



Australian
National
University



THE AUSTRALIAN BELIEFS AND
ATTITUDES TOWARDS SCIENCE SURVEY
AUGUST 2017

Australian National Centre for
Public Awareness of Science



Australian Government
**Department of Industry,
Innovation and Science**



**Australian
National
University**

AUSTRALIAN NATIONAL CENTRE FOR
THE PUBLIC AWARENESS OF SCIENCE

This survey was funded by the Department of Industry, Innovation and Science (DIIS). The research was designed and conducted by Dr Rod Lamberts and the report prepared at The Australian National Centre for the Public Awareness of Science (CPAS) at The Australian National University.

Preferred citation

Lamberts, R (2017) *The Australian Beliefs and Attitudes Towards Science Survey*. The Australian National University. Canberra, Australia

CONTENTS

Introduction	3
Key findings	4
Results – descriptive statistics	5
Defining science for the survey	5
Day-to-day STEM use at work	5
Interest in popular topics	5
Responses to general statements about science	6
Conversations about science	6
International comparisons	7
How Australian science compares to the rest of the world	7
Childhood vaccination	7
Appropriate use of medical technology	7
Food safety	8
Support for scientific advances	8
<i>Animals in scientific research</i>	8
<i>Nuclear energy</i>	8
<i>Fracking</i>	8
<i>GM plants to replace gasoline</i>	8
<i>Early access to drugs before complete clinical trials</i>	8
Climate change	9
People who say there is solid evidence the earth is getting warmer	9
People who say there is NO solid evidence the earth is getting warmer	9
Contribution and prestige of professions	9
Contribution	10
Prestige	10
The relationship between contribution and prestige	11
What science has done, and what it will do	11
What science HAS done	12
What science WILL do	12
Associations between key attitudes, beliefs and demographics	13
Sex Differences	13
How informed do you feel about science?	13
How has science affected our lives?	13
Approval and appropriateness of scientific and medical advances	13
Food Safety	13

How informed do you feel about science?	13
Level of education	13
How has science affected our lives?	13
Climate change	14
Approval and appropriateness of scientific and medical advances	14
Food Safety	14
Conversations about science	14
Frequency of science conversations	14
<i>Level of education</i>	14
<i>How has science affected our lives?</i>	14
<i>Climate change</i>	14
<i>Approval and appropriateness of scientific and medical advances</i>	15
<i>Food Safety</i>	15
Positivity of science conversations	15
<i>Level of education</i>	15
<i>How has science affected our lives?</i>	15
<i>Climate change</i>	15
<i>Approval and appropriateness of scientific and medical advances</i>	15
<i>Food Safety</i>	15
Education level	15
How has science affected our lives?	15
Climate change	16
Approval and appropriateness of scientific and medical advances	16
Food Safety	16
Appendix A–Data collection and sampling strategy	17
Demographics	17
Sex	17
Age	17
Household pre-tax income	18
Country of birth	18
Education	18
Employment	19

INTRODUCTION

This report provides an overview of the results of the Department of Industry, Innovation and Science-Centre for the Public Awareness of Science Australian Beliefs and Attitudes towards Science Survey (ABAS).

The ABAS both updates and expands upon a seven year old Australian national survey of public opinion about science (Lamberts *et. al.* 2010).¹ It also provides original Australian data to allow for international comparisons on some key questions from a recent US national survey (Pew Research Center, 2015)².

In this report, analyses from the ABAS' nationally representative sample of Australian adults are presented. The earlier sections of the report present the frequencies of the main findings of the survey. Where pertinent, comparisons to the 2010 ANUpoll, the 2015 Pew data and occasionally to the most recent ANUpoll focussing on innovation, science and business (Sheppard & Gray, 2017)³ are made.

The final part covers significant associations between key characteristics of respondents and their beliefs and attitudes towards science and science-related questions and statements.

1 Lamberts, R., Grant, W.J & Martin, A (2010) Public opinion about science. ANUpoll No.8, Canberra, The Australian National University. http://politicsir.cass.anu.edu.au/sites/politicsir.anu.edu.au/files/2010-12-07_ANUpoll_science_0.pdf

2 Pew Research Center, January 29, 2015, "Public and Scientists' Views on Science and Society" <http://www.pewinternet.org/2015/01/29/public-and-scientists-views-on-science-and-society/>

3 Sheppard, J & Gray, M, (2017) Australian Innovation, Science, and Business: Attitudes to Government Support. ANUpoll No.23, Canberra, The Australian National University http://politicsir.cass.anu.edu.au/sites/politicsir.anu.edu.au/files/ANUpoll_23_Innovation-Science_Business.pdf

KEY FINDINGS

The *Australian Beliefs and Attitudes Towards Science Survey* provides many reasons to feel encouraged about the Australian public's beliefs about, and attitudes towards, science. Overall, these results show that the majority of people are positively inclined towards science (and science, technology, engineering and mathematics (STEM) more broadly) and are having some kind of science-related conversations regularly.

Provisional comparisons with the most comparable Australian survey, the 2010 ANUpoll (Lamberts *et. al.*, 2010), have revealed both similarities and changes in public beliefs and attitudes about science over the last seven years. International comparisons with United States (US) respondents demonstrate some clear differences between Australian and US publics on science related issues.

Our relationship with science-related matters is not simple, and many Australians are at least wary of some of the past and potential undertakings conducted under the auspices of science. While most of us think the benefits of science have outweighed the harmful effects, and also that overall science has made our lives easier, still around half of us think science has made our way of life change too fast. Our confidence in GM foods and food grown with pesticides is not uniform across the population, many of us are against fracking and nuclear energy and are also suspicious about the potential of bioengineering.

Australians overwhelmingly consider scientists to be people who, along with doctors and farmers, contribute enormously to society, but many are also aware that the relative prestige of science as a profession does not match this high level of contribution.

Australians are generally positive about science and are clearly still interested in science or science-related topics above all others. The majority of Australians feel fairly well, or very well, informed about science and this has increased since 2010.

This links to an emerging pattern in the ABAS: the more informed people feel they are about science, the more likely they are to be broadly positive about it. Note though, this is how informed people *believe* or *feel* themselves to be, not an indicator of how much science they actually 'know'.

While the results suggest that higher levels of education in general are also somewhat associated with feeling more informed, the relationships revealed here are more nuanced and do not simply suggest that 'more education equals more positive attitudes to science'.

In other highlights:

- > Ninety per cent of Australians feel science has made life easier overall.
- > Around 80% of Australians say the benefits of science have been greater than harmful effects, but despite this nearly half of them feel that science has changed our way of life too fast.
- > Of the 86% of people who say they have conversations about science at least once or twice a month, nearly 70% report that these conversations are generally positive.
- > Australians overwhelmingly think parents should be required to vaccinate their children (85% think this, compared to 68% of US adults).
- > Australians are noticeably happier about eating GM foods than foods grown with pesticides, which is interesting given how common the use of pesticides is in comparison to the relatively low presence of GMOs on Australian supermarket shelves.
- > Around half of Australians are opposed to using animals in scientific research, and a similar proportion also oppose using nuclear energy.
- > Seven out of ten Australians are opposed to fracking.
- > Eighty per cent believe there is solid evidence the world has been warming the last few decades, with more than half of these people saying this is because of human activity (The US equivalent is 46%).
- > The top three professions that most Australians rate as contributing a lot to the wellbeing of society are scientists (80.9%), followed very closely by doctors (80.5%) and then farmers (78.5%).
- > The top three profession that most Australians rated as very prestigious were doctors (72.9%), followed by scientists (62.1%) and then engineers (55.2%).
- > Australian's perceptions of the connection between the *contribution* and the *prestige* of professions vary widely, most notably in the case of scientists.
- > Looking at STEM skills, among the people working full-time, part-time or on a casual basis (around half of all respondents), more than 90% use technology skills at least a number of times a week, and nearly 80% use maths skills at least a number of times a week. More than 50% also said they use science skills at least a number of times a week, with engineering skills being used at this level by a little less than 40% of this group of people.
- > A number of findings suggest that men are a little more likely to approve of controversial scientific interventions in our lives (such as bioengineering to create artificial organs for transplants), and also to consider it safe to eat GM foods or food grown with pesticides.
- > Women, on the other hand, are a little more likely than men to think that science has made our way of life change too fast.
- > More than 70% of people feel at least 'fairly well informed' about science.
- > People who had completed education to year 12 or below are the least likely to feel informed about science. This began to change for people with technical and trade qualifications, while those with bachelor's degrees or higher are the most likely to report feeling at least 'fairly well' informed about science.
- > Overall, people who have more frequent conversations about science and who feel more informed about science are more likely to express positive sentiments about it, and also disagree with statements like 'science has made our way of life change too fast' and 'we have depended too much on science and not enough on faith'.
- > In general, people who report having more frequent conversations about science are more likely to feel positively disposed towards science and its impacts on society.

RESULTS – DESCRIPTIVE STATISTICS

The results presented in this section provide an overview of some core characteristics of the sample including the beliefs and attitudes towards science and technology in Australia in 2017¹. Details about the sampling strategy and the demographic characteristics of the sample can be found at Appendix A. Full data tables are available separately in the document *The Australian Beliefs and Attitudes towards Science Survey: Data Tables*.

