laboratory -- a worry
       HUGE worry: terrible and very likely to happen 32
       Very big worry                                  24
       A big worry                                     24
       A small worry                                   18
       No worry at all                                  2
                                                       ---
                                                       100% (mean= 66)

b. That genetically engineered plants might get out of hand and spread on
their own?
       HUGE worry: terrible and very likely to happen 22
       Very big worry                                  23
       A big worry                                     26
       A small worry                                   25
       No worry at all                                  5
                                                       ---
                                                       100% (mean= 58)

c. That genetically engineered food plants might be a long run danger to
human health, if people ate them for years?
       HUGE worry: terrible and very likely to happen 23
       Very big worry                                  22
       A big worry                                     26
       A small worry                                   24
       No worry at all                                  5
                                                       ---
                                                       100% (mean= 59)
```

The worry that is uppermost in the public's mind is "That medical genetic engineering could accidentally create a new disease, something that might escape from the laboratory". 32% say that is a huge worry, 24% say it is a very big worry, and another 24% say it is a big worry. 18% say it is just a small worry and only 2% that it is no worry at all. The average Australian thinks this risk is somewhere between a 'very big' worry and a 'big' worry, rating it 66 points out of 100.

A little less worrying, scoring 58 or 59 points out of 100, are:

- "That genetically engineered plants might get out of hand and spread on their own" and
- "That genetically engineered food plants might be a long run danger to human health, if people ate them for years".

6.2 A Culture of Worry?

To put genetic engineering in perspective, the survey also asked about other worries:

```
d. Do you worry about chemical pesticides used in farming?
       HUGE worry: terrible and very likely to happen 28
       Very big worry                                  28
       A big worry                                     23
       A small worry                                   18
       No worry at all                                  3
                                                       ---
                                                  100% (mean= 65)

