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Technology And Trust: Public Perceptions Of Technological Change In Australia

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Abstract

This article examines how comfortable Australians are in relation to the rate of technological change; how comfortable they are about different technologies; and how much they trust different institutions, organisations and groups in relation to information about technological change. It finds that Australians are mostly comfortable about the rate of technological change. There is no evidence of a 'deep chasm between science and public awareness', as suggested by some observers in relation to western societies. In particular, Australians trust CSIRO, universities, hospitals and scientists for information about new technologies. Apart from age, trust in these groups is the best predictor for feeling comfortable about new technologies. By the same token, there is some evidence of ambivalence, uncertainty, division and possible volatility in relation to public perceptions of technological change. In particular, most Australians are uncomfortable in relation to genetic engineering technologies; some Australians (especially those who are older, and those who have a religious affiliation) are less comfortable with new technologies than others; and most Australians do not trust key institutions such as government, major companies or the media for information about new technologies. Replications of the study in future years will provide an opportunity to explore the robustness of Australians' comfort with technological change, or conversely the volatility of their perceptions.

Key Words: Trust, technological change, public perceptions, biotechnology

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Introduction

From the eighteenth century 'Age of Reason', there is a long history of 'basic faith and optimism in scientific progress'. In the course of the twentieth century, this faith was 'alternatively challenged and revived' (Hiskes and Hiskes 1986: 3). The Great Depression in the 1930s precipitated 'widespread disillusionment' (Hiskes and Hiskes 1986: 7); World War II and the post-war boom fuelled optimism; from the late 1960s nuclear proliferation and hazardous waste engendered strong anti-science ideologies and popular scepticism; and during the 1990s a new wave of technological innovation, especially in the information and communication industries, generated renewed faith.

The movement between faith and disillusion looks like the movement of a pendulum. Yet it is more complicated than this. In general terms, there emerged a more sceptical approach to science and technology in the course of the twentieth century. This was on account of the sheer scale of human intervention upon our material environment. As the English sociologist Anthony Giddens observed, in earlier times human societies experienced risk as 'coming from the outside, from the fixities of tradition or nature'. In contrast, our society 'lives after the end of nature', where risk is 'manufactured', 'created by the very impact of our developing knowledge upon the world' (Giddens 2002: 26). Our world is not more dangerous than was the case in earlier times, but it is one 'where hazards created by ourselves are as, or more, threatening than those that come from the outside' (Giddens 2002: 34). In turn, most people are forced into 'a much more active or engaged relationship with science and technology than used to be the case' (Giddens 2002: 31).

> We cannot simply 'accept' the findings which scientists produce, if only because scientists so frequently disagree with each other, particularly in situations of manufactured risk. And everyone now recognises the essentially mobile character of science. Whenever someone decides what to eat, what to have for breakfast, whether to drink decaffeinated or ordinary coffee, that person takes a decision in the context of conflicting and changeable scientific and technological information. (Giddens 2002: 31)

In this context, there was a growing stream of inquiry concerning public perceptions of science and technology. This stream of inquiry had its beginnings with large-scale public attitude surveys in the 1950s. It became systematic and international during the 1980s and 1990s (Wynn 1995; Kelly 1995). This article addresses public perceptions in the Australian context, drawing upon the Swinburne National Technology and Society Monitor. First, it addresses the issue of trust, a crucial issue in the context of popular scepticism. Second, the article describes the Swinburne National Technology and Society Monitor, a random large-scale survey of the Australian population concerning perceptions of emerging technologies. Third, the article addresses the findings of the Monitor: that is, how 'comfortable' Australians are in relation to technological change, compared with Americans; how comfortable Australians are in relation to different types of technologies, and the factors that make some Australians more comfortable than others; and the extent to which Australians trust different social institutions in relation to information about new technologies, and the role of trust in making some Australians more comfortable than others in relation to new technologies. Finally, the article discusses public perceptions of technological change in contemporary Australia, and the robustness of these perceptions.

Trust

Faith in science and technology during the 1980s and 1990s was heavily fuelled by the information and communication industries, or the so-called 'IT revolution'. During the same period, there also occurred dramatic changes in the life sciences, resulting in growing talk of a 'biotechnology revolution'. Yet biotechnology generated a much more ambivalent public response than the information and communication technologies, presumably because it raised questions about the very nature of our species. It highlighted that public support for emerging technologies – not just in life sciences, but also in IT (say, with the spread of child pornography on the Internet), cybernetics and nanotechnology - could not be taken for granted. It also highlighted the importance of trust in underpinning public support for emerging technologies.