Defining science for the survey

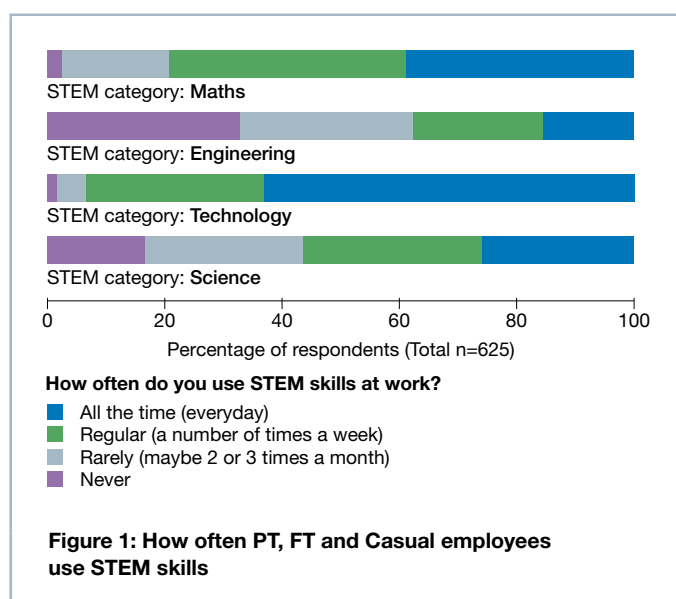
A broad definition of ‘science’ was used for the ABAS. Before they began answering survey questions, respondents were told the following:

Before we begin, you should know that when I talk about ‘science’ during the survey, this refers to science in a general and broad sense, and includes anything to do with science such as technology, health, research and other things.

Day-to-day STEM use at work

Six hundred and twenty five of the 1203 ABAS respondents indicated they were employed on a casual, part-time or full-time basis. These respondents were asked to indicate how often their day-to-day jobs required them to use STEM skills, and the results are shown in Figure 1.

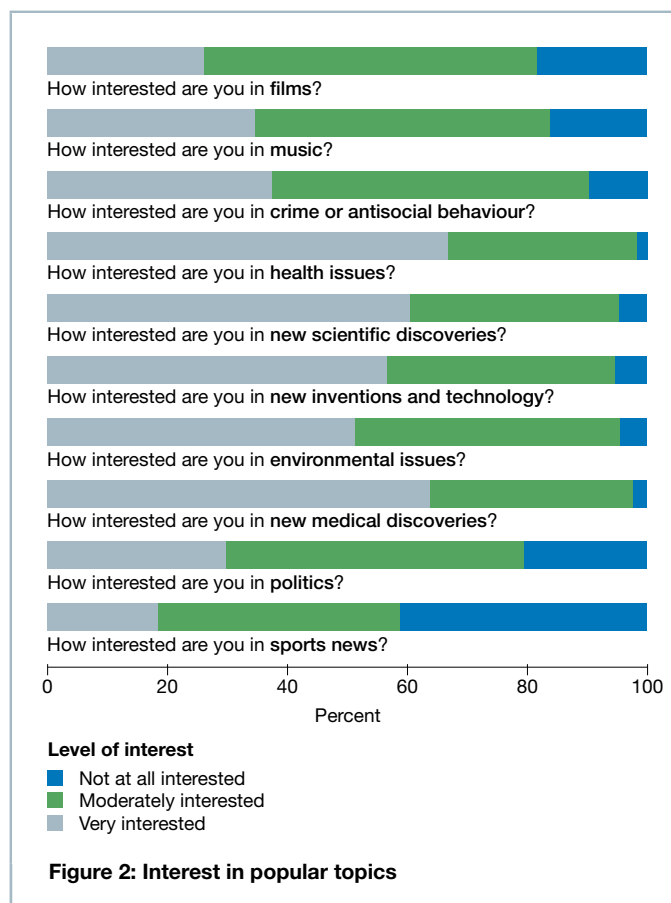
Clearly, technology is the most common skill these people regularly call upon, with more 60% saying they use it every day, eclipsing the next most frequently used skill, mathematics, at 40% of respondents.



Interest in popular topics

Respondents were clearly interested in science or science-related topics above all others (Figure 2). The topics in which more than 50% of respondents reported they were ‘very interested’ were:

- > Health issues – 66.8%
- > New medical discoveries – 63.7%
- > New scientific discoveries – 60.5%
- > New inventions and technologies – 56.6%
- > Environmental issues – 51.2%



1. Total sample was 1,203 people, data gathered between 15 March and 3 April, 2017

On the other end of the scale, 41.3% indicated they were 'not interested at all' in sports news and 20.6% said the same for politics.

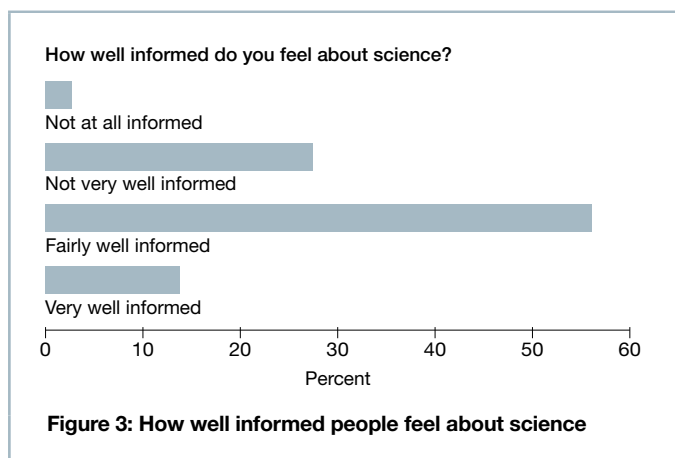
These were broadly similar to the 'very interested' results of the 2010 ANUpoll (Lamberts *et. al.*, 2010):

- > Health issues – 73.3%
- > New medical discoveries – 62.7%
- > Environmental issues – 56.4%
- > New scientific discoveries – 48.2%
- > New inventions and technologies – 45.2%

The most common 'not at all interested' categories were the same as in 2010, although politics appears to have become less unpopular, and sports news notably more so:

- > Politics – 31.8%
- > Sports news – 25.7%

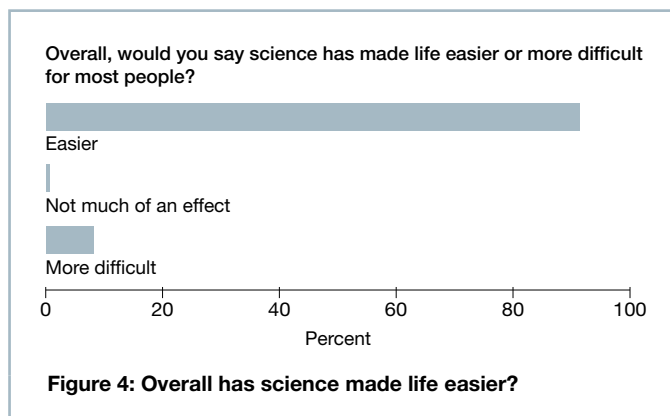
Responses to general statements about science



The majority of respondents (55.8%) felt they were 'fairly well informed' about science, with only 2.7% considering themselves 'not at all informed' (Figure 3).

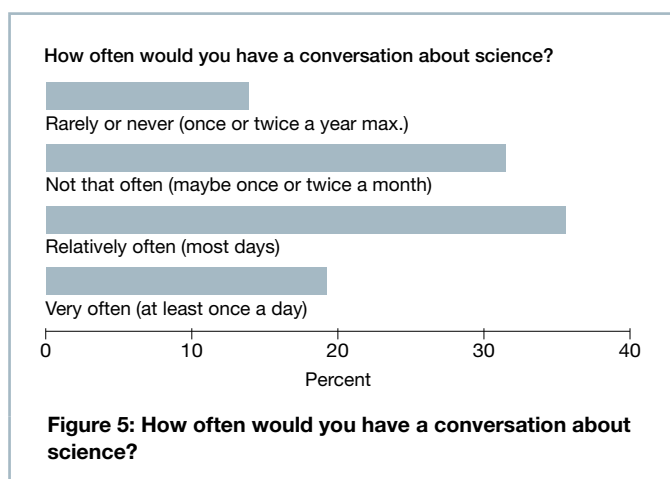
This represents an improvement since 2010, with only 45% feeling 'fairly well informed' and 4% seeing themselves as 'not at all informed' (Lamberts *et. al.*, 2010). The proportion of people feeling 'very well informed' has also increased from 10% in 2010 to nearly 14% in 2017.

Nearly 9 out of 10 respondents (89.2%) said that science has, on the whole, made life easier for most people, while 8%, or 96 people, said it has made life more difficult (Figure 4). This is similar to the situation in 2010, with comparison results of 86.2% (easier) and 9.2% (more difficult) respectively.

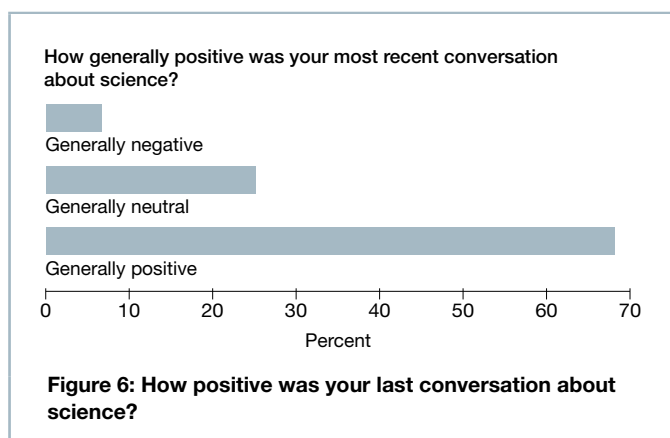


Conversations about science

More than half of the respondents reported having a conversation about science on at least 'most days' (54.5%), with 166 people (13.8%) 'rarely or never' talking about it (Figure 5).



Among those who said they have a conversation about science 'maybe once or twice a month' or more (1033 people, or 85.8% of the whole sample), 66% suggest these conversations are 'generally positive' (Figure 6).