e. Fluorides are added to the drinking water in most parts of Australia to
reduce tooth decay. Do you worry that they might be dangerous to people's
health in the long run?
       HUGE worry: terrible and very likely to happen 13
       Very big worry                                  18
       A big worry                                     21
       A small worry                                   32
       No worry at all                                 17
                                                       ---
                                                       100% (mean= 45)
```

Australians were just as worried about chemical pesticides as about genetic engineering, giving it 65 points on average. 28% said it was a huge worry and another 28% said it was a very big worry. 23% said it was a big worry, 18% a small worry, and only 3% said chemical pesticides were no worry at all.

Australians also worry a fair bit about some widely accepted practices. Fluoridation of drinking water to reduce tooth decay is a well established public health measure used for decades in Australia and many other countries without any evidence of danger to people's health. But when asked about it, the public nonetheless give it fully 45 points out of 100 on the worry scale. 13% said it was a huge worry, 18% a very big worry, 20% a big worry, 32% a small worry and only 17% said fluorides were no worry at all.

This level of worry in the face of overwhelming scientific support, over a period of decades, and in many nations, suggests there is a culture of worry in Australia (and possibly in other rich nations) -- a tendency to hold irrational fears. While there are surely many genuine , rational fears about genetic engineering, this suggests that a substantial proportion of the fears are irrational. It also suggests that even if experience over the next few decades shows genetically engineered products to be entirely safe, the public will nonetheless continue to have a substantial level of unease.

Thus the real-world baseline for an entirely safe food technology is not a public perception that it is without risk. Instead even something without real risk will be seen by the public as a “big worry”!

6.3 The Structure of Opinion on Risk

Factor analysis shows that opinions on the various risks of genetic engineering all very much go together, with those who worry about one kind of risk also worrying about the others. So it is reasonable to combine them into a single measure of perceived risk:

[Definition] ***Perceived risk of genetic engineering*** *= mean(Worry about new disease, worry about plants spreading on their own, worry about danger to health)*

The worries about chemical pesticides and fluorides in drinking water are correlated with perceived risk, and with each other, but the pattern of correlations is not consistent with their

being part of the same factor. Rather there seem to be three separate, albeit correlated risk factors: perceived risks of genetic engineering, perceived risk of chemical pesticides, and perceived risk of fluorides:

[Definition] ***Perceived risk of chemical pesticides*** *= Single item on worries about chemical pesticides)*

[Definition] ***Perceived risk of fluoridation*** *= Single item on worries about fluoridation of drinking water)*

6.4 Social Differences in Perceptions of Risk

6.4.1 Perceived Risk of Genetic Engineering

Perceived risks of genetic engineering are fairly broadly spread throughout the population. Old and young, the well educated and the poorly educated, high status and low, supporters of Labor and Coalition supporters, Catholic and Protestant, devout and atheist, all have similar levels of worry. But men are substantially less worried than women (beta= -.10).

Neither knowledge of science in general, nor of genetic engineering in particular, makes any difference. This may be because knowledge has offsetting effects, decreasing some simple "Frankenstein monster" type fears while at the same time increasing awareness of the myriad possibilities for things going wrong.

The strongest difference is that those who are generally fearful of spiders, car accidents and the like -- people with an inclination to worry about all sorts of risks -- are much more worried about genetic engineering (beta= .17).

Environmentalists are also substantially more worried than other people (beta=.12).

6.4.2 Perceived Risk of Chemical Pesticides

Perceptions of the risks associated with chemical pesticides shows a similar pattern. There are no appreciable demographic differences, except that men are less worried than women (beta= -.11). Those who are generally fearful of spiders, car accidents and the like are much more worried about chemicals (beta =.20). And, most strikingly, environmentalists are very much more worried than others (beta= .29).

6.4.3 Perceived Risk of Fluoridation

Perceptions of the risks of fluoridating drinking water also shows a similar pattern. There are no important demographic differences. Labor supporters are less worried than supporters of other parties (beta=-.13), for reasons that are not clear. Environmentalists are substantially more worried (beta= .11).

Most strikingly, those who are generally fearful of spiders, car accidents and the like are much more worried about fluoridation (beta =.21).

6.5 Summary: Risks

The survey also asked about the potential risks associated with genetic engineering. The results can be expressed in the form of a worry scale, from zero ("No worry") to 100 ("Huge worry, terrible and very likely to happen"). The results showed Australians to be a worrying lot, even when the observed risks are quite low: fluorides -- which are added to drinking water to reduce tooth decay in most parts of Australia -- elicited 45 points on the worry scale. At the other

extreme, concern with the use of chemical pesticides in farming elicited 65 points on the worry scale.

Concern that genetic engineering could accidentally create a new disease which could escape from the laboratory (67) points was about as high as concern with chemical pesticides. Concerns about the possible long-term risks of eating genetically engineered food (59 points) and fears that genetically engineered plants might escape into the environment and become weeds (58) were lower.

Even people most concerned with potential risks generally believe that the benefits of genetic engineering will outweigh the risks in the long run (as shown below in section 10.2). The results suggest that Australians have a balanced view about genetic engineering: they recognize that with any new technology there will always be risks but that these risks need to be, and can be, balanced against the prospective benefits.

7. SOCIAL DIFFERENCES IN APPROVAL OF GENETICALLY ENGINEERED PRODUCTS

7.1 The model

We have seen that the public endorses a wide array of specific genetic engineering products. We have also seen that underlying the surface differences in attitudes towards genetically engineered organisms there is a general dimension indicating overall approval or disapproval of genetic engineering. So there are good statistical reasons for combining desirability ratings for the different products into one summary scale measuring approval or disapproval of genetic engineering, as described above. We use this scale as a dependent variable in a regression analysis of the sources of differences of opinion on genetic engineering.

What about the causes of approval of genetic engineering -- why do some people approve and other not? Most public policies are controversial to varying degrees, with some groups in favour and others opposed. Genetic engineering is no exception. To assess the social sources of differences of opinion about genetic engineering, we need a model that specifies causal connections.

7.1.1 Causes