Consider, for example, the enduring controversy around genetically engineered (GE) foods. At the beginning of the 1990s, the agricultural biotechnology giant Monsanto considered going down the path of closer government regulation in the industry, including labelling requirements for GE products. A leadership change in the company meant that it decided against this path, on the grounds that there was no scientific evidence of health risks from GE foods. American farmers took up the new GE products, and American consumers did not for the most part object. A radical environmentalist opposition, though, did take shape in North America. In the European Union, opposition was more broad-based, culminating in legislation that insisted upon labelling requirements. US farmers had no way of differentiating between their modified and unmodified crops, locking them out of the European market. In turn, they cut back their planting of GE crops and turned their anger against Monsanto.

The UK sociologist Alison Pilnick has explained the different trajectory of public opinion in the US and Europe in terms of recent food scares, in particular the outbreak of BSE (bovine spongiform encephalopathy) in the UK.

> This has led to a public lack of trust in food production generally, and a reluctance to believe assurances from scientists that technologies are safe, when these same assurances were given with BSE. Critics and consumer groups have become sceptical of the reliability of safety assessments procedures and the judgements of expert committees. (Pilnick 2002: 133)

The fact that BSE in the UK was associated with the deregulation of the feed industry had also destroyed public trust in commercially driven enterprises. Cost cutting in animal feed had resulted in cows being fed infected materials from dead animals. The presumption of trust that existed before BSE had been destroyed, leading to low trust in relation to GE technologies and biotechnology companies.

In more general terms, the Canadian biologist Mark Winston - in his book Travels in the Genetically Modified Zone - attempted to explain the opposition campaign against GE foods in both North America and the United Kingdom. Winston was cautious about the science of GE crops, but fundamentally sympathetic. Given the 'so-far clean bill of health for bioengineered crops and their positive economic benefits', he believed that the opposition campaign 'should not have been so successful'. More than this: 'the vast public relations resources of industry and government' should have been more than enough to counter the savvy but financially constrained protest movement (Winston 2002: 127-8). Winston concluded that the 'blatantly self-serving attitudes of industry' in introducing the new technology with minimal independent testing or regulation eroded public confidence:

> Biotechnology opponents have grasped one simple public relations fact considerably better than industry. Science and data cannot substitute for actions and statements that engender trust. (Winston 2002: 129)

In other words, public opinion is not based only on the science of a new technology. It is grounded in social context, which varies from one country to another. It also depends heavily upon the way in which the science of a new technology is articulated into politics and social practice. Public opinion can trip up a new technology in which billions of dollars have been invested. Companies and governments are increasingly recognising that they cannot afford to hold public opinion in contempt.

As a result of the GE foods controversy, there is now much more awareness of the volatility of public opinion and the importance of trust. There is a danger, though, that this will lead to a fairly cynical approach to social science research and public relations. For example, the ethicist Robert Dingwall has observed how companies are now incorporating 'social and ethical aspects' into their research programs as a form of 'defensive practice', or 'insurance' against adverse outcomes (Dingwall 2002: 170-1). Mark Winston calls for a more radical approach:

> We have made considerably greater progress in achieving scientific breakthroughs than we have in managing the chaotic controversies that swirl around them. The biotechnology experience has revealed a deep chasm between science and public awareness, a divide that will not be bridged until we learn to conduct informed public discussion with the same rigor, creativity, and skill with which we invent new technologies. (Winston 2002: 256)

More generally, Anthony Giddens has observed that the communications revolution demands a 'deepening of democracy', encouraging disclosure, transparency and engagement. The alternative is an anti-scientific outlook, already evident in religious revivalism, New Age philosophies and some parts of the ecology movement. In his words:

> We do not currently possess institutions which allow us to monitor technological change, nationally or globally. The BSE debacle in Britain and elsewhere, might have been avoided, if a public dialogue had already been established about technological change and its problematic consequences. More public means of engaging with science and technology wouldn't do away with the quandary of scaremongering versus cover-ups, but it might allow us to reduce some of its more damaging consequences. (Giddens 2002: 35)

The Current Study

The main vehicle for research on public perceptions of science and technology has been large-scale public surveys. In the Australian context, this line of research has mainly addressed biotechnology (Kelley 1995; Biotechnology Australia 2001). The general drift of these surveys was that Australians were mostly supportive of biotechnology and genetic engineering, albeit with some reservations. There is a vigorous critique of such surveys, arguing that they are essentially conducted or funded by government and corporate organisations as 'defensive practice'. More specifically, they are 'blunt instruments', serving 'to construct public opinion in a way that legitimates the commercialisation of biotechnology without necessarily enabling effective public debate' (Davison, Barns and Schibeci 1997: [2]).

In April and May 2003 the Australian Centre for Emerging Technologies and Society (ACETS) conducted quantitative and qualitative studies – entitled the Swinburne National

Technology and Society Monitor - concerning public perceptions of emerging technologies in Australia. The Monitor was intended as a contribution towards a more informed understanding of 'public awareness' about new technologies, in the spirit of building 'more public means of engaging with science and technology' (Giddens 2002:35). Notwithstanding the critique of surveys, the Monitor included a large-scale survey in order to grasp general attitudinal patterns in Australian society. The authors took care to frame the survey in a way that would take uncertainty, ambivalence, volatility and diversity into account. They also took care to explore the issue of trust, including trust in government and corporate organisations. It is intended that the survey will provide the basis for longitudinal analysis (through comparison with future surveys) and more detailed qualitative analysis (see Turney et al. 2003).