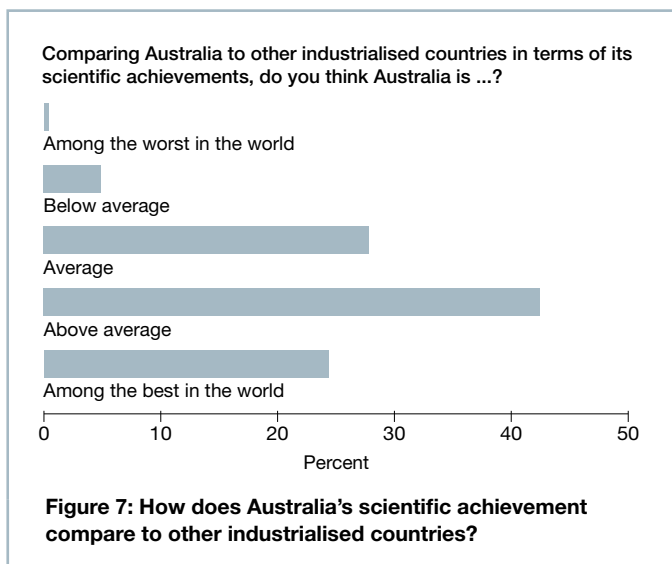


International comparisons

How Australian science compares to the rest of the world

In comparing Australia to other industrialised countries in terms of its scientific achievements, most respondents considered our scientific achievements to be 'above average' (41.6%), followed by 'average' (27.3%). Nearly a quarter of the sample (23.9%) rated us as 'among the best in the world', with few rating us as 'below average' (4.8%) or 'among the worst in the world' (0.4%).

A very similar version of this question was used in both the 2010 Lamberts *et. al.* and 2017 Sheppard and Gray ANUpolls. However, there was one subtle difference in the language of the ABAS version. For the most positive response option, rather than asking people if Australian science is 'the best in the world', the ABAS asked if it is 'among the best in the world' (Figure 7).

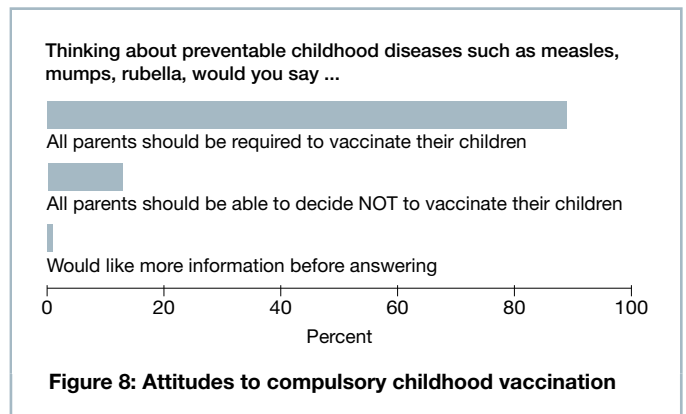


Unsurprisingly, people were more reluctant to label Australia's scientific achievements as *the* best, with approximately 5% choosing this option in both previous polls, compared to nearly 24% rating it as *among* the best in the ABAS survey.

Childhood vaccination

When asked whether parents should be required to vaccinate their children, respondents overwhelmingly said they should, with 84.9% choosing this option. Twelve per cent believed parents should be allowed to choose not to vaccinate, and 10 people (less than 1%) wanted more information before answering (Figure 8).

This represents a noticeably different pattern of responses to the recent US Pew poll in which 68% of respondents thought parents should be required to vaccinate their children, with 30% saying parents should be able to decide against vaccination (Pew Research Center, 2015).

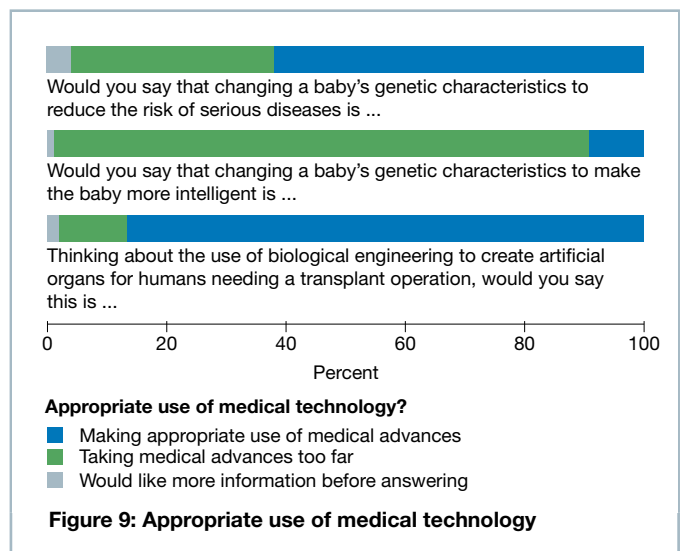


Appropriate use of medical technology

When it comes to attitudes towards appropriate use of medical technology (Figure 9), the clear majority of respondents (87.5%) believed that changing a baby's genetic characteristics to make it more intelligent was taking medical advances too far. This reflects Pew poll findings, with 83% of American respondents feeling the same way (Pew Research Center, 2015).

Opinions shift significantly when the same question is posed, but this time with the goal of changing the baby's genetic characteristics to reduce risk of serious diseases. Over half of the Australian respondents (59.7%) believed this was appropriate use of medical technology, with 32.7% seeing this as going too far. In the US, the proportions for this same question were 46% and 50% respectively: a considerable difference (Pew Research Center, 2015).

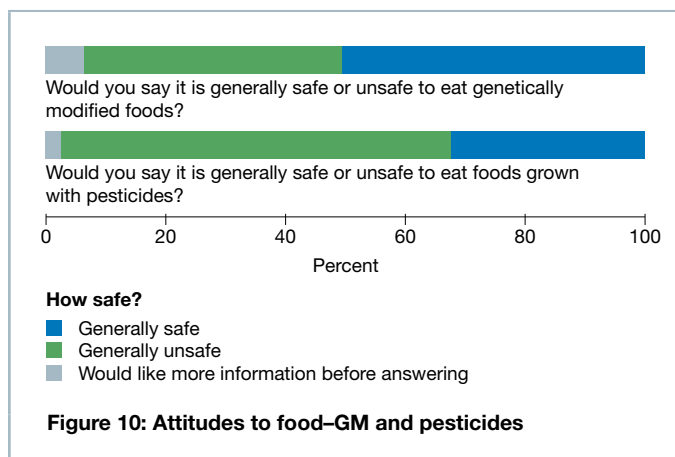
Moving to the creation of artificial organs for transplants, 84.5% of Australian respondents saw this as appropriate use of medical technology, with 74% of US respondents choosing this option. Twenty three per cent of US respondents believed this was taking medical advances too far, more than double the proportion of Australians who felt the same way (Pew Research Center, 2015).



Food safety

We turn now to people's attitudes to food safety (Figure 10). Nearly half of the Australian respondents (46.6%) believed it is generally safe to eat GM foods, compared to 37% of Americans (Pew Research Center, 2015). A sizable minority of Australians (39.6%) feel GM foods are generally unsafe, a number that rises to 57% in the US.

When it comes to eating foods grown with pesticides, ABAS respondents are more wary, with 62.3% feeling these are generally unsafe, compared to nearly a third (31.1%) who believe them to be generally safe. Results in the Pew poll were similar, with 69% considering such food unsafe and 28% seeing them as generally safe (Pew Research Center, 2015).



Support for scientific advances

Respondents were asked to rate the extent to which they supported a list of five scientific advances on a five point scale from 'strongly oppose' to 'strongly favour'. This was modified from the original Pew questions in which respondents were given a binary choice of 'favour' or 'oppose'. For ease of comparison here, the ABAS 'strongly oppose' and 'oppose' categories are combined, as are 'strongly favour' and 'favour'. The full range of responses is presented graphically in Figure 11.

Animals in scientific research

First, the use of animals in scientific research. Nearly half of the Australian respondents (48.1%) were broadly opposed to using animals this way, almost the same as the 50% who were opposed in the US (Pew Research Center, 2015). More US respondents were in favour of such research (47%) while 41% of Australians felt the same way.

Nuclear energy

A similar proportion of Australian and American respondents favour the use of nuclear energy (41.3% and 45% respectively). This close similarity is mimicked among those who oppose it, with 48.1% of Australians and 51% of Americans holding this view (Pew Research Center, 2015).

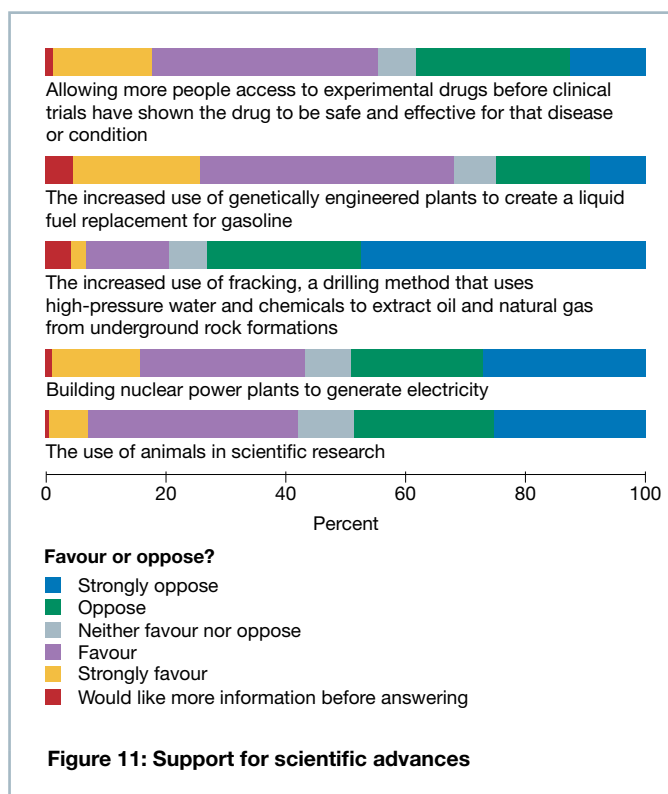


Figure 11: Support for scientific advances

Fracking

A clear majority of Australian respondents are opposed to fracking (70.7%), compared to just over half of the American cohort (51%). The proportion of Americans who favour fracking outnumber Australians by nearly three to one (15.7% vs. 39%).