Our model begins with potential causes that are stable characteristics, and are known to affect many attitudes and values. Demographic characteristics (age, gender) must be included, because some researchers have argued that the continuing process of scientific discovery leaves older people far behind (perhaps because for many people scientific knowledge acquired at school is rarely up-dated), and because men and women are known to differ on a number of science-related and technology-related topics. Education (mostly acquired by young adulthood) needs to be included because of its strong connections with knowing and learning. People's work shapes many aspect of their lives, including some of their attitudes and values, so we include occupation to assess the impact of social-class differences (occupational status is very stable over time). Many political scientists hold that people follow the lead offered by their political party, especially on new, low-salience, possibly obscure issues; it is also true that Labor, Coalition, and Green partisans differ on many long-standing issues, particularly regarding the economy. Political party identification is also an enduring characteristic, and so can reasonably be regarded as causally prior to highly specific attitudes on very new topics, notably genetic engineering. Religious denomination and religious belief are also enduring characteristics that shape many social and political opinions on a wide range of topics (e.g. sexual behaviour, abortion, women's employment). They are actually especially pertinent here; religious and scientific elites have reached a (sometimes- uneasy) truce, but it is far from clear that the laity endorses this truce -- instead, as we shall see, the conflict between science and religion is a strong one in the mass public.

7.1.2 Intermediate causes

I examine several groups of intermediate potential causes:

- **Information**. The information-base -- separate measures for self-rated knowledge of science in general and knowledge of genetic engineering in particular -- is included because one theory of decision-making holds that people only form attitudes about technologies and techniques after they have acquired relevant information. Some researchers in this tradition would hold that more knowledge makes people more sympathetic to genetic engineering,

other researchers would posit the opposite effect, so it is important to allow these possibilities in the model.

- **Goals**. Other theories of decision-making hold that people are less concerned with understanding mechanisms when they evaluate techniques and technologies than with judging whether techniques and technologies help attain valued goals: they judge the "means" by the “ends”. Accordingly the desirability of goals -- here the desirability of scientists striving for improvements to health and agriculture -- are also included as potential intermediate goals in the model.

- **Fears**. Fears about possible risks in genetically engineered products.

- **Scientific World-view**. Finally, adherence to an over-arching scientific world-view (measured by adherence to modern cosmology and evolutionary theory) will, on some arguments, substantially affect attitudes towards genetic engineering. In particular, people who reject the scientific world-view might be inclined to see genetic engineering as tampering with divine creation, and hence tremendously dangerous.

7.2 Results

The measurement of these causes (and intermediate causes) has been described in previous sections. The results of the analysis, estimated by ordinary-least-squares regression, show that :

7.2.1 Age and Gender

- The demographic forces of gender and age do not immediately affect approval of genetic engineering (their effects are not statistically significant).

- But gender and age do affect some of the intermediate variables, thereby exerting (very weak) flow-on (or "indirect") effects. In particular, men exhibit higher levels of scientific knowledge and they are more inclined to adopt a scientific world-view.

- But, interestingly, men and women do not differ in their assessment of the desirability of improvements in health and agriculture as goals for Australian scientists.

- The old know less about science than the young but their knowledge of genetic engineering is no worse than that of young people. And the old are less inclined than the young to accept the scientific world-view.

- Old and young agree on the importance of improving health as a goal for Australian scientists, but the old are more favorable than the young towards improving agriculture as a goal for Australian scientists.

7.2.2 Education and Class

There are strong educational differences in respect to knowledge but not in respect to attitudes:

- As expected, education has a very large effect on scientific knowledge and a large effect on knowledge of genetic engineering.

- But education has no direct impact on attitudes towards genetic engineering, and neither does occupational status.

Working class and middle class Australians are opposed on many political issues, but they are:

- Equally positive towards health improvements as a goal for Australian scientists,

- Equally positive towards improvements in agriculture as a goal for Australian scientists, and
- Equally positive towards genetic engineering.

7.2.3 Politics and Religion

Political differences on these issues are modest:

- People who are warm supporters of Labor, of the Coalition, and of the Greens do not differ in their knowledge of genetic engineering, nor in their general scientific knowledge, nor in their inclination to accept a scientific world-view, nor in their endorsement of improvements in health as a goal for Australians scientists. These matters are closer to common ground than to political cleavages.
- But Coalition supporters differ in one respect: they more warmly endorse improvements in agriculture as a goal for Australian scientists.
- Green supporters also differ in one respect: they are less favorable towards genetic engineering (this is a direct effect, not mediated by differences in world-view or knowledge). This too is a substantial effect (see the standardized regression coefficient, or beta, of -.09).

Religion has no direct connection to approval of genetic engineering, but most people with strong Christian beliefs reject the scientific world-view, which thereby indirectly reduces their support for genetic engineering by a small amount.

7.2.4 Knowledge

Interestingly, neither of our information-base indicators -- scientific knowledge and knowledge of genetic engineering -- has any impact on approval of the projects we have asked about.

One might venture the interpretation that this reflects the fact that both effects posited by (opposing) information-base decision theorists are real: increases in knowledge lead some people to be more supportive of genetic engineering, but lead other people to be less supportive, and the two effects cancel each other out.

7.2.5 Goals

By contrast, there is substantial support for a goal-oriented model of judgments about genetic engineering. People who value goals that genetic engineering could serve are much more supportive of it:

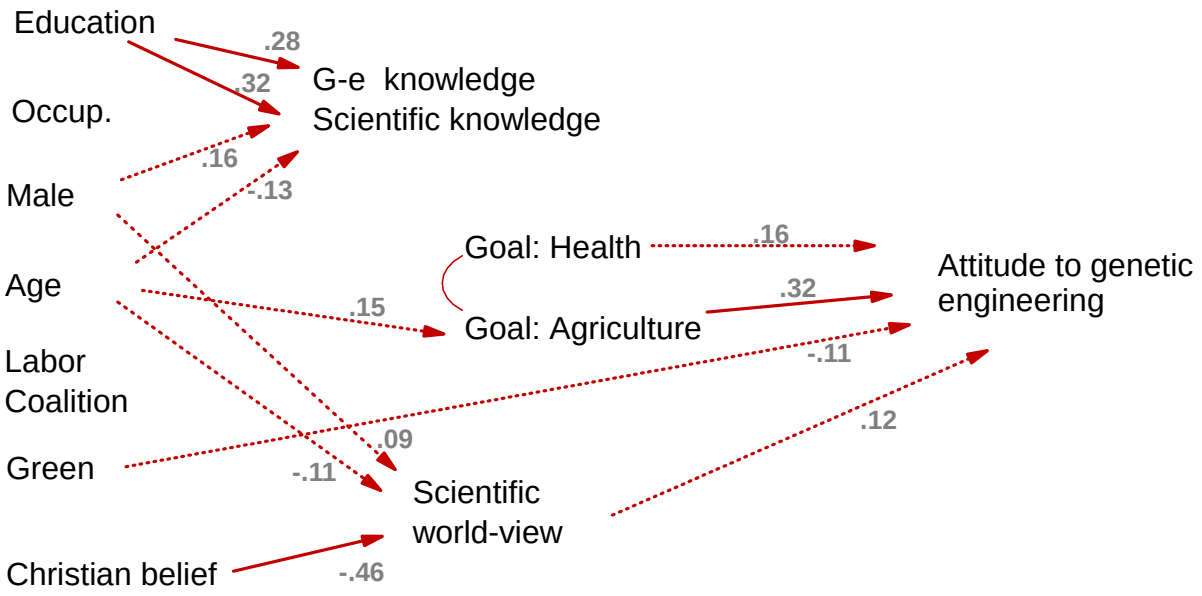
- People who warmly endorse health improvement as a goal for Australian scientists are more favorable towards genetic engineering (this is a substantial effect, beta=.14).
- People who warmly endorse agricultural improvements as a goal for Australian scientists are very favorable towards genetic engineering (this is a very large effect with a standardized regression coefficient of .33)

7.2.6 The Scientific World-View

Adherence to an over-arching scientific world-view -- as measured by adherence to modern cosmology and evolutionary theory -- leads people to favour genetic engineering . This is a substantial effect (see the standardized regression coefficient of .12). Another way of putting the same fact is that opposition to genetic engineering is substantially greater among those who reject the theory of evolution and those who reject modern astronomy.

7.3 Summary: Social Differences

Most Australians approve of genetic engineering, and there are few social differences in approval. They approve of genetic engineering mainly because they see it as serving goals that they value, not because they understand much about it. Indeed, knowledge of genetic engineering has no net impact on approval of the projects we have asked about (although it does, as we will see later, have some impact on people's personal willingness to use genetically modified products, and on their overall evaluation of the balance of costs and benefits to be expected from genetic engineering). Opposition to genetic engineering is concentrated among people who put a low priority on improvements in health and agriculture as goals for Australians scientists, among supporters of the Greens, and among people who dissent from the scientific world-view.



(Standardized partial regression coefficients; only statistically significant effects with | t| > 3 are shown. See appendix Table B for the full model.)

Figure 2. What shapes attitudes to genetic engineering? Australia, 1994-95.

8. LABELING

8.1 Views on Labeling Genetically Engineered Products

The question of whether or not genetically engineered products should be labeled was tested by several questions on genetically engineered tomatoes. Just after the lengthy introduction to genetic engineering using the tomato as an example, the survey continued:

```
4 ... a. Would you like to try eating this new tomato?
              Yes, definitely                  17
              Yes, probably                    44
              Mixed feelings; yes and no       16
              No, probably not                 17
              No, definitely not                7
                                               ---
                                               100% (mean= 62)

b. Should they be clearly labeled as genetically engineered, so you can
decide for yourself whether or not to eat them?
              Yes, definitely                  46
              Yes, probably                    43
              Mixed feelings; yes and no        7
              No, probably not                  4
              No, definitely not                1
                                               ---
                                               100% (mean= 82)


c. If clearly labeled, are these new tomatoes a good idea or a bad idea?
              Very good idea                   17
              Good idea                        47
              Mixed feelings, hard to say      28
              Bad idea                          6
              Very bad idea                     3
                                               ---
                                               100% (mean= 67)

d. And if the genetically engineered tomatoes were not clearly labeled?
              Very good idea                    2
              Good idea                         9
              Mixed feelings, hard to say      24
              Bad idea                         41
              Very bad idea                    24
                                               ---
                                               100% (mean= 31)
```

After the question on eating the tomato, the next question asked directly about labeling. The public is overwhelmingly in favour of clear labeling and the consumer's right to choose. 46% say “Yes, definitely” and a further 43% “Yes, probably” -- an overwhelming majority for labeling. Only 6% are undecided and a minuscule 4% against labeling.

In all, labeling gets 82 points out of 100. This is consistent with the public's strong general preference for consumer choice in many other contexts (Kelley, 1990: Ch. 5) and with public opinion in several overseas nations specifically on labeling genetically modified products (Hoban and Kendall, 1992; Optima, 1994: 17).

The next question asked about marketing a clearly labeled genetically engineered tomato (this question has already been discussed). If the tomatoes are to be clearly labeled, people would regard them as quite a good idea, at 67 points. A clear majority say they are either "good idea" or "very good idea".

The following question asked about marketing an **unlabeled** genetically engineered tomato. By contrast to the previous question, if not labeled, a clear majority would think the genetically engineered tomatoes a "bad" or "very bad" idea. Specifically, only 2% said an unlabeled tomato was a very good idea, 9% said it was a good idea, and 24% had mixed feelings. But 41% said it was a bad idea and no less than 24% said it was a very bad idea. This gives unlabeled tomatoes only 31 points out of 100 -- overwhelming rejection by the public.

Thus, judging from this series of questions on tomatoes, the public is decidedly sympathetic to genetically engineered foods, if these foods are labeled so that consumers can choose for themselves whether or not to eat them. Without labeling, a clear majority opposes genetically engineered foods.

8.2 Social Differences in Views about Labeling

8.2.1 Who Thinks Genetically Engineered Products Should be Labeled?

There are no appreciable social or demographic differences in who thinks genetically engineered products should be labeled. Old and young, men and women, the well educated and the poorly educated, believers and non-believers, Catholics and Protestants, Labor and Coalition supporters all have much the same views. Only environmentalists are more inclined than others to want labeling (beta=.10).

Knowledge makes no difference either. Those who know a lot about science in general or a lot about genetic engineering in particular have much the same views as those who know little.

Worries about genetically engineered products do matter, and quite a lot (beta=.24). Those who worry are much keener on labeling.

But it is noteworthy that even among those who have not the slightest worry about genetically engineered products, but are average in other respects, labeling commands majority support. There is no substantial subgroup of the population that gives anything short of majority support to labeling.

8.2.2 Labeled versus Unlabeled Tomatoes

Two parallel analyses of public support for unlabeled genetically engineered tomatoes and public support for labeled tomatoes are instructive. Worry about genetic engineering is the main influence on views about unlabeled tomatoes, with a very large effect indeed (beta=-.27). But worry matters rather less for labeled tomatoes (beta=-.21; the corresponding metric regression coefficients are -.25 and -.18, both with standard error of .03).

Conversely, support for agricultural goals creates only a modest amount of support for unlabeled tomatoes (beta=.09) compared to the huge amount of support it creates for labeled tomatoes (beta=.27; the corresponding metric regression coefficients are .13 and .37, both with a standard error of .05).

8.3 Labeling and Choice

8.3.1 Unlabeled Genetically Engineered Products.

Judging from the tomato example, the key difficulty with unlabeled products is a cost (in the consumer's view) imposed on them without their consent: if genetically engineered products are unlabeled, consumers cannot easily avoid using them.

- A perceived risk to health is probably the main cost.

  - Assurances by government committees are not sufficient to allay people's fears, probably because governments have only modest creditability in the public mind, in Australia or overseas (INRA 1993; U.S. Congress Office of Technology Assessment 1987: 89-90).

  - Moreover the prevailing 'culture of fear' -- evidenced by widespread fears about fluorides in drinking water, despite clear evidence of its safety -- suggests that even the most scientifically persuasive evidence will not necessarily dissipate fears.

- Overseas evidence also suggests that some consumers will have moral or ethical objections which would lead them to prefer avoiding genetically modified products.

8.3.2 Genetically Engineered Products Labeled as Such.

Judging from the tomato example, the public reacts to clearly labeled genetically engineered foods largely on the basis of potential agricultural benefits, and rather less on the basis of fear.

- Essentially the proposal to introduce them is something like "regulatory bodies think they are safe, so farmers will be allowed to grow them, while you the consumer can eat them only if you want to".

- Risk is a smaller part of this (since consumers who are worried, or have other objections, can avoid most risks by continuing to buy the same conventional tomatoes they have in the past instead of genetically engineered ones).

- With little personal risk involved, consumers then are sympathetic to potential gains by others -- to farmers (popular) and to other consumers who want to try the products (also popular). Sympathy for consumer choice is not unique to Australia. In Canada, for example, 68% think "biotech-produced foods should be available to consumers who wish to buy them", 18% are undecided, and only 12% are opposed (Optima, 1994: 17).

8.3.3 Implications for Public Policy.

These results provide a strong argument for labeling of genetically engineered foods, at least for a period of years until public understanding and acceptance grows. This would:

- **Reassure** the public that they are not implicitly required to consume genetically engineered foods unknowingly;

- Allow people to **choose for themselves** whether or not to consume genetically modified foods. Even if genetically engineered foods are entirely safe -- a scientific issue not to be settled by public opinion polling -- people nonetheless want to make the choice themselves

- Vastly **increase public acceptance** of genetically engineered foods.

Voluntary labeling (as has happened with tomatoes in the U.S.) might meet most public concerns.

8.4 Summary: Labeling

The public wants genetically engineered food products to be clearly labeled, so they can choose for themselves whether or not to use them. Even if genetically engineered foods are in fact entirely safe -- a scientific issue not to be settled by public opinion polling -- people nonetheless want to make the choice themselves. Voluntary labeling might meet most public concerns.

9. PERSONAL USE OF GENETICALLY ENGINEERED PRODUCTS

9.1 How Many People Would Use Genetically Engineered Products?

The ISSS survey asked whether people would themselves use genetically engineered products:

```
4 ... a. Would you like to try eating this new [genetically modified]
tomato?
              Yes, definitely                  17
              Yes, probably                    44
              Mixed feelings; yes and no       16
              No, probably not                 17
              No, definitely not                7
                                               ---
                                               100% (mean= 62)
...
6. How do you feel about using genetically engineered products yourself...
a. Would you wear clothes made from genetically engineered cotton?
              Yes, definitely                  25
              Yes, probably                    52
              Mixed feelings; yes and no       18
              No, probably not                  4
              No, definitely not                1
                                               ---
                                               100% (mean= 74)

b. Would you eat leaner, healthier pork developed by genetic engineering?
              Yes, definitely                  14
              Yes, probably                    42
              Mixed feelings; yes and no       24
              No, probably not                 14
              No, definitely not                6
                                               ---
                                               100% (mean= 61)

c. Eat healthier cooking oil or margarine made by genetic engineering?
              Yes, definitely                  18
              Yes, probably                    48
              Mixed feelings; yes and no       22
              No, probably not                  9
              No, definitely not                3
                                               ---
                                               100% (mean= 67)
```

Most people would like to try eating genetically engineered tomatoes: 17% definitely yes and 44% probably yes. Some 16% are undecided, 17% think probably not and 7% definitely not. So in all, a majority of Australians would eat them, 61% yes, 16% are undecided, and 24% would not. A plurality of Canadians would also eat them (44% yes, 22% undecided, 32% no: Optima 1994: 15).

The public is quite comfortable about wearing clothes made from genetically engineered cotton. 25% would definitely wear them and a further 52% would probably wear them -- in all, an overwhelming majority. 18% have mixed feelings. Only 4% would probably not wear them and 1% definitely not. This gives a mean approval score of 74 points out of 100.

Most people would eat genetically engineered lean pork. 14% definitely would and 42% probably would, in all a modest majority. 22% are undecided and 14% probably would not eat it and 6% definitely not eat it (a few of these may be people who don't eat any kind of pork). In all, this gives genetically engineered pork 61 points out of 100.

The public is pretty comfortable with genetically engineered cooking oil or margarine. 18% would definitely use it and 48% probably would, in all a strong majority. 22% are undecided, 9% would probably not use it, and 3% would definitely not use it.

9.2 Patterns of Use

People who would eat genetically engineered pork are very likely to use genetically engineered cooking oil as well, and vice versa. Wearing clothes from genetically engineered cotton is somewhat different from these. So it is appropriate to distinguish two aspects of use:

[Definition] ***Use of Genetically Engineered Food*** *= mean(Eat G-E pork, use G-E cooking oil)*

[Definition] ***Use Genetically Engineered Cotton*** *= Single item: Wear clothes from G-E cotton)*

9.3 Who Would Use Genetically Engineered Products?

9.3.1 Genetically Engineered Foods

Men are a little more likely than women to eat genetically engineered foods (beta=.11). Otherwise there are few differences between social or demographic groups.

Knowledge matters: those who know more about genetic engineering are substantially more likely to be willing to eat genetically engineered foods (beta=.12).

Holding a scientific world-view also makes one more likely to eat genetically modified foods (beta=.12).

People who are worried about the risks of genetically engineered products are much less likely to be willing to use them themselves (beta=-.27). Those who worry about fluorides in the drinking water are also dubious about genetically engineered food (beta=-.13.

Finally, those who support scientific research on agriculture in general are themselves more willing to eat genetically engineered foods (beta=.29).

9.3.2 Clothes from Genetically Engineered Cotton

Men are neither more nor less willing than women to wear clothes from genetically engineered cotton. The old are not as keen as the young (beta=-.10) but otherwise there are no noticeable differences between demographic or social groups.

Knowledge and a scientific world-view are conducive to using genetically engineered cotton.

People who are worried about the risks of genetically engineered products are somewhat less keen on genetically engineered cotton (beta=-.-19), as are those who worry about fluorides in the drinking water (beta=-.11).

Finally, people who support scientific research on agriculture in general are a little keener on genetically engineered cotton (beta=.14), as are those keen on medical research (beta=.09).

9.4 Summary: Use of Genetically Modified Products

The vast majority of Australians would wear clothes made from genetically engineered cotton (77%). The rest are mostly undecided (18%), with only 5% definitely unwilling. Clear majorities would eat genetically engineered cooking oil (60%), tomatoes (61%), and pork (56%) with most of the rest undecided rather than definitely unwilling.

Most willing to use genetically engineered products are those who generally support scientific research on agriculture, those less worried about the risks of genetic engineering, those more knowledgeable about it, and those who have a scientific rather than religious world-view.

10. WEIGHING UP BENEFITS AND RISKS

10.1 Do the Benefits of Genetic Engineering Outweigh the Risks?

The ISSS survey first asked about possible benefits from scientific research on food and medicine, went on to explain what genetic engineering is, and then raised some of the benefits that might come from it and some of the risks that might be involved. At the end it asked people to weigh up the benefits and risks:

7a. Thinking back over the good things and the bad things that might come from it, over the next 20 years, do you think the benefits of genetic engineering are likely to outweigh the risks?

Yes, definitely	*14*
Yes, probably	*49*
Mixed feelings; yes and no	*27*
No, probably not	*7*
No, definitely not	*2*

	100% (mean= 67)

A clear majority of Australians believe that the good will outweigh the bad, most of the rest are uncertain, and only a tiny minority believe the bad will outweigh the good. Some 14% of the public said "yes, definitely" and a further 49% said "yes, probably". Another 27% had "mixed feelings, yes and no". Only 7% said "no, probably not" and 2% said "no, definitely not". The average Australian gives genetic engineering a favorable 66 points out of 100 .

In sum, the Australian public believes that the long term benefits from genetic engineering are likely to outweigh the risks.

10.2 Who Thinks the Benefits Of Genetic Engineering Outweigh The Risks?

10.2.1 Background, Knowledge, and Risks

Background, knowledge and perceptions of risk all shape people's view of whether the benefits of genetic engineering are likely to outweigh the risks over the next 20 years. They do this partly directly and partly indirectly, by influencing people's personal evaluation of various genetic engineering products and people's decisions about using genetic engineered products themselves. The effects, combining both direct and indirect elements, are these:

Background. Optimism about the benefits of genetic engineering is more or less equally widespread in all demographic groups. Multiple regression analysis shows no important differences between old and young, men and women, the well educated and the poorly educated, Catholic and Protestant, church-goers and the unchurched, or between Labor and Coalition sympathizers. There is only a marginal difference between environmentalists and others (beta=.08, .05<p<.01).

Knowledge. People who are knowledgeable about genetic engineering are a little more optimistic about its long run benefits (beta = .10). General science knowledge makes no difference.

Goals. Views about the value of the benefits involved are very important. Those (many) who are keen on the agricultural benefits from scientific research are most optimistic about using genetic engineering to achieve those goals, while the (few) who are unimpressed with scientific research are unsympathetic to genetic engineering (beta =.21). In the extreme, someone who is "delighted" about all six food and agricultural goals asked about in the questionnaire are will, on average, be

28 points more optimistic about genetic engineering than someone who thinks all six are "terrible".

Risks. Views about the possible risks of genetic engineering are also important. Those who are greatly worried about the risks are much less optimistic than those who are not very worried (beta=-.24). In the extreme, someone who thinks all three risks asked about in the survey are a "huge worry: terrible and very likely to happen" will on average be 20 points less optimistic about genetic engineering than someone who thinks all three risks are "no worry at all".

Importantly, even extreme worriers are nonetheless likely to think that the benefits of genetic engineering will slightly outweigh the costs in the long run -- their views falling, on average, between "mixed feelings" and "yes, probably" benefit.

There is also an element of irrational risk aversion: those who worry about the dangers of fluoridated drinking water are substantially less supportive of genetic engineering (beta=-.10).

Scientific World-View. Those who hold a scientific world-view -- accepting Darwin's theory of evolution and modern views about astronomy -- are also much more optimistic (beta=.17). Thus much of the opposition to genetic engineering comes from people who reject the theory of evolution and other aspects of the scientific world-view.

10.3 Self-interest and Personal Approval

In politics, self-interest is widely believed to be the ultimate force shaping voting decisions -- this is the Australian voter's famous "hip-pocket" nerve. Much the same appears to be true for genetic engineering: Australians who expect to use genetically engineered products themselves, or who personally approve of them, are very much more likely to believe that the benefits of genetic engineering outweigh the risks:

- Those who expect to eat genetically engineered food are very much more likely to think the benefits will outweigh the risks (beta=.30).
- Those who expect to wear clothes made from genetically engineered cotton are somewhat more supportive (beta= .12).
- And people who themselves approve of various genetically engineered products are much more likely to think the benefits will outweigh the risks (beta=.26).

10.4 Summary: Benefits and Risks

A clear majority of the Australian public think the benefits of genetic engineering will outweigh the risks. Most of the rest have mixed feelings and fewer than 10% think the risks will outweigh the benefits.

Table 3 presents a simple, summary model compactly summarizing who thinks the benefits of genetic engineering will outweigh the risks, and who does not. The results show that Australians who see genetic engineering as promising more benefit than risk -- the majority -- tend to be those who:

- favour the goals, especially agricultural benefits;
- are less worried than the average about potential costs;
- do not particularly fear fluoridation;

- are relatively knowledgeable about genetic engineering; and
- have a scientific world-view.

Conversely, those who see genetic engineering's risks as outwieghing its potential benefits -- the minority -- tend to be those who:

- are less keen on agricultural goals than most Australians;
- are more worried than the average about potential risks;
- fear fluoridation;
- know little about genetic engineering; and
- reject Darwin's theory of evolution and modern astronomy.

These results suggest that Australian public will become more supportive of genetic engineering in the future as levels of knowledge increase.

Table 3. Who thinks the benefits of genetic engineering are likely to outweigh the risks? Regression analysis, Australia, 1994.

	Standardized regression coefficient*	t-test, significance
Potential benefits	.18	t=6.6, p<.001
Rational worries about potential costs	-.18	t=-6.0, p<.001
Irrational worries (fluoridation)	-.09	t=-3.1, p<.01
Knowledge of genetic engineering	.09	t=3.1, p<.01
Scientific world-view	.14	t=4.3, p<.001
Gender (male=1, female=0)	.03	Not significant
Age (years)	.00	Not significant
Education (years)	.04	Not significant
Christian belief (5 item scale)	-.01	Not significant
Environmentalists (rating, 0 to 100)	-.07	t=2.6, p<.01

Source: International Social Science Survey / Australia. N=1378.

NOTES: * A standardized regression coefficent may also be called a "Beta" or a "B".

11. ATTITUDES IN OTHER NATIONS

Public opinion on genetic engineering differs greatly among countries, as shown by the Eurobarometer surveys, the largest and most closely comparable international surveys to date (Lemkow 1993: 10-14; Schibeci et al. 1994: 20-21). Hence overseas results offer no firm guidance about Australian opinion.

Our basic findings for Australia are similar to those for the USA, Canada and some European Community nations. The US Office of Technology Assessment's excellent 1987 survey's main, conclusion could equally well stand for our Australian survey:

> **"**In summary, most Americans appear to be pragmatists on the issue of genetic engineering. They are concerned about both the morality and the risks of the technology. **The survey finds that while the public expresses concern about genetic engineering in the abstract, it approves nearly every specific environmental or therapeutic application**. ... **This survey indicates that a majority of the public believes the expected benefits of science, biotechnology, and genetic engineering are sufficient to outweigh the risks"** (U.S. Congress, Office of Technology Assessment, 1987: Executive Summary; emphasis in the original).

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13. APPENDICES

13.1 The Questionnaire

```
SCIENCE

1. Would you say these are true or false...
a. The universe began with a
huge explosion . . . . . .  True!!  True  ??  False  False!!

b. Elsewhere in the universe, there
are probably thousands of planets
much like our own. . . . . .  True!!  True  ??  False  False!!

c. There is probably life on other
planets elsewhere in the universe. . . . .  True!!  True  ??  False  False!!

d. Modern animals and plants evolved
over millions of years, through
survival of the fittest. . . . . .  True!!  True  ??  False  False!!

e. Mankind evolved by natural selection
from lower animals, as Darwin's theory
of evolution says. . . . . .  True!!  True  ??  False  False!!

f. The earliest humans appeared
millions of years ago in Africa. . . . . .  True!!  True  ??  False  False!!

g. Mankind's ancestors were apes . . . . .  True!!  True  ??  False  False!!