This article reports on that part of the large-scale survey concerned with how 'comfortable' Australians are in relation to technological change, and how much they trust different institutions for information concerning emerging technologies. The survey involved a random sample of 1044 Australians over the age of 18 years (amounting to about 30% of those contacted), conducted through the ACETS Computer Assisted Telephone Interviewing (CATI) facility. Overall, the sample was representative of all Australian states and territories as measured by the 2001 Census. It was also representative in terms of employment status and median income. Women and older Australians were over-represented in the sample, reflecting the fact that these groups were more likely to be at home to answer the telephone. The sample was also more educated than the general population, perhaps reflecting the greater willingness of educated respondents to participate in a survey on attitudes towards new technologies.

Respondents were asked six questions designed to measure their overall orientation towards technological change. One of these questions, following a US survey conducted a year earlier (by the Center for Science, Policy and Outcomes at Columbia University), asked respondents about how comfortable they were with the overall rate of technological change. Respondents were required to rate their degree of comfort on a scale from 0 (not at all comfortable) to 10 (very comfortable). The remaining five questions presented respondents with a statement, where they indicated whether they agreed or disagreed on a scale from 0 (strongly disagree) to 10 (strongly agree). The statements were:

- Scientists have too much control over nature.
- Science and technology can solve most problems faced by human beings.
- Science and technology are continuously improving our quality of life.
- It is important for governments to regulate new technologies.
- Science and technology are out of control, and beyond the control of governments.

Respondents were also asked to rate on a 10 point scale how 'comfortable' they were in relation to 11 specific technologies, ranging from relatively established technologies (for example, mobile phones and the Internet) to ones that are still speculative (for example, cloned human babies and drugs for enhancing female sexual function). These technologies included:

- Mobile phones
- The Internet

- Drugs for reducing social anxiety
- Genetically engineered plants for food
- Genetically engineered animals for food
- Cloned human babies
- Using animals to grow human organs for transplant
- Stem cell research using left over IVF embryos
- Stem cell research using tissue from adults
- Drugs for enhancing male sexual function, such as Viagra
- Drugs for enhancing female sexual function.

Respondents were also asked to rate their trust in a variety of institutions, organisations and groups; more specifically how much they could trust them 'for information about new technologies, such as genetically modified foods and stem cell research'. In this instance we adopted a different scale from the rest of this survey – from 0 (don't trust at all) to 5 (trust a very great deal) – in order to enable comparisons with the International Social Science Survey Australia. Respondents rated their trust in the following institutions, organisations and groups:

- The federal government
- Major Australian companies
- Universities
- The media
- Small business
- The churches
- The environmental movement
- The public service
- Scientists
- State government
- The churches
- CSIRO
- Trade unions
- Hospitals

Finally, we asked respondents about a variety of demographic and personal questions, designed to identify the different 'publics' that feel more or less comfort in relation to technological change. These variables included gender, age, employment status, occupation, income, country of birth, parents' country of birth, state, voting behaviour, religion, religiosity (or active participation in religious activity), marital status, computer and Internet use, and life satisfaction.

Comfort With The Rate Of Technological Change

Australian respondents barely differed from those in the US survey in terms of their mean comfort with the rate of technological change (see Table 1). In the US the mean score was 6.82 (Columbia University 2002), and in Australia it was 6.90. At the same time, the distribution of responses across the two countries was somewhat different. There was more variation - or less agreement - in the US than there was among Australians (as reflected in the standard deviations). More specifically, US respondents were more likely than Australians to nominate values at either extreme of the scale. Of the US respondents, 4.9% nominated 0 ('not at all comfortable) and 20.3% nominated 10 ('very comfortable'), whereas only 1.8% of Australian respondents nominated 0 and only 11.8% nominated 10. The mode (that is, the most commonly expressed value) for US respondents was 10, compared with 8 for the Australian sample (nominated by 25.3% of respondents).

Table 1: Comfort with the overall rate of technological change in US 2002 and Australia 2003: 0 = Not at all comfortable, and 10 = Very comfortable.

	US Survey 2002	**Australian Survey 2003**
Mean	6.82	6.90
Standard deviation	2.69	2.16
Mode	10	8
Percentage 'not at all comfortable'	4.9	1.8
Percentage 'very comfortable'	20.3	11.8

Sources: Columbia University (2002), Genie National Project Study for US data; Swinburne National Technology and Society Monitor for Australian data.

Given that most Australian respondents indicated that they were comfortable – in some measure – with the rate of technological change, it is not surprising that the majority of respondents also agreed with the statement 'Science and technology are continuously improving our quality of life'. The mean response to this question was 7.1, and the mode (chosen by almost one-quarter of respondents) was 10 (see Table 2).