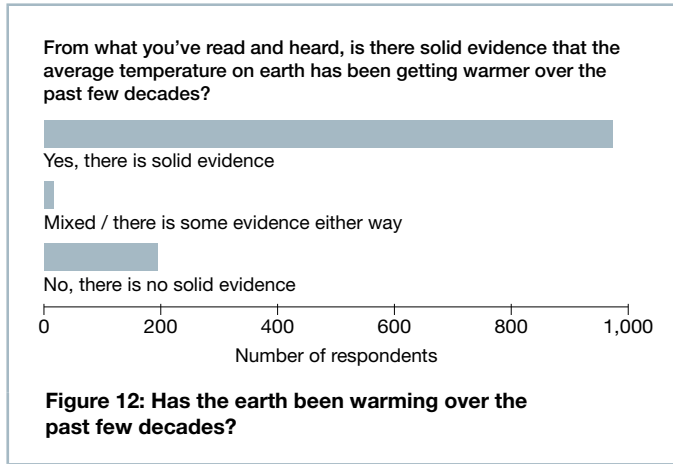
GM plants to replace gasoline

Here Australian and US respondents are very similar, with 61.6% of Australians, and 68% of Americans favouring this science. Opposed to this are 24.1% of Australians and 26% of Americans.

Early access to drugs before complete clinical trials

Australian and US respondents equally favour releasing drugs before full clinical trial approval (53.5% and 54% respectively). More than six per cent of Australians are ambivalent about this, leaving 37.9% opposed compared to 43% of American respondents holding the same view (Pew Research Center, 2015).

Climate change

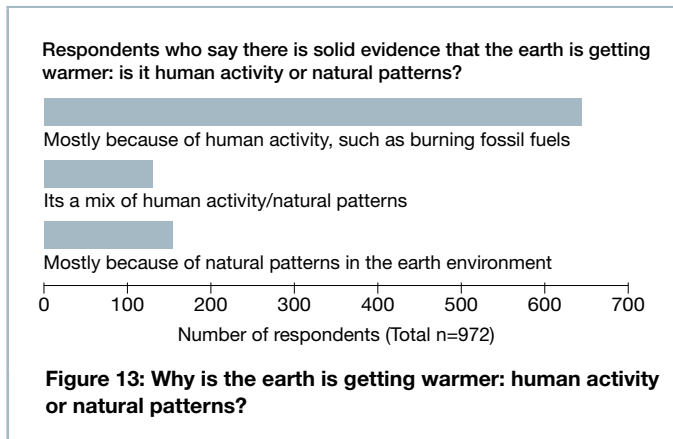


More than eight out of ten Australians (80.8%) believe there is solid evidence that earth has been getting warmer over the last few decades (Figure 12), while 16.2% believe there is no solid evidence, which contrasts with 25% of Americans who think there is no solid evidence (Pew Research Center, 2015).

People who say there is solid evidence the earth is getting warmer

All the percentages referred to in this section are based on the 972 ABAS respondents who believed there is solid evidence that the earth is getting warmer not the total survey sample. More than half of these 972 respondents (53.6%) say the warming earth is mostly because of human activity (Figure 13), contrasting with 46% of similar US respondents (Pew Research Center, 2015).

Only 12.8% of these ABAS respondents (154 people) suggested this warming is due to natural environmental patterns, which is slightly more than half the proportion (22%) who believe this in the US (Pew Research Center, 2015).



There are myriad reasons why these 972 respondents believe the earth has been warming recently, with the five most popular being:

- > 'because of the negative effect of greenhouse gasses' (24.4%)
- > 'because of the negative effect of human activity' (20.3%)
- > 'because of scientific evidence or research' (18.1%)
- > 'historically there have been naturally occurring fluctuations in global temperature' (10.8%)
- > 'because of what I read or see in the media' (9.1%)

Note that the first three are related to common, orthodox scientific positions, whereas it is not unusual to see the fourth presented as part of more controversial opinions on the subject.

People who say there is NO solid evidence the earth is getting warmer

The top five reasons the 195 respondents (16.2% of the sample) who said they thought there was no solid evidence that the average temperature on earth has been getting warmer over the past few decades were:

- > 'historically there have been naturally occurring fluctuations' (25.6%)
- > 'because of my own observations' (19.5%)
- > 'current changes are not significant compared to historical changes that have occurred' (12.3%)
- > 'incomplete or inconclusive scientific evidence' (10.8%)
- > 'scientific evidence fake or flawed' (8.2%)

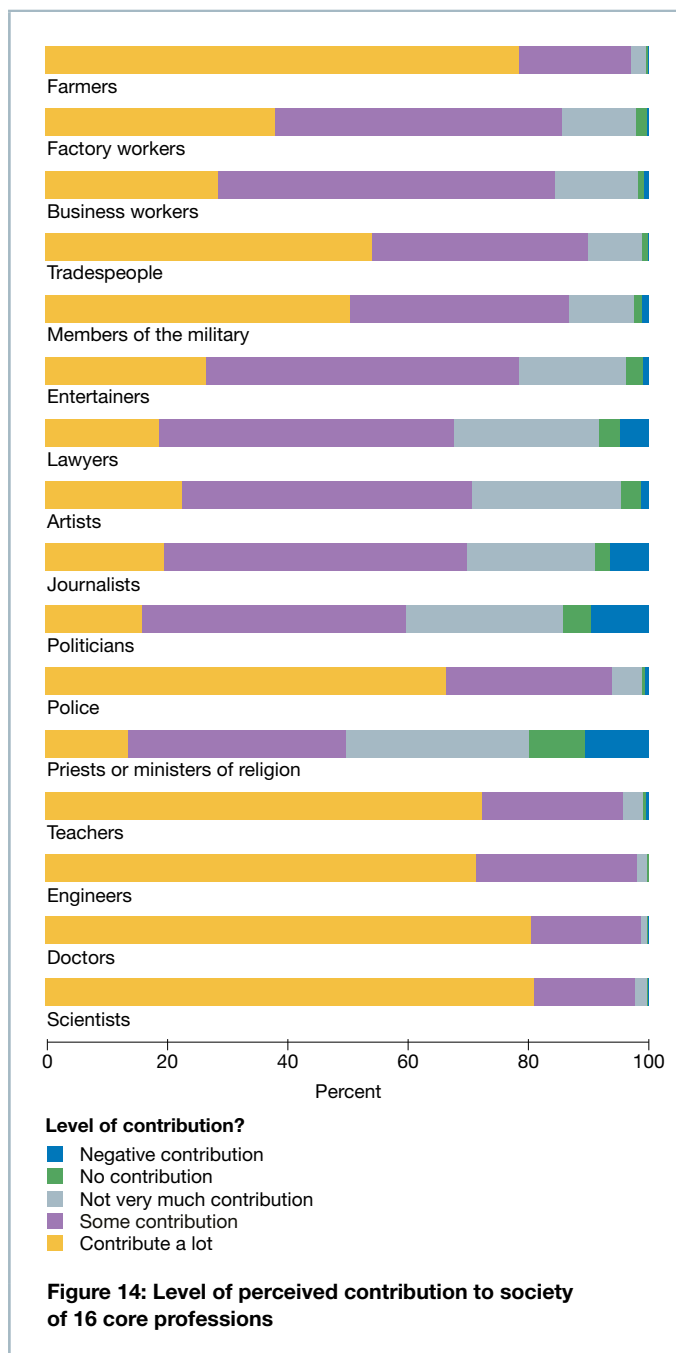
Interestingly, reasons 1 and 3 don't necessarily mean these respondents don't believe there is no solid evidence for warming, rather they disagree that it means changes are human-induced.

Contribution and prestige of professions

Respondents were asked to rate their impressions of the level of contribution to the wellbeing of society, and perceptions of prestige, of a list of 16 common professions. Rating options for 'level of contribution' were on a five point scale running from 'negative contribution' through to 'contribute a lot'. Ratings for 'perceptions of prestige' ran on a four point scale from 'not at all prestigious' to 'very prestigious'.