2a. Do you understand how a picture
appears on a TV? . . . . . .  Yes!!  Yes  ??  No  No!!

b. Understand why plants are green?. . . . . .  Yes!!  Yes  ??  No  No!!

c. Understand how aeroplanes fly?. . . . . .  Yes!!  Yes  ??  No  No!!

d. Understand computers? . . . . . .  Yes!!  Yes  ??  No  No!!


3.  Australian scientists do a lot of research on food and medicine. Here are some
things they could try to do, some goals for the future. How do you feel about
developing...

                                  Delighted                        Terrible
a. New medicines to cure
serious diseases like cancer?. . . . . 1   2   3   4   5   6   7   8   9

b. Tastier, fresher food?. . . . . 1   2   3   4   5   6   7   8   9

c. Cheaper food? . . . . . 1   2   3   4   5   6   7   8   9

d. Healthier, more nutritious foods. . . . 1   2   3   4   5   6   7   8   9

e. Higher yielding crops, which would
increase farmers' earnings . . . . . 1   2   3   4   5   6   7   8   9

f. Crops that would create a new
export market for Australian farmers . . . 1   2   3   4   5   6   7   8   9

g. Reducing the use of chemicals
and pesticides in farming. . . . . 1   2   3   4   5   6   7   8   9

h. Protecting the environment. . . . . 1   2   3   4   5   6   7   8   9

                                  Page 61
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4. Genetic engineering is a new way to create new products. Scientists can use genetic engineering on plants or animals to change things like their size, colour, or taste. They do this by moving a gene from one kind of animal or plant to another, or by turning a gene off.

Recently, scientists have made an improved variety of tomato that has a better texture, costs less, and might make a valuable export. They turned off one of its genes, which would otherwise have made the tomato go mushy.

After careful study, a government regulatory committee believes that the new tomatoes are safe. Most scientists agree. But a few are worried and some nation-wide environmental groups say the tomatoes might be dangerous and should be banned.
>> Most people have not heard much about genetic engineering. We just want your opinion, your best guess.

a. Would you like to try eating this new tomato? . . . . . Yes!! Yes ?? No No!!

b. Should they be clearly labeled as genetically engineered, so you can decide for yourself whether or not to eat them?. . . . . Yes!! Yes ?? No No!!

Good!! -- Very good idea
Good -- Good idea
?? -- Mixed feelings, hard to say
Bad -- Bad idea
Bad!! -- Very bad idea

c. If clearly labeled, are these new tomatoes a good idea or a bad idea?. . . . . Good!! Good ?? Bad Bad!!

d. And if the genetically engineered tomatoes were not clearly labeled? . . . . . Good!! Good ?? Bad Bad!!

e. Here are some other things scientists might make with genetic engineering...
a. A treatment that would save the lives of people who have blood cancer . . . . . Good!! Good ?? Bad Bad!!

f. A genetically engineered drug that lowers blood pressure better than other drugs, reducing the risk of heart attack. . . . . Good!! Good ?? Bad Bad!!

g. Genetically engineered cotton that resists insect pests -- this could greatly reduce the use of chemical pesticides . . . . . Good!! Good ?? Bad Bad!!

h. Genetically modified viruses to protect farm crops by attacking insect pests, such as beetles and locusts. . . . . Good!! Good ?? Bad Bad!!

i. Modified viruses to control imported animal pests (such as rabbits or feral pigs) by preventing them from breeding . . . Good!! Good ?? Bad Bad!!

j. Leaner, healthier pork (assuming it is clearly labeled, so you can decide for yourself whether or not to buy it) . . . Good!! Good ?? Bad Bad!!

k. Healthier cooking oil and margarine, with more of the desirable unsaturated fats and fewer of the undesirable fats? . . . . . Good!! Good ?? Bad Bad!!

Page 62

5. Genetic engineering might have some risks as well as benefits. Here are some possible worries, things that some people think might happen...

1 HUGE worry: terrible and very likely to happen
2 Very big worry
3 A big worry
4 A small worry
5 No worry at all

	Huge worry				No worry
a. That medical genetic engineering could accidentally create a new disease, something that might escape from the laboratory -- a worry?.	1	2	3	4	5
b. That genetically engineered plants might get out of hand and spread on their own?.	1	2	3	4	5
c. That genetically engineered food plants might be a long run danger to human health, if people ate them for years?	1	2	3	4	5
d. Do you worry about chemical pesticides used in farming?.	1	2	3	4	5
e. Fluorides are added to the drinking water in most parts of Australia to reduce tooth decay. Do you worry that they might be dangerous to people's health in the long run?	1	2	3	4	5

Yes!! -- Yes, definitely
Yes -- Yes, probably
?? -- Mixed feelings; yes and no
No -- No, probably not
No!! -- No, definitely not

6. How do you feel about using genetically engineered products yourself...					
a. Would you wear clothes made from genetically engineered cotton?	Yes!!	Yes	??	No	No!!
b. Would you eat leaner, healthier pork developed by genetic engineering?.	Yes!!	Yes	??	No	No!!
c. Eat healthier cooking oil or margarine made by genetic engineering?	Yes!!	Yes	??	No	No!!
7a. Thinking back over the good things and the bad things that might come from it, over the next 20 years, do you think the benefits of genetic engineering are likely to outweigh the risks?. .	Yes!!	Yes	??	No	No!!
b. Before reading about it in this questionnaire, had you heard much about genetic engineering?	Yes!!	Yes	??	No	No!!
c. Would you say you have a basic understanding of genetic engineering?.	Yes!!	Yes	??	No	No!!
d. Are you interested in genetic engineering?. .	Yes!!	Yes	??	No	No!!
e. Do you have a basic understanding of science and technology generally?.	Yes!!	Yes	??	No	No!!

Page 63

13.2 Frequencies

GMEDIC p61q3a-Feel re new medicines for cancer

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Terrible =0	0	3	0	0	0
12	13	3	0	0	0
25	25	5	0	0	1
38	38	7	1	1	1
50	50	24	2	2	3
62	63	23	2	2	5
75	75	36	3	3	8
88	88	96	7	7	15
Delighted =100	100	1155	84	85	100
	.	26	2	Missing	
	Total	1378	100	100	
Mean 96	Std dev	13			

- -

GTASTY p61q3b-Feel re tastier fresher food

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Terrible =0	0	26	2	2	2
12	13	18	1	1	3
25	25	28	2	2	5
38	38	23	2	2	7
50	50	164	12	12	19
62	63	123	9	9	28
75	75	177	13	13	42
88	88	141	10	11	52
Delighted =100	100	647	47	48	100
	.	31	2	Missing	
	Total	1378	100	100	
Mean 80	Std dev	25			

- -

GCHEAPF p61q3c-Feel re cheaper food

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Terrible =0	0	17	1	1	1
12	13	10	1	1	2
25	25	21	2	2	4
38	38	29	2	2	6
50	50	155	11	12	17
62	63	100	7	7	25
75	75	182	13	14	38
88	88	188	14	14	52
Delighted =100	100	646	47	48	100
	.	30	2	Missing	
	Total	1378	100	100	
Mean 82	Std dev	23			

- -

GHLTHYF p61q3d-Feel re healthier foods

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Terrible =0	0	8	1	1	1
12	13	3	0	0	1
25	25	6	0	0	1
38	38	6	0	0	2
50	50	51	4	4	6
62	63	80	6	6	11
75	75	163	12	12	24
88	88	198	14	15	38
Delighted =100	100	832	60	62	100
	.	31	2	Missing	
	Total	1378	100	100	
Mean 90	Std dev	17			