Table 2: Attitudes concerning science and technology in Australia 2003: 0 = Strongly disagree, and 10 = Strongly agree.

	Mean	Standard Deviation	Strongly Agree (%)	Strongly disagree (%)	Mode (incl. %)
(1) Scientists have too much control over nature.	5.2	2.77	9.2	8.2	5 (24.6)
(2) Science and technology can solve most problems faced by human beings.	4.9	2.81	7.4	10.7	5 (24.0)
(3) Science and technology are continuously improving our quality of life.	7.1	2.47	23.3	2.9	8 (17.7)
(4) It is important for governments to regulate new technologies.	7.6	2.42	31.8	2.4	10 (32.8)
(5) Science and technology are out of control, and beyond the control of governments.	4.9	2.75	6.3	11.2	5 (25.5)

At the same time, respondents were much more ambiguous in their responses to three statements: namely, ‘scientists have too much control over nature’; ‘science and technology can solve most problems faced by human beings’; and ‘science and technology are out of control, and beyond the control of governments’. In each instance, the mean was very close to 5, and the mode was 5. Moreover, most respondents agreed with the statement ‘It is important for governments to regulate new technologies’. The mean response here was 7.6, and the mode (chosen by almost one-third of respondents) was 10.

Briefly, the findings suggest optimism in relation to science and technology, but not unqualified optimism. The optimism is tempered by uncertainty, or perhaps ambivalence: hence a strong commitment to regulation by governments.

Comfort With Different Technologies

In the Australian survey, we proceeded to discriminate on the basis of comfort with different types of technology. Altogether we identified 11 distinct technologies, ranging from those that were well established to those that were highly speculative. Further analysis (a principal components analysis using oblique rotation) identified four clear factors or groups of technologies (see Table 3 for factor loadings). That is, there were four main patterns whereby respondents who were comfortable with one technology (say, mobile phones) were also likely to be comfortable with another technology (say, the Internet). The groups of technologies were as follows:

1. Mobile phones and the Internet (labelled 'communication technologies');
2. Stem cell research using adult tissue and stem cell research using leftover IVF embryos (labelled 'stem cell technologies');
3. Drugs for enhancing female sexual performance, drugs for enhancing male sexual performance, and drugs for reducing social anxiety (labelled 'pharmaceutical technologies');
4. Using animals to grow human organs for transplant, genetically engineered animals for food, genetically engineered plants for food, and cloning human babies (labelled 'biological engineering technologies').

Given the association between these questions, we computed total scores by averaging each question for each factor, thereby obtaining total mean comfort scores for communication technologies, stem cell technologies, pharmaceutical technologies and biological engineering technologies. Australians were most comfortable with communication technologies, followed by stem cell research, pharmaceutical and biological engineering technologies (see Table 3). Comparison of the four mean scores revealed that these differences were statistically significant and strong (that is, all F statistics comparing adjacent means in order from highest to lowest were significant at $p<.001$ and effect sizes ranged from .05 to .81).

Australians were very comfortable with the 'established' communication technologies; slightly more so the Internet (with a mean score of 7.8) than mobile phones (7.5) (see Table 4). Only a small proportion of respondents nominated 0 for these technologies; 4.0% for the Internet, and 3.3% for mobile phones. The mode for both of these technologies was 10: more than one-third of respondents were 'very comfortable' with the Internet, and a little under one-third were 'very comfortable' with mobile phones.

Table 3: Factor loadings, Eigenvalues, means and standard deviations for questions about different technologies: Australia 2003

	Factor loading			
Technology	Communication	Stem cell	Pharmaceutical	Genetic engineering
The Internet	**0.85**	0.04	-0.04	-0.05
Mobile phones	**0.86**	-0.04	0.01	0.06
Stem cell research using tissue from adults	0.02	**0.89**	-0.02	-0.09
Stem cell research using left-over IVF embryos	-0.01	**0.84**	-0.01	0.05
Drugs for enhancing female sexual function	0.04	-0.06	**-0.98**	-0.04
Drugs for enhancing male sexual function, such as Viagra	0.02	-0.06	**-0.97**	-0.01
Drugs for reducing social anxiety	-0.04	0.18	**-0.46**	0.08
Genetically engineered plants for food	0.01	-0.08	-0.04	**0.87**
Genetically engineered animals for food	-0.09	-0.02	-0.01	**0.92**
Using animals to grow human organs for transplant	0.03	**0.41**	-0.07	**0.40**
Cloning human babies	0.14	0.07	0.02	**0.50**
Eigenvalue	1.22	1.02	1.36	3.93
Mean	7.68	6.24	5.30	3.05
Standard deviation	2.20	2.84	2.56	2.09

Note: Bolded values are significant. Factor loadings at or above .35 were significant. Means and standard deviations are calculated by averaging comfort scores for each item loading on each factor. N = 807. Unsure responses were treated as missing data.