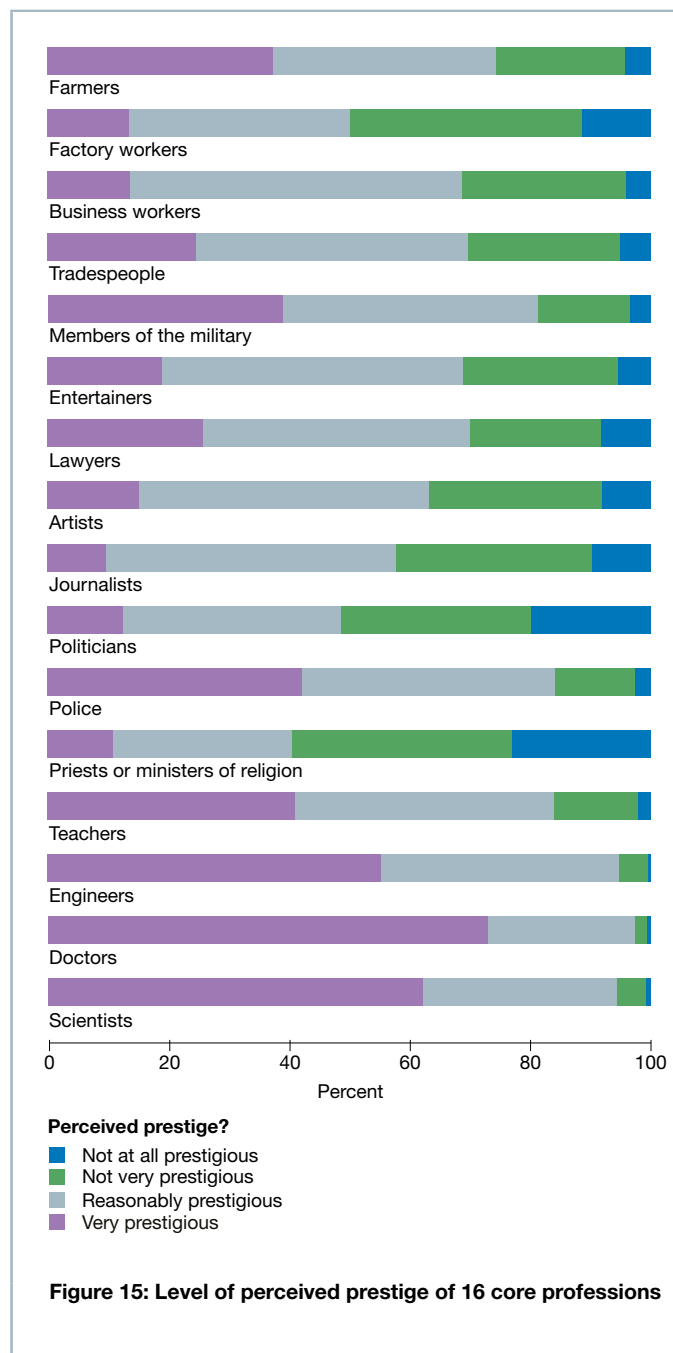
Contribution

Respondents' ratings of the level of contribution they believe the professions make to the wellbeing of society is presented in Figure 14.



Prestige

Respondents' perceptions of how prestigious they believe the professions to be is presented in Figure 15.



The three professions that were most frequently rated as ‘contributing a lot’ are scientists (80.9% of respondents), followed very closely by doctors (80.5% of respondents) and then farmers (78.5% of respondents).

At the other end of the scale, the 3 professions most frequently rated as making a ‘negative contribution’ are priests or ministers of religion (10.5% of respondents), politicians (9.5% of respondents) and then journalists (6.4% of respondents).

This question expands on the equivalent one in the 2010 ANUpoll. The ABAS survey increased the original list of 12 professions by four, adding farmers, factory workers, business workers and tradespeople.

In 2010, doctors were most highly regarded as the profession that contributed a lot to the wellbeing of society. This was followed by teachers (who were fourth in the ABAS), with scientists coming in third (Lamberts *et. al.*, 2010).

Priest or ministers of religion were also rated at the bottom of the ‘contribution to the wellbeing of society’ scale in 2010, with lawyers next worst, followed by politicians coming in at third worst. It should be noted however, that the lowest rating option in 2010 was ‘contribute nothing at all’ whereas in the current survey, ‘negative contribution’ was the most negative possible option.

The three professions that were most frequently rated as ‘very prestigious’ were doctors (72.9%), followed closely by scientists (62.1%) and then engineers (55.2%).

At the other end of the scale, the three professions most frequently rated as ‘not prestigious at all’ were priests or ministers of religion (23%), politicians (19.9%) and then factory workers (11.4%).

The relationship between contribution and prestige

Finally in this section, the relationship between people’s perceptions of the *prestige* of a profession, and their ratings of that professions’ *contribution* to the wellbeing of society is examined. In essence, this section asks: *if a person considers a profession to be prestigious, how likely are they to believe the profession contributes a lot to society as well?*

Interestingly, this relationship between prestige and contribution was lowest for people’s ratings of scientists. This means the belief that they contribute a lot to the wellbeing of society was not regularly related to high levels of perceived prestige. This also means that those who considered science to be a prestigious profession did not necessarily see it as one that contributes a lot to society.

The correlations between ratings of prestige and contribution to the wellbeing of society for all 16 professions are presented in Table 1. If people saw prestige and contribution to society as closely connected, there would be a strong correlations between their prestige and contribution ratings (indicated by correlation values closer to 1.0)¹.

Table 1: Relationship between professions–ratings of prestige and contribution to wellbeing of society

Profession	Spearman’s rho*
Priests or ministers	$r=0.617$
Military	$r=0.538$
Journalists	$r=0.520$
Politicians	$r=0.509$
Artists	$r=0.499$
Lawyers	$r=0.491$
Police	$r=0.453$
Entertainers	$r=0.400$
Factory workers	$r=0.385$
Doctors	$r=0.385$
Business workers	$r=0.362$
Teachers	$r=0.354$
Engineers	$r=0.327$
Farmers	$r=0.305$
Tradespeople	$r=0.300$
Scientists	$r=0.295$

* all results statistically significant at $p=.01$

The relationship between respondents’ perception of prestige and contribution to society was notably strongest for priests, members of the military, journalists and politicians. People who rated these professions as contributing more to the wellbeing of society were more likely to also consider these professions as prestigious. People who felt they did not contribute much were more like to rate them low on prestige as well.

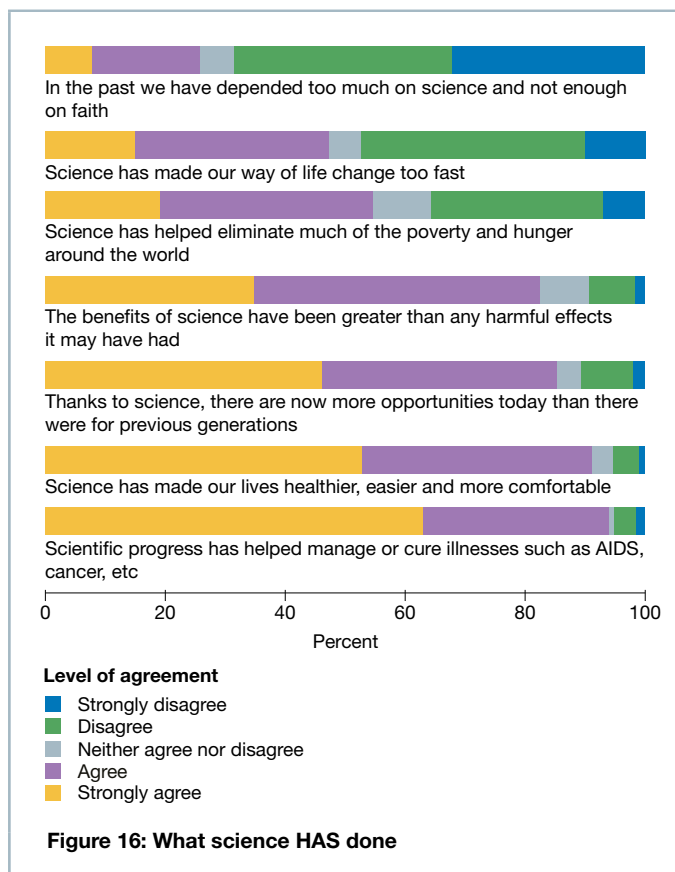
What science has done, and what it will do

In this section of the survey, respondents were asked about their level of agreement with a series of statements about what science has done, and what science will do in the future.

For both sets of statements, respondents were asked to indicate the extent to which they agreed on a five point scale from ‘strongly disagree’ to ‘strongly agree’.

¹ Spearman’s *rho* correlation coefficients between prestige and contribution were calculated to examine the association. While there is no absolute rule for what constitutes a weak, medium or strong correlation result (coefficient), it is relatively uncontroversial to use the following rule of thumb: values from 0.1 to 0.29 are weak, 0.30 to 0.49 are medium, and 0.5–1.0 are strong. Although there are strong correlations between prestige and contribution ratings for some professions, most fall in the medium range.

What science HAS done



The three statements with the most ‘strongly agree’ responses were ‘Scientific progress has helped manage or cure illnesses such as AIDS, cancer, etc.’ (62.9%), followed by ‘Science has made our lives healthier, easier and more comfortable’ (52.8%) and third, ‘Thanks to science, there are now more opportunities today than there were for previous generations’ at 46.1% (see Figure 16 for a graphical representation of all responses).

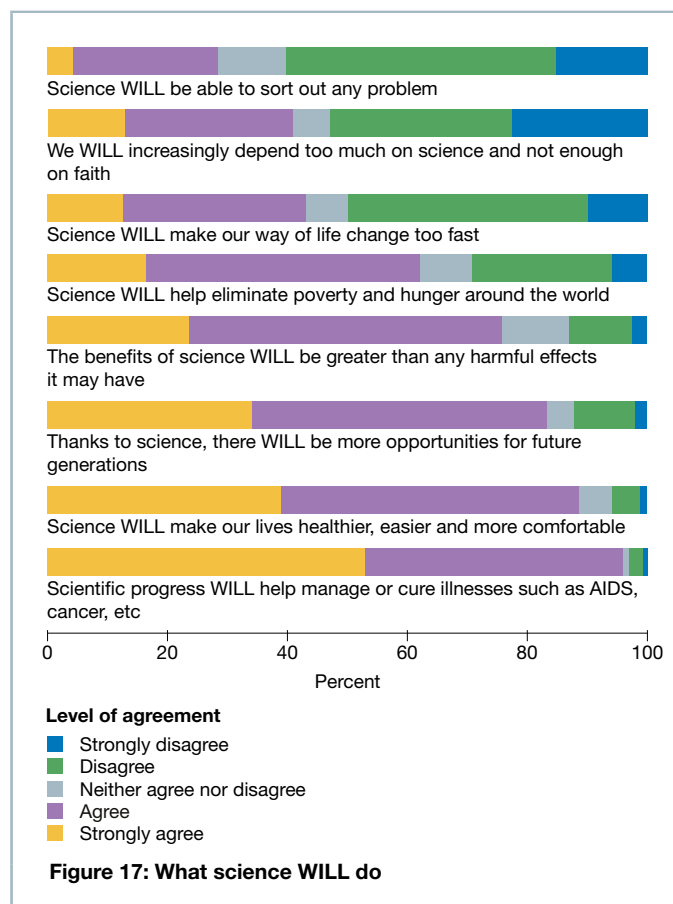
There were two statements with which more than 10% respondents strongly disagreed. First, nearly a third (32.1%) strongly disagreed with the statement ‘In the past we have depended too much on science and not enough on faith’. Just over a tenth (10.1%) indicated they strongly disagree that ‘Science has made our way of life change too fast’.