- -

GFCROP p61q3e-Feel re higher yeilding crops

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Terrible =0	0	17	1	1	1
12	13	6	0	0	2
25	25	18	1	1	3
38	38	17	1	1	4
50	50	88	6	7	11
62	63	94	7	7	18
75	75	190	14	14	32
88	88	219	16	16	48
Delighted =100	100	698	51	52	100
	.	31	2	Missing	
	Total	1378	100	100	
Mean 85	Std dev	21			

- -

GEXCROP p61q3f-Feel re crops for new export mark

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Terrible =0	0	5	0	0	0
12	13	1	0	0	0
25	25	4	0	0	1
38	38	11	1	1	2
50	50	38	3	3	4
62	63	68	5	5	9
75	75	167	12	12	22
88	88	210	15	16	37
Delighted =100	100	845	61	63	100
	.	29	2	Missing	
	Total	1378	100	100	
Mean 90	Std dev	16			

- -

GCHEM p61q3g-Feel re reducing chemical pestici

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Terrible =0	0	11	1	1	1
12	13	2	0	0	1
25	25	6	0	0	1
38	38	12	1	1	2
50	50	36	3	3	5
62	63	42	3	3	8
75	75	98	7	7	15
88	88	191	14	14	30
Delighted =100	100	951	69	71	100
	.	29	2	Missing	
	Total	1378	100	100	
Mean 92	Std dev	16			

- -

GENVIR p61q3h-Feel re protecting the environmen

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Terrible =0	0	5	0	0	0
12	13	4	0	0	1
25	25	5	0	0	1
38	38	4	0	0	1
50	50	45	3	3	5
62	63	50	4	4	8
75	75	103	8	8	16
88	88	163	12	12	28
Delighted =100	100	969	70	72	100
	.	30	2	Missing	
	Total	1378	100	100	

Mean 92 Std dev 15

- -

UTOMAT p62q4a-Like to eat new tomato

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No, definitely not	0	93	7	7	7
No, probably not	25	219	16	17	24
Mixed feelings	50	216	16	16	40
Yes, probably	75	581	42	44	84
Yes, definitely	100	219	16	17	100
	.	50	4	Missing	
	Total	1378	100	100	

Mean 62 Std dev 29

- -

TLABEL p62q4b-Should they be clearly labeled as

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No!!	0	9	1	1	1
No	25	49	4	4	4
??	50	86	6	7	11
Yes	75	570	41	43	54
Yes!!	100	605	44	46	100
	.	59	4	Missing	
	Total	1378	100	100	

Mean 82 Std dev 20

- -

TOKLBL p62q4c-If clearly labeled, good or bad i

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Very bad idea	0	36	3	3	3
Bad idea	25	79	6	6	9
Mixed feelings	50	369	27	28	36
Good idea	75	624	45	47	83
Very good idea	100	232	17	17	100
	.	38	3	Missing	
	Total	1378	100	100	

Mean 67 Std dev 23

- -

TNOLBL p62q4d-If not clearly labeled, good or b

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Very bad idea	0	322	23	24	24
Bad idea	25	546	40	41	65
Mixed feelings	50	324	24	24	89
Good idea	75	116	8	9	98
Very good idea	100	27	2	2	100
	.	43	3	Missing	
	Total	1378	100	100	

Mean 31 Std dev 24

- -

GELEUKM p62q4e-Treatment for blood cancer

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Very bad idea	0	8	1	1	1
Bad idea	25	10	1	1	1
Mixed feelings	50	68	5	5	6
Good idea	75	390	28	29	36
Very good idea	100	863	63	65	100
	.	39	3	Missing	
	Total	1378	100	100	

Mean 89 Std dev 17

- -

GEBLOOD p62q4f-GE drug for lowering blood pressu

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Very bad idea	0	8	1	1	1
Bad idea	25	15	1	1	2
Mixed feelings	50	79	6	6	8
Good idea	75	442	32	33	41
Very good idea	100	794	58	59	100
	.	40	3	Missing	
	Total	1378	100	100	

Mean 87 Std dev 18

- -

GECOTTN p62q4g-GE cotton for resisting pests

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Very bad idea	0	8	1	1	1
Bad idea	25	12	1	1	2
Mixed feelings	50	81	6	6	8
Good idea	75	454	33	34	41
Very good idea	100	785	57	59	100
	.	38	3	Missing	
	Total	1378	100	100	

Mean 87 Std dev 18

- -

GEBUGVR p62q4h-Gen modified viruses for crops

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Very bad idea	0	40	3	3	3
Bad idea	25	70	5	5	8
Mixed feelings	50	246	18	18	27
Good idea	75	437	32	33	59
Very good idea	100	545	40	41	100
	.	40	3	Missing	
	Total	1378	100	100	

Mean 76 Std dev 26

- -

GEPSTVR p62q4i-Modif viruses for imported pests

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Very bad idea	0	43	3	3	3
Bad idea	25	71	5	5	9
Mixed feelings	50	226	16	17	25
Good idea	75	459	33	34	60
Very good idea	100	538	39	40	100
	.	41	3	Missing	
	Total	1378	100	100	
Mean 76	Std dev	26			

- -

GEPORK p62q4j-Leaner healthier pork

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Very bad idea	0	41	3	3	3
Bad idea	25	60	4	5	8
Mixed feelings	50	255	19	19	27
Good idea	75	595	43	45	71
Very good idea	100	384	28	29	100
	.	43	3	Missing	
	Total	1378	100	100	
Mean 73	Std dev	24			

- -

GEOIL p62q4k-Healthier cooking oil

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Very bad idea	0	22	2	2	2
Bad idea	25	31	2	2	4
Mixed feelings	50	179	13	13	17
Good idea	75	564	41	42	60
Very good idea	100	542	39	41	100
	.	40	3	Missing	
	Total	1378	100	100	
Mean 79	Std dev	22			

- -

WSICK p63q5a-GE could create new disease

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No worry at all	0	25	2	2	2
Small worry	25	242	18	18	20
Big worry	50	327	24	24	44
Very big worry	75	317	23	24	68
Huge worry: terrible	100	429	31	32	100
	.	38	3	Missing	
	Total	1378	100	100	
Mean 66	Std dev	29			

- -

WSPREAD p63q5b-GE plants could spread on their o

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No worry at all	0	69	5	5	5
Small worry	25	328	24	25	30
Big worry	50	343	25	26	55
Very big worry	75	301	22	23	78
Huge worry: terrible	100	297	22	22	100
	.	40	3	Missing	
	Total	1378	100	100	
Mean 58	Std dev	30			

- -

WHEALTH p63q5c-GE food plants might endanger hea

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No worry at all	0	60	4	5	5
Small worry	25	327	24	24	29
Big worry	50	349	25	26	55
Very big worry	75	298	22	22	77
Huge worry: terrible	100	306	22	23	100
	.	38	3	Missing	
	Total	1378	100	100	
Mean 59	Std dev	30			

- -

WCHEM p63q5d-Worry about chem pesticides in fa

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No worry at all	0	43	3	3	3
Small worry	25	244	18	18	21
Big worry	50	302	22	23	44
Very big worry	75	372	27	28	72
Huge worry: terrible	100	379	28	28	100
	.	38	3	Missing	
	Total	1378	100	100	
Mean 65	Std dev	29			