The majority of respondents were also relatively comfortable with stem cell technologies; the mean score for stem cell research using tissue from adults was 6.8, and the mean for stem cell research using leftover IVF embryos was 5.7. The mode for both of these technologies was again 10 (nominated by 21.2% and 17.5% respectively). At the same time, the second most commonly nominated value in relation to stem cell research using leftover IVF embryos was 0, nominated by 16.2% of respondents. In other words, the mean rating of 5.7 indicated strong commitments to competing viewpoints – and polarisation – in relation to stem cell research using leftover IVF embryos.

The majority of respondents were also comfortable with pharmaceutical technologies, although less so than for stem cell research. The mean score for drugs that enhance female sexual function – which are not currently available – was 5.5: the mode was 5, nominated by 22.5% of respondents. The mean score for drugs that enhance male sexual function – which are currently available on the market – was 5.4: the mode was again 5, nominated by 21.9% of respondents. The mean score for drugs that reduce social anxiety – which are also currently available on the market – was 5.1: the mode was also 5, nominated by a

resounding 57.5% of respondents. Compared with stem cell research using leftover IVF embryos, the mean scores for pharmaceutical drugs reflected convergence around the midpoint of the scale, rather than opposing commitments to extreme positions. This may indicate ambivalence among respondents, or uncertainty, or indifference.

Table 4: Attitudes concerning science and technology in Australia 2003: 0 = Strongly disagree, and 10 = Strongly agree.

	Mean	Standard Deviation	Not at all comfortable (%)	Very comfortable (%)	Mode (incl. %)
The Internet	7.8	2.55	4.0	34.2	10 (34.2)
Mobile phones	7.5	2.56	3.3	29.3	10 (29.3)
Stem cell research using tissue from adults	6.8	2.85	6.3	21.2	10 (21.2)
Stem cell research using left-over IVF embryos	5.7	3.50	16.2	17.5	10 (17.5)
Drugs for enhancing female sexual function	5.5	3.09	11.7	13.9	5 (22.5)
Drugs for enhancing male sexual function, such as Viagra	5.4	3.03	11.8	11.6	5 (21.9)
Drugs for reducing social anxiety	5.1	2.84	10.6	6.8	5 (57.5)
Using animals to grow human organs for transplant	4.4	3.16	20.9	6.9	0 (20.9)
Genetically engineered plants for food	4.0	3.10	22.9	4.4	0 (22.9)
Genetically engineered animals for food	2.8	2.86	34.2	3.1	0 (34.2)
Cloned human babies	1.0	2.04	68.4	.9	0 (68.9)

The majority of respondents in this survey were not comfortable with biological engineering technologies. The mean score for using animals to grow human organs for transplant was 4.4; for genetically engineered plants for food it was 4.0; for genetically engineered animals for food it was 2.8; and for cloning human babies it was 1.0. In each instance the mode was 0. In the case of using animals to grow human organs for transplant and genetically

engineered plants for food, roughly one in five respondents nominated 0; in the case of genetically engineered animals for food roughly one in three nominated 0; and in the case of cloning human babies, more than two in three nominated 0. In turn, the distribution of responses varied substantially. In the case of using animals to grow human organs for transplant, ratings were fairly evenly distributed across the range of possible responses; in the case of genetically engineered plants for food, there was some indication of polarised views; in the case of genetically engineered animals for food and cloning human babies, discomfort was unambiguous, with progressively less respondents nominating the higher values. Only 3.1% of respondents were 'very comfortable' with genetically engineered animals for food, and less than 1% were 'very comfortable' with cloning human babies.

Latent cluster analysis (Magidson and Vermunt 2003) identified homogenous groups of respondents exhibiting different patterns of comfort across the four types of technologies. There were three distinct patterns or categories of comfort scores. The first category consisted of 44% of the respondents, the second 37% and the third, 19%. All three categories demonstrated a similar pattern to the whole sample in that they were all most comfortable with communication technologies and least comfortable with genetic engineering (see Figure 1). At the same time, the respondents in Category 1 were significantly less comfortable about all four technologies than the other two categories of respondents. The only distinction between Categories 2 and 3, on the other hand, was that the respondents in Category 3 were significantly more comfortable than those in Category 2 with communication technologies. Category 1 was therefore labelled the 'Uncomfortable' group, Category 2 the 'Comfortable' group, and Category 3 the 'Very Comfortable' group.