Worth noting here is that some 80% of respondents say the benefits of science have been greater than harmful effects, but still nearly half of them feel that science has changed our way of life too fast. The section on associations, further down contains further information about the kinds of people who are more likely to express this concern.

What science WILL do

Because of its future orientation, this section of the survey included one statement in addition to those in the previous section (‘what science HAS done’): ‘Science will be able to sort out any problem’.

All three of the statements with the most ‘strongly agree’ responses in this section were the same as the last, though they had fewer people registering strong agreement. The statement ‘Scientific progress has helped manage or cure illnesses such as AIDS, cancer, etc.’ once more came first (52.9%), followed by ‘Science will make our lives healthier, easier and more comfortable’ (39.0%) and again, ‘Thanks to science, there are now more opportunities today than there were for previous generations’ came in third at 34.1% (see Figure 17 for a graphical representation of all responses).



This time there were three statements with which more than 10% respondents strongly disagreed. First again was strong disagreement with the statement ‘In the past we have depended too much on science and not enough on faith’ but at a lower 22.6%. Just over 15% (15.2%) strongly disagreed with the additional statement ‘Science will be able to sort out any problem’. This time exactly 10% indicated they strongly disagreed that ‘Science has made our way of life change too fast’.

ASSOCIATIONS BETWEEN KEY ATTITUDES, BELIEFS AND DEMOGRAPHICS

This section presents a range of associations between key attitudes, beliefs and demographic characteristics of the survey sample. The results here reveal many interesting patterns that exist within the broader Australian public about their beliefs and attitudes towards science as they were in early 2017. A comprehensive explanation for, and interpretation of these results however is beyond the scope of the ABAS project on its own.

Unless otherwise indicated, the associations reported in this section are based on the Chi-Square 'test for independence' statistical technique (indicated by the symbol X^2). As well as the value of X^2 for each association, the relevant degrees of freedom and significance levels are presented.

There is also a 'strength of effect' statistic included with each X^2 value. The strength of the effect aids interpretation of X^2 values, and the choice of statistic depends on the structure of the contingency table used to calculate X^2 . Here the strength of effect will be indicated using either the Phi coefficient or Cramer's V statistics, with an associated significance value as well.

As a rule of thumb, a value of .01 is considered as small effect for Phi, with medium beginning at .30, and large at .50. The strength-of-effect for Cramer's V can vary depending on the number of rows and columns in the contingency tables used when calculating X^2 . Unless otherwise indicated, the relevant strength-of-effect values here are the same as noted for Phi.

Only statistically significant associations are reported.

Sex Differences

How informed do you feel about science?

Males were slightly more likely than females to feel 'informed' or 'very well informed' about science ($X^2=11.767$, $df=1$, $sig=.001$, $\phi=.099$, $sig=.001$).

How has science affected our lives?

Females were slightly more likely to agree that 'science has made our way of life change too fast' ($X^2=4.426$, $df=1$, $sig=.035$, $\phi=-.061$, $sig=.035$).

Approval and appropriateness of scientific and medical advances

Men were more likely than women to 'strongly favour' or 'favour'

- > the use of animals in scientific research ($X^2=42.448$, $df=2$, $sig=.000$, Cramer's $V=.189$, $sig=.000$)
- > building nuclear power plants to generate electricity ($X^2=66.247$, $df=2$, $sig=.000$, Cramer's $V=.238$, $sig=.000$)
- > increasing the use of genetically modified plants to create liquid fuel replacement for gasoline ($X^2=6.626$, $df=2$, $sig=.036$, Cramer's $V=.077$, $sig=.036$)

Women were a little more likely than men to consider using biological engineering to create artificial organs for humans needing a transplant operation as 'taking medical advances too far' ($X^2=12.687$, $df=2$, $sig=.002$, Cramer's $V=.104$, $sig=.002$).

Men were a little more likely to report that changing a baby's genetic characteristics to make the baby more intelligent is 'making appropriate use of medical advances' ($X^2=32.294$, $df=2$, $sig=.000$, Cramer's $V=.166$, $sig=.000$).

Food Safety

When it comes to eating food grown with pesticides, men were more likely to see this as 'generally safe' than women ($X^2=54.109$, $df=2$, $sig=.000$, Cramer's $V=.217$, $sig=.000$). The association is quite similar for eating GM foods, with men being somewhat more likely to see this as 'generally safe' ($X^2=58.814$, $df=2$, $sig=.000$, Cramer's $V=.230$, $sig=.000$).

How informed do you feel about science?

Overall, people who felt more informed about science were likely to have more frequent conversations about it (Pearson's $r=0.520$, $p<.000$). These people were also more likely to report that their conversations about science were 'generally positive' than those who felt less informed ($X^2=18.531$, $df=2$, $sig=.000$, Cramer's $V=.135$, $sig=.000$). Sex differences on this belief were noted in the previous section.

Level of education

There was a small-to-moderate effect when respondents' feelings of being informed about science were compared between people with differing levels of education (Cramer's $V=.220$, $sig=.000$). People with high levels of completed education (bachelor's degree or above) were more likely to say they feel 'fairly well' or 'very well' informed about science. This pattern was present among people with trade or technical qualifications but to a lesser extent. For people whose highest level of education was year 12 or less, the pattern was reversed ($X^2=115.681$, $df=6$, $sig=.000$).

How has science affected our lives?

People who felt less informed about science (those reporting feeling 'not very well' or 'not at all' informed) were a little more likely than others to suggest that science had made life more difficult ($X^2=37.226$, $df=3$, $sig=.000$, Cramer's $V=.179$, $sig=.000$).

People who reported feeling 'very well informed/fairly well informed' were a little more likely than those who felt 'not very well informed/not at all informed'¹ to agree/strongly agree that:

- > science has made our lives healthier, easier and more comfortable ($X^2=17.984$, $df=1$, $sig=.000$, $\phi=.123$, $sig=.000$)
- > the benefits of science have been greater than any harmful effects it may have had ($X^2=16.864$, $df=1$, $sig=.000$, $\phi=.120$, $sig=.000$)

The same people disagree/strongly disagree that:

- > science has made our way of life change too fast ($X^2=25.235$, $df=1$, $sig=.000$, $\phi=-.146$, $sig=.000$)
- > in the past we have depended too much on science and not enough on faith ($X^2=45.565$, $df=1$, $sig=.000$, $\phi=-.198$, $sig=.000$)

Climate change

When asked 'from what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades?', people who felt 'very well' or 'fairly well' informed about science were a little more likely than those who did not to say there is solid evidence to support this ($X^2=22.322$, $df=6$, $sig=.001$, Cramer's $V=.097$, $sig=.001$).

Approval and appropriateness of scientific and medical advances

People who considered themselves to be at least fairly well informed about science were a little more likely to favour/strongly favour:

- > the use of animals in scientific research ($X^2=16.783$, $df=2$, $sig=.000$, Cramer's $V=.119$, $sig=.000$)
- > building nuclear power plants to generate electricity ($X^2=7.489$, $df=2$, $sig=.024$, Cramer's $V=.08$, $sig=.024$)

These respondents were also more likely to oppose/strongly oppose the increased use of fracking ($X^2=11.572$, $df=2$, $sig=.003$, Cramer's $V=.102$, $sig=.003$).

People who felt more informed about science were less likely to feel the following were 'taking medical advances too far':

- > using biological engineering to create artificial organs for humans needing a transplant operation ($X^2=18.005$, $df=2$, $sig=.000$, Cramer's $V=.124$, $sig=.000$)
- > changing a baby's genetic characteristics to reduce the risk of serious diseases ($X^2=14.189$, $df=2$, $sig=.001$, Cramer's $V=.111$, $sig=.001$)

1 Results based on collapsed 'Informed' variable as in almost every case for the relevant comparison variables, the change in opinion / belief between observed and expected results in X^2 contingency tables reverses at the "fairly well informed/not very well informed" boundary. Results are therefore based on associations between 2 groups: people who are report feeling either "very well informed/fairly well informed", or "not very well informed/ not at all informed".

Food Safety

People who felt at least 'fairly well' informed about science were more likely to say that eating food grown with pesticides ($X^2=9.663$, $df=2$, $sig=.008$, Cramer's $V=.092$, $sig=.008$) and eating GM foods was 'generally safe' ($X^2=24.610$, $df=2$, $sig=.000$, Cramer's $V=.149$, $sig=.000$).

Conversations about science

Frequency of science conversations

Level of education

A moderate correlation exists suggesting that as education levels increase, so too does the frequency of conversations about science (Spearman's $\rho=-.340$, $p=.000$).²

How has science affected our lives?

People who had a conversation about science on 'at least most days' were slightly more likely to say that overall science has made life easier ($X^2=13.334$, $df=6$, $sig=.038$, Cramer's $V=.075$, $sig=.038$).