- -

WFLUOR p63q5e-Fluorides dangerous to health in

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No worry at all	0	224	16	17	17
Small worry	25	422	31	32	48
Big worry	50	274	20	21	69
Very big worry	75	244	18	18	87
Huge worry: terrible	100	170	12	13	100
	.	44	3	Missing	
	Total	1378	100	100	
Mean 45	Std dev	32			

- -

UCOTTON p63q6a-Wear clothes made from GE cotton

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No, definitely not	0	16	1	1	1
No, probably not	25	57	4	4	6
Mixed feelings	50	238	17	18	23
Yes, probably	75	690	50	52	75
Yes, definitely	100	331	24	25	100
	.	46	3	Missing	
	Total	1378	100	100	
Mean 74	Std dev	21			

- -

UPORK p63q6b-Eat GE pork

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No, definitely not	0	85	6	6	6
No, probably not	25	181	13	14	20
Mixed feelings	50	316	23	24	44
Yes, probably	75	558	41	42	86
Yes, definitely	100	187	14	14	100
	.	51	4	Missing	
	Total	1378	100	100	
Mean 61	Std dev	27			

- -

UOIL p63q6c-Eat GE cooking oil or margarine

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No, definitely not	0	38	3	3	3
No, probably not	25	120	9	9	12
Mixed feelings	50	290	21	22	34
Yes, probably	75	636	46	48	82
Yes, definitely	100	245	18	18	100
	.	49	4	Missing	
	Total	1378	100	100	
Mean 67	Std dev	24			

- -

GEALL p63q7a-GE benefits to outweigh risks ove

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No, definitely not	0	26	2	2	2
No, probably not	25	98	7	7	9
Mixed feelings	50	364	26	27	37
Yes, probably	75	650	47	49	86
Yes, definitely	100	189	14	14	100
	.	51	4	Missing	
	Total	1378	100	100	
Mean 67	Std dev	22			

- -

GEHEAR p63q7b-Hear much about GE before this qu

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No, definitely not	0	48	4	4	4
No, probably not	25	259	19	19	23
Yes & no	50	121	9	9	32
Yes, probably	75	646	47	49	81
Yes, definitely	100	258	19	19	100
	.	46	3	Missing	
	Total	1378	100	100	
Mean 65	Std dev	28			

- -

GEKNOW p63q7c-Have basic understanding of GE

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No, definitely not	0	47	3	4	4
No, probably not	25	236	17	18	21
Yes & no	50	214	16	16	37
Yes, probably	75	654	48	49	86
Yes, definitely	100	181	13	14	100
	.	46	3	Missing	
	Total	1378	100	100	
Mean 63	Std dev	26			

- -

INTRS#GE p63q7d-Interested in GE

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No, definitely not	0	50	4	4	4
No, probably not	25	250	18	19	23
Mixed feelings	50	355	26	27	49
Yes, probably	75	539	39	41	90
Yes, definitely	100	138	10	10	100
	.	46	3	Missing	
	Total	1378	100	100	
Mean 59	Std dev	25			

- -

SCIKNOW p63q7e-Basic understanding of science &

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No, definitely not	0	32	2	2	2
No, probably not	25	204	15	15	18
Yes & no	50	312	23	23	41
Yes, probably	75	630	46	47	88
Yes, definitely	100	155	11	12	100
	.	45	3	Missing	
	Total	1378	100	100	

Mean 63 Std dev 24

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13.3 Appendix Tables

Appendix Table A. Correlations, means and standard deviations. N=1503. Australia, 1994-95.

Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1. Education	1.000														
2. Status	0.574	1.000													
3. Male	0.094	0.079	1.000												
4. Age	-0.344	0.018	0.037	1.000											
5. Labor Party	0.016	0.024	0.035	-0.028	1.000										
6. Coalition	-0.068	-0.068	-0.078	0.094	-0.371	1.000									
7. Greens	0.120	0.053	-0.150	-0.144	0.313	-0.123	1.000								
8. Christian belief	-0.094	-0.054	-0.143	-0.024	-0.096	0.126	-0.075	1.000							
9. Catholic	-0.012	-0.013	-0.046	-0.049	0.038	0.025	-0.008	0.291	1.000						
10. Knowledge: GE	0.280	0.182	0.093	-0.089	-0.011	-0.078	0.019	-0.130	-0.061	1.000					
11. Scientific knowledge	0.376	0.233	0.180	-0.233	-0.026	-0.042	0.042	-0.105	-0.026	0.587	1.000				
12. Scientific world-view	0.154	0.094	0.140	-0.111	0.076	-0.110	0.128	-0.478	-0.065	0.249	0.253	1.000			
13. Goal: Agriculture	-0.145	-0.095	-0.051	0.150	-0.001	0.091	-0.047	0.087	0.037	-0.072	-0.082	-0.019	1.000		
14. Goal: Medical	-0.048	-0.041	0.001	0.066	0.008	0.042	-0.064	0.025	0.026	-0.011	-0.026	0.016	0.425	1.000	
15. Evaluation: GE	-0.028	-0.058	0.059	0.042	-0.012	0.060	-0.124	0.003	0.047	0.012	-0.001	0.102	0.389	0.302	1.000
Mean	11.88	54.27	0.53	45.72	46.91	41.59	49.62	53.39	0.24	63.85	62.23	61.25	85.37	96.04	79.27
Standard deviation	2.96	27.36	0.50	15.21	28.41	23.98	23.76	29.79	0.43	24.79	24.28	18.71	16.67	12.33	15.93

Appendix Table B. Standardized partial regression coefficients. Full equation (first column) and equation including only variables with |t| >3.0 (second column). N=1503. Australia, 1994-95.

Independent variable:	10. Knowledge of genetic engineering		11. Scientific knowledge		12. Scientific world-view		13. Goal: agriculture		14. Goal: Medical		15. Evaluation of genetic engineering	
1. Education	0.24*	0.28*	0.26*	0.32*	0.03		-0.05		0.01		0.05	
2. Status	0.03		0.07		0.04		-0.06		-0.04		-0.06	
3. Male	0.05		0.15*	0.16*	0.08*	0.09*	-0.04		-0.01		0.05	
4. Age	-0.01		-0.15*	-0.13*	-0.10*	-0.11*	0.14*	0.15*	0.06		0.00	
5. Labor Party	-0.05		-0.05		-0.02		0.05		0.05		0.02	
6. Coalition	-0.06		0.00		-0.03		0.07		0.04		0.03	
7. Greens	0.00		0.02		0.09	0.09*	-0.03		-0.07		-0.11*	-0.11*
8. Christian belief	-0.09		-0.06		-0.48*	-0.46*	0.10		0.04		0.02	
9. Catholic	-0.03		0.00		0.08		0.01		0.02		0.03	
10. Knowledge: GE							-0.03		0.00		0.02	
11. Scientific knowledge							0.01		-0.01		-0.02	
12. Scientific world-view							0.08		0.06		0.12*	0.12*
13. Goal: Agriculture											0.32*	0.32*
14. Goal: Medical											0.15*	0.16*
R-squared	0.090	0.078	0.180	0.176	0.261	0.255	0.043	0.023	0.005	0.000	0.196	0.196

* Significantly different from zero, p<.001, two-tailed.