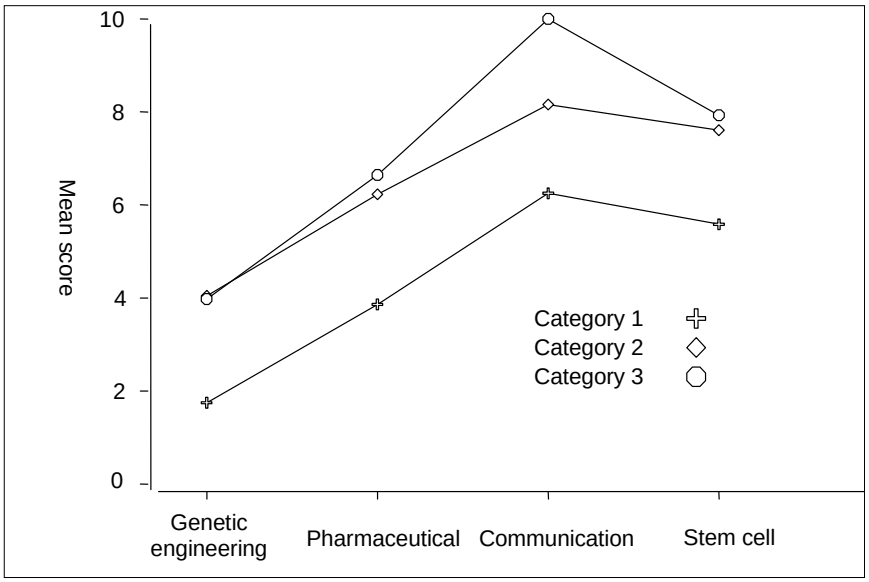

Figure 1: Mean comfort with technology scores by category: Australia 2003.

Note: The three categories were found to differ mostly on comfort with communication technology ($\eta 2$ = .44), followed by comfort with genetic engineering ($\eta 2$ = .32), comfort with stem cell research ($\eta 2$ = .27) and comfort with pharmaceutical technologies ($\eta 2$ = .25).Partial eta –squared (i.e. $\eta 2$) represents the proportion of variation in the comfort score which is explained by the group differences. For example, 44% of the variation in comfort with communication technologies is explained by the three categories.

A demographic analysis indicates that there were significant differences between the three groups based upon gender, age, marital status, education, religious affiliation and life satisfaction (see Table 5). Given that many of the demographic variables were correlated (for example, age and marital status, gender and marital status, gender and religion, age and religion), we undertook further analyses to assess the unique impact of each demographic variable on the comfort with technology categories. This made it possible to fine-tune our analysis, isolating the underlying variables that influenced comfort with new technologies. The variables of gender, age, education, religious affiliation and life satisfaction were used to predict category membership using Latent class cluster analysis. Marital status was excluded from the analyses, given the small numbers of men and younger people in the widowed category.

The analysis indicated that age (Wald = 25.66, $p<.001$), religious affiliation (Wald = 21.89, $p<.001$), life satisfaction (Wald = 22.00, $p<.001$), education (Wald = 18.82, $p<.001$) and gender (Wald = 11.76, $p<.005$) – in that order - all had a unique and significant influence on comfort with technology. More specifically, respondents who were young male graduates, had no religious affiliation and were relatively satisfied with their lives were most likely to be comfortable with new technologies. Conversely, elderly women who left school before year 12, had a religious affiliation and were relatively dissatisfied with their lives were most likely to be uncomfortable with new technologies.

At the same time, it should be noted that gender had only a small effect on comfort with technology. A large part of the gender effect (evident in Table 4) was in fact an expression of the fact that women were more likely to be religious and have left school before year 12. (It was not an expression of life satisfaction or age, which did not differ significantly by gender in this survey.) Even so, there was still an independent gender effect, whereby women were less comfortable with new technologies irrespective of religion and education.

Trust In Australian Institutions

Following consideration of different technologies, we asked respondents to identify the extent to which they trusted different institutions, organisations and groups in relation to information about new technologies. Principal components analysis using oblique rotation identified three main groups of responses among the 13 trust questions (see Table 6). That is, there were three main patterns whereby respondents who trusted one institution (say, universities) were also likely to trust another institution (say, hospitals). The groups were as follows:

1. Scientists, CSIRO, universities, hospitals;
2. Federal government, the churches, state government, major Australian companies, the media, the public service, small business, the media;
3. The environment movement, trade unions.

The common theme of the first group is that they are all grounded in higher education and organised on a ‘professional’ basis. They include the public institutions of science, funded by government but nonetheless relatively autonomous. The second group of institutions consists of the instruments of business, government and the church – all forms of constituted authority or ‘governance’ (albeit some more so than others). The third group consists of institutions that are ‘oppositional’ to the status quo in some measure. Accordingly, the categories were labelled ‘professional institutions’, ‘governance institutions’ and ‘oppositional institutions’ respectively. As

with the comfort questions described above, scores were averaged to obtain three trust factors; trust in professional institutions, trust in governance institutions, and trust in oppositional institutions.