People who reported having conversations about science on 'at least most days' were a little more likely than those who had less frequent conversations to agree/strongly agree that:

- > science has made our lives healthier, easier and more comfortable ($X^2=8.785$, $df=3$, $sig=.032$, Cramer's $V=.086$, $sig=.032$)
- > the benefits of science have been greater than any harmful effects it may have had ($X^2=10.505$, $df=3$, $sig=.015$, Cramer's $V=.095$, $sig=.015$)

The same people disagree/strongly disagree that:

- > science has made our way of life change too fast ($X^2=25.642$, $df=3$, $sig=.000$, Cramer's $V=.147$, $sig=.000$)
- > in the past we have depended too much on science and not enough on faith ($X^2=36.736$, $df=3$, $sig=.000$, Cramer's $V=.178$, $sig=.000$)

Climate change

When asked 'From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades?', people who more frequently had conversations about science were somewhat more likely than those who did not to say there is solid evidence to support this ($X^2=19.138$, $df=3$, $sig=.000$, Cramer's $V=.128$, $sig=.000$). These people were also more likely to indicate they thought this was 'Mostly because of human activity, such as burning fossil fuels' than people who had few or no conversations about science ($X^2=17.174$, $df=6$, $sig=.009$, Cramer's $V=.096$, $sig=.009$).

2 The correlation coefficient is negative as lower scores on the relevant education variable used for this calculation indicated higher level of completed education

Approval and appropriateness of scientific and medical advances

The respondents who had conversations about science on 'at least most days' or more were more likely to oppose/strongly oppose the increased use of fracking ($X^2=21.343$, $df=6$, $sig=.002$, Cramer's $V=.098$, $sig=.002$).

The same respondents were less likely to feel the following were 'taking medical advances too far':

- > using biological engineering to create artificial organs for humans needing a transplant operation ($X^2=33.677$, $df=6$, $sig=.000$, Cramer's $V=.120$, $sig=.000$)
- > changing a baby's genetic characteristics to reduce the risk of serious diseases ($X^2=16.161$, $df=6$, $sig=.013$, Cramer's $V=.084$, $sig=.013$)

Food Safety

People who had conversations about science on 'at least most days' or more were more likely to say that eating food grown with pesticides ($X^2=18.670$, $df=6$, $sig=.005$, Cramer's $V=.092$, $sig=.005$) and eating GM foods was 'generally safe' ($X^2=24.610$, $df=2$, $sig=.000$, Cramer's $V=.149$, $sig=.000$).

Positivity of science conversations

Level of education

Respondents with bachelor's degree or higher were somewhat more likely to say their most recent conversation about science was 'generally positive' ($X^2=25.484$, $df=4$, $sig=.000$, Cramer's $V=.113$, $sig=.000$).

How has science affected our lives?

People who reported their most recent conversation about science as being 'generally positive' were a little more likely than others to agree/strongly agree that:

- > scientific progress has helped manage or cure illnesses such as AIDS, cancer, etc. ($X^2=27.529$, $df=2$, $sig=.000$, Cramer's $V=.166$, $sig=.000$)
- > science has made our lives healthier, easier and more comfortable ($X^2=26.903$, $df=2$, $sig=.000$, Cramer's $V=.164$, $sig=.000$)
- > thanks to science, there are now more opportunities today than there were for previous generations ($X^2=6.451$, $df=2$, $sig=.040$, Cramer's $V=.081$, $sig=.040$)
- > the benefits of science have been greater than any harmful effects it may have had ($X^2=20.070$, $df=2$, $sig=.000$, Cramer's $V=.142$, $sig=.000$)

The same people disagree/strongly disagree that:

- > science has made our way of life change too fast ($X^2=16.370$, $df=2$, $sig=.000$, Cramer's $V=.128$, $sig=.000$)

- > in the past we have depended too much on science and not enough on faith ($X^2=13.314$, $df=2$, $sig=.001$, Cramer's $V=.117$, $sig=.001$)

Climate change

When asked 'From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades?', people whose most recent conversations about science were 'generally negative' or 'generally neutral' were somewhat more likely to say there is no solid evidence that the climate has been warming these last few decades ($X^2=11.531$, $df=4$, $sig=.021$, Cramer's $V=.076$, $sig=.021$).

Approval and appropriateness of scientific and medical advances

Respondents whose most recent conversation about science was 'generally positive' were more likely to favour/strongly favour:

- > the use of animals in scientific research ($X^2=10.091$, $df=4$, $sig=.039$, Cramer's $V=.071$, $sig=.039$)
- > building nuclear power plants to generate electricity ($X^2=11.942$, $df=4$, $sig=.018$, Cramer's $V=.078$, $sig=.018$)

Respondents whose most recent conversation about science was 'generally positive' were slightly more likely to say that 'all parents should be required to vaccinate their children' ($X^2=11.027$, $df=4$, $sig=.026$, Cramer's $V=.075$, $sig=.026$). They were also a little more likely to say that 'using biological engineering to create artificial organs for humans needing a transplant operation' was making appropriate use of medical advances ($X^2=17.177$, $df=4$, $sig=.002$, Cramer's $V=.093$, $sig=.002$).

Food Safety

Respondents whose most recent conversation about science was 'generally positive' were more likely to say that eating GM foods was 'generally safe' ($X^2=12.261$, $df=2$, $sig=.016$, Cramer's $V=.081$, $sig=.016$).

Education level

How has science affected our lives?

People with a bachelor's degree or higher were a little more likely to agree/strongly agree that:

- > science has made our lives healthier, easier and more comfortable ($X^2=15.125$, $df=2$, $sig=.001$, Cramer's $V=.113$, $sig=.001$)
- > the benefits of science have been greater than any harmful effects it may have had ($X^2=6.635$, $df=2$, $sig=.036$, Cramer's $V=.075$, $sig=.036$)

- > science has helped eliminate much of the poverty and hunger around the world ($\chi^2=11.525$, $df=2$, $sig=.003$, Cramer's $V=.100$, $sig=.003$)

The same people disagree/strongly disagree that:

- > science has made our way of life change too fast ($\chi^2=17.285$, $df=2$, $sig=.000$, Cramer's $V=.121$, $sig=.000$)
- > in the past we have depended too much on science and not enough on faith ($\chi^2=34.875$, $df=2$, $sig=.000$, Cramer's $V=.173$, $sig=.000$)

Climate change

When asked 'From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades?', people with a bachelor's degree or higher were somewhat more likely to say 'yes, there is solid evidence' that the climate has been warming these last few decades ($\chi^2=45.477$, $df=4$, $sig=.000$, Cramer's $V=.139$, $sig=.000$).

These people were also more likely to indicate they thought this was 'Mostly because of human activity, such as burning fossil fuels' ($\chi^2=29.112$, $df=4$, $sig=.000$, Cramer's $V=.125$, $sig=.000$).

Approval and appropriateness of scientific and medical advances

Respondents with a bachelor's degree or higher were somewhat more likely to favour/strongly favour the use of animals in scientific research ($\chi^2=30.715$, $df=4$, $sig=.000$, Cramer's $V=.114$, $sig=.000$).

Food Safety

The most highly educated respondents were a little more likely to feel that eating GM foods was 'generally safe' ($\chi^2=11.490$, $df=4$, $sig=.022$, Cramer's $V=.072$, $sig=.022$).

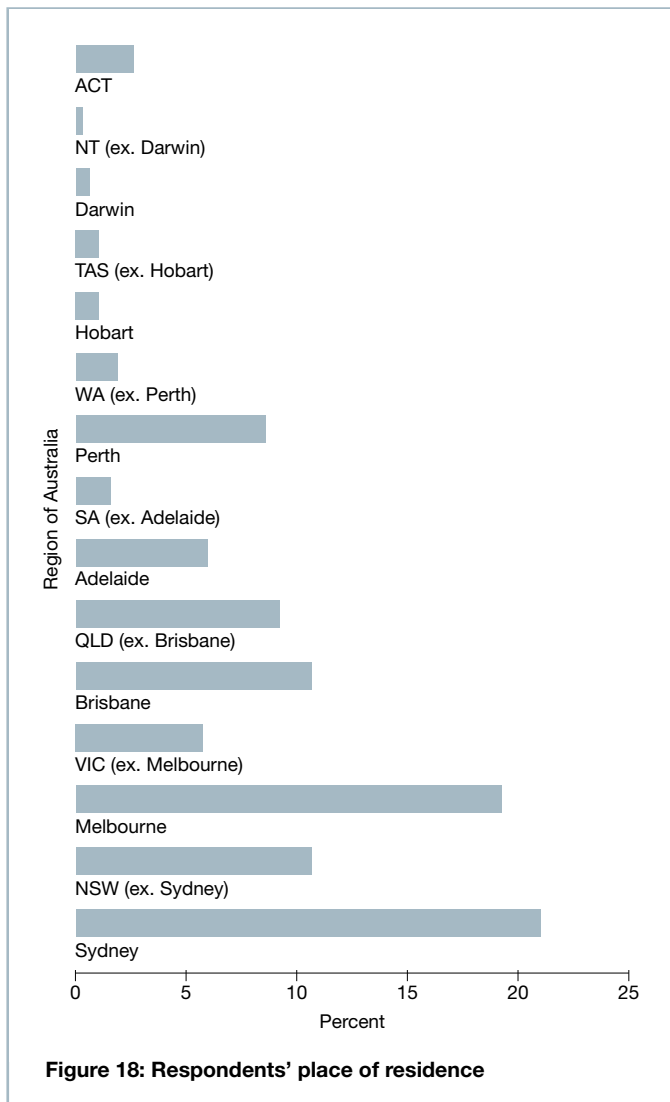
APPENDIX A—DATA COLLECTION AND SAMPLING STRATEGY

The Department of Industry, Innovation and Science-Australian National Centre for Public Awareness of Science ABAS Survey was conducted for The Australian National Centre for the Public Awareness of Science (CPAS), ANU and the Australian Government Department of Industry, Innovation and Science by the Social Research Centre (SRC), an ANU Enterprise business. The survey was administered to a nationally representative sample of the adult population of Australia, and was conducted by telephone (both landline and mobile).