Table 5. Probability of category membership (for comfort with technology) by demographic variables: Australia 2003

	Probability of category membership		
	Uncomfortable (.44)	Comfortable (.37)	Comfortable – communication (.19)
Gender			
Males	.37[a]	.43[a]	.20
Females	.47	.34	.19
Education			
Less than year 12 secondary school	.57[b]	.30	.13[b]
Year 12 secondary school	.38	.42	.19
TAFE diploma or certificate	.43	.37	.20
University degree or diploma	.37	.40	.24[b]
Postgraduate degree	.34	.40	.26[b]
Marital status			
Never married	.39	.40	.22
Currently de facto	.35	.45	.19
Currently married	.35	.42	.19
Divorced or separated	.54[c]	.26[c]	.20
Widowed	.65[c]	.20[c]	.14
Religion			
No religion	.31	.43	.26
Christian	.48[d]	.35	.17
Non Christian	.40	.40	.20
	Mean		
Decade born	4.68[e]	5.22	5.38
Life satisfaction	7.77	7.82	8.37[e]

Note: a = Significantly different from females at p<.001, $\eta 2$ for uncomfortable and comfortable categories = .01. b = Significantly different from all other education groups at p<.05, $\eta 2$ for uncomfortable category = .04, $\eta 2$ for comfortable communication category = .01 c = Significantly different from all other marital status groups at p<.001, $\eta 2$ for uncomfortable category = .04, $\eta 2$ for comfortable category = .03. d = Significantly different from Non Christians and other religion groups at p<.001, $\eta 2$= .03. e= Mean was significantly different from all other clusters at p<.001, $\eta 2$. for age = .03, $\eta 2$. for life satisfaction was = .02, Life satisfaction was scored from 0 = 'Not at all satisfied with my life' to 10 = 'Very satisfied'. Decade born ranged from 1 = 'Before 1920' to 8 = '1980 or after'; 4 corresponds to ''1940-49', and 5 corresponds to '1950-59'.

A large majority of Australians trusted the professional institutions that are directly involved in the development of new technologies (see Table 7). The most trusted institution was the

CSIRO (with a mean rating of 3.78), followed by universities (3.68), hospitals (3.61) and then scientists (3.36). More than one in four Australians trusted CSIRO 'a very great deal'; more than one in five trusted universities and hospitals 'a very great deal'; and the mode for CSIRO, universities and hospitals was 4 (nominated by roughly two in five respondents).

Table 6. Factor loadings, Eigenvalues, means and standard deviations for questions about trust: Australia 2003.

	Factor loading		
Question	Professional	Governance	Oppositional
CSIRO	**-.79**	-.04	-.05
Universities	**-.65**	-.04	.30
Hospitals	**-.63**	.14	-.02
Scientists	**-.80**	.03	-.04
Small business	-.09	**.46**	.07
The public service	-.12	**.48**	.33
The churches	.24	**.76**	-.03
State government	-.14	**.58**	.18
Federal government	-.20	**.76**	-.32
Major Australian companies	-.21	**.53**	.09
The media	-.05	**.50**	.18
The environmental movement	.00	-.02	**.83**
Trade unions	-.03	.12	**.72**
Eigenvalue	1.22	4.49	1.17
Mean	2.40	3.61	2.47
Standard deviation	.87	.83	1.19

Note: Bolded values are significant. Factor loadings at or above .35 were significant at $p<.05$. Means and standard deviations are calculated by averaging trust scores for each item loading on each factor.

Respondents trusted CSIRO, universities and hospitals more than they trusted scientists. Only 13.9% of respondents trusted scientists 'a very great deal', while the mode was 3. The implication is that the institutions of science on their own are not enough for many people: organisational context makes a difference. That is, respondents trusted a scientist in CSIRO more than they trusted a scientist who worked for a private company.

Although the professional institutions were the most trusted sources of information about new technologies, the pattern in relation to governance and oppositional institutions did not follow such a coherent pattern. After the professional institutions, the most trusted institutions were those of small business (with a mean score of 3.13), from the governance group; then, the environmental movement (2.82), from the oppositional group; and then the public service (2.55), another of the governance institutions.

All other institutions scored a mean below 2.5, indicating that they were not generally trusted for information concerning new technologies. In order, these institutions were the churches (with a mean of 2.39), state government (2.39), federal government (2.36), major companies (2.33), trade unions (2.10) and the media (1.64). In each of these instances, more people nominated 0 ('don't trust at all) than 5 ('trust a very great deal'). The mode for the churches, state government, federal government and major companies was 3; for trade unions and the media it was 2. Trust in the media was especially dismal. Almost one in four respondents did not trust the media at all. In this connection, it should be emphasised that just because people say that they do not trust the media (or any other institutions) does not necessarily

mean that they act on this basis: indeed our qualitative study of DNA paternity testing found that participants depended almost completely upon media information, and largely took this information at face value (Turney et al. 2003).

Table 7: Trust in institutions, organisations and groups concerning information about new technologies in Australia 2003: 0 = Don't trust at all, and 5 = Trust a very great deal.

	Mean	Standard Deviation	Don't trust at all (%)	Trust a very great deal (%)	Mode (incl. %)
CSIRO	3.78	1.09	1.8	26.9	4 (40.5)
Universities	3.68	1.04	1.6	20.8	4 (42.5)
Hospitals	3.61	1.11	2.6	20.6	4 (38.9)
Scientists	3.36	1.09	2.1	13.9	3 (36.8)
Small business	3.13	1.27	4.6	14.3	3 (34.4)
Environmental movement	2.82	1.42	9.4	11.9	3 (29.8)
Public service	2.55	1.29	9.2	6.3	3 (35.0)
Churches	2.39	1.53	16.7	8.9	3 (24.8)
State government	2.39	1.34	11.6	5.5	3 (32.6)
Federal government	2.36	1.40	13.2	6.3	3 (29.6)
Major companies	2.33	1.31	12.0	4.8	3 (33.1)
Trade unions	2.10	1.48	17.6	5.4	2 (28.5)
The media	1.64	1.27	24.5	1.7	2 (29.3)

In order to examine whether trust in the various institutional groups was associated with level of comfort in technology, the three trust factors were used to predict membership in the categories of 'Uncomfortable', 'Comfortable' and 'Very Comfortable'. The results showed that those who trusted professional institutions were much more likely to belong to the 'Comfortable' categories (Wald = 31.90, $p<.001$); those who trusted governance institutions were somewhat more likely to belong to the 'Uncomfortable' category (Wald = 18.67, $p<.001$); while those who trusted oppositional institutions were neither more nor less likely to belong to any of the categories. Further analyses controlled for the demographic variables that were strongly and independently correlated with membership of the different categories – age, religious affiliation, education and life satisfaction. In these circumstances, trust in 'professional' institutions remained significantly and strongly associated with

comfort in relation to new technologies (Wald = 29.80.73, $p<.001$). Indeed, apart from age of the respondents (Wald = 33.26, $p<.001$), trust was the strongest contributor to comfort levels, followed by religious affiliation (Wald = 26.01, $p<.001$), education (Wald = 23.32, $p<.001$), life satisfaction (Wald = 20.63, $p<.001$), gender (Wald = 11.06, $p<.05$), and finally trust in governance institutions (Wald = 7.68, $p<.05$).

The strong relationship between trust in professional institutions – or the public institutions of science - and feeling comfortable about new technologies is not surprising. It is consistent with the proposition that public support for new technologies depends upon trust in public institutions. The negative relationship – albeit a weak one - between trust in governance institutions and feeling comfortable about new technologies is more curious. It highlights that

the articulation between trust and comfort with new technologies is not straightforward, and warrants closer scrutiny. In the meantime, here is a suggestion. It may be that some people who feel unnerved by the rate of change in contemporary society seek refuge in established structures of authority. If this is the case, then a 'deepening of democracy' – as advocated by Giddens – will not necessarily provide reassurance. By the same token, it may contribute towards more trust in established structures of authority, notably government and major companies, thereby generating more confidence in technological change overall.

Public Perceptions Of Technological Change In Australia

In general terms, Australians are comfortable with the current rate of technological change. The mean level of comfort in Australia is roughly the same as in the US, although there are fewer Australians who are 'very comfortable' and 'not at all comfortable' about the rate of change. At the same time, most Australians are qualified in their comfort regarding science and technology. There is some evidence of uncertainty, ambivalence, division and possible volatility. Australians are sometimes polarised around new technologies (notably stem cell research using leftover IVF embryos), sometimes uncertain (for example, in relation to drugs for social anxiety), and sometimes uncomfortable (for example, in relation to genetically engineered crops and animals). Most Australians strongly support government regulation of new technologies.

In this context, Australians trust some institutions for information about new technologies much more than others. They trust CSIRO, universities and hospitals a good deal. They are somewhat trusting of scientists, small business, the environmental movement and the public service. They do not – on the whole - trust state governments, churches, federal government, major companies, trade unions or the media. The lack of trust for government is striking, given the strong commitment to government regulation. The lack of trust for the media is also striking, given reliance upon the media for information about new technologies. Again, it suggests uncertainty, ambivalence and possible volatility.

Australians who trust professional institutions, organisations and groups - CSIRO, universities, hospitals and scientists – are especially comfortable in relation to new technologies generally. This variable was more significant than any other tested in this study, except for age. Religious affiliation, education and life satisfaction (in order) also contributed towards comfort in new technologies. Gender had a significant but small effect; ethnicity, occupation and income had no significant effect at a general level.

This study does not provide evidence of a 'deep chasm between science and public awareness', as described by Winston. By the same token, it leaves no doubt that public perceptions are complex and variegated, and cannot be taken for granted. It also leaves no doubt about the importance of trust in relation to technological change. Trust in the public institutions of science is especially important. Replications of the study in future years will provide an opportunity to explore the robustness of this trust, and the robustness of Australians' comfort with technological change.

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