The metropolitan component of the sample was 67.2%, and the regional component, 31.4%¹. The proportion of respondents broken down by state appears at Figure 17.

The SRC interviewed 1,203 people between 15 March and 3 April 2017 with a response rate of 32.3%.

The average interview length was 19.3 minutes. The survey's margin of error is ± 2.5 per cent.



Demographics

Sex

There were 585 males and 618 females in the sample.

Age

The age breakdown of respondents is presented graphically in Figure 19, and a comparison of the sample age categories with ABS data for 2016 is at Table 2.

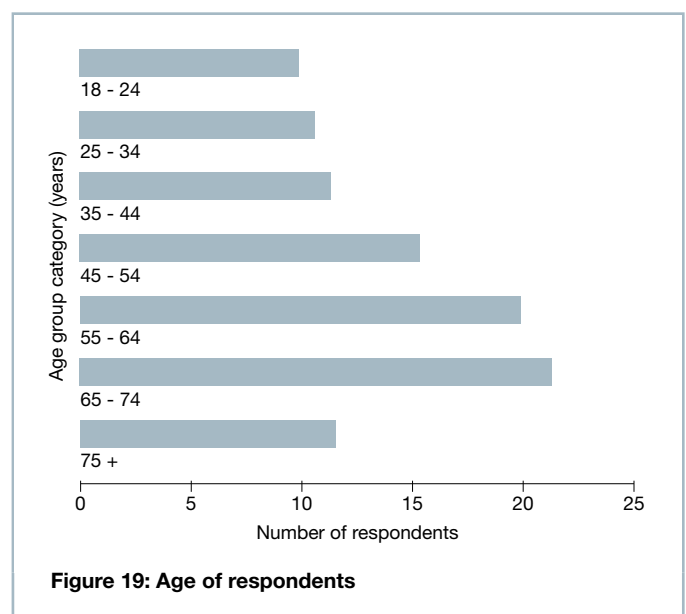


Table 2: Age of respondents—proportional comparison to the Australian population

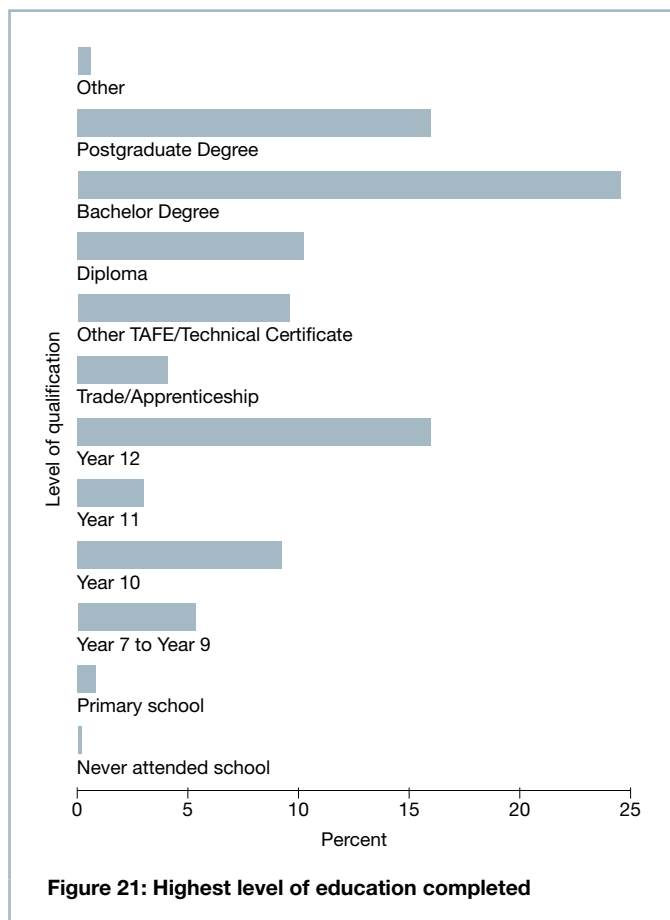
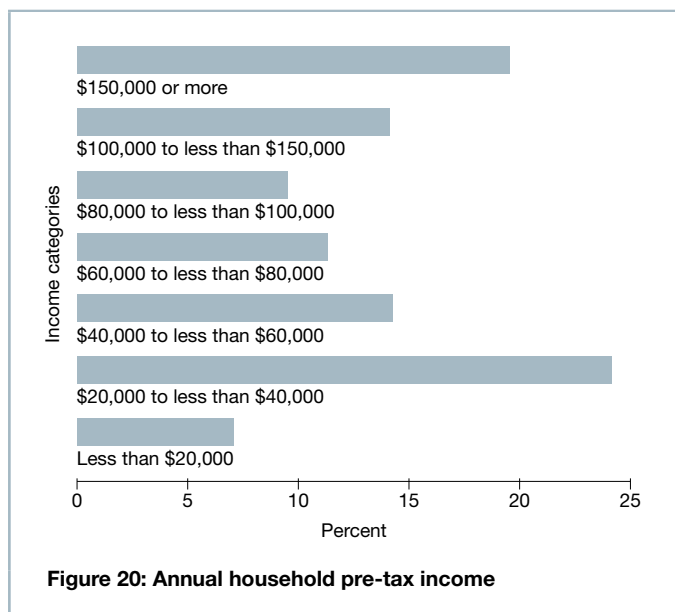
Age category	% of Australian population ²	% of sample
18–24 years	8.7	11.9
25–34 years	9.3	18.6
35–44 years	11.5	16.9
45–54 years	14.5	16.4
55–64 years	20.9	14.6
65–74 years	21.8	10.9
75 + years	12.8	10.7

1 16 responses to the metropolitan/regional question were missing

2 31010DO002_201609 Australian Demographic Statistics, Sep 2016
Released at 11:30 am (Canberra time) Thurs 23 Mar 2017

Household pre-tax income

Household income is presented in Figure 20. Note that 10% of the sample refused to answer this question and 11% were unsure or didn't know.



Country of birth

The majority of respondents (just over 82%) were born in Australia (n=878 or 73%), followed by The United Kingdom (n=83 or 7%), then New Zealand (n=29 or 2.4%). A full breakdown of respondents' country of birth is available in the supplementary document *Australian Beliefs and Attitudes Towards Science: Data Tables*.

Education

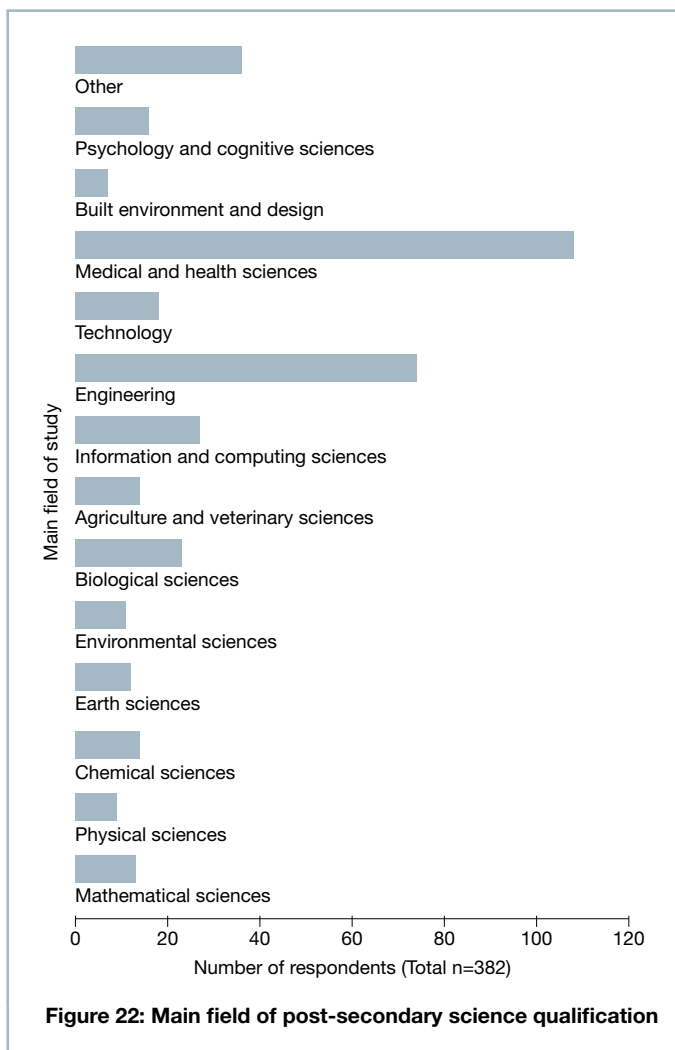
The most common level of education among respondents was a bachelor degree (n=295 or 24.5%) with postgraduate degree and Year 12 certificate equal second (n=192 or 16%). The full range of qualifications appears in Figure 21, with Table 3 presenting a comparison between the sample and Australian census data from 2011.

Table 3: Highest level of education completed: ABAS sample compared to Australian population

Education level	Australia (2011 census) ³	ABAS survey (2017)
Postgraduate degree, Grad diploma, Grad certificate	5.3%	16.0%
Bachelor degree	13.5%	24.5%
Advanced diploma, diploma, Certificate III/IV	23.3%	23.9%
Year 12	16.6%	16.0%
Year 11 and below	28.8%	18.7%

One of the goals of this survey was to see what kind of respondents' characteristics might be associated with particular beliefs and attitudes towards science and technology. A key characteristic here is the level of science education respondents have completed.

³ ABS data 2011 (Highest level of education from ABS.gov.au/census) for people 15 and older. Note also ABS summary table percentages from original source sheet don't add up to 100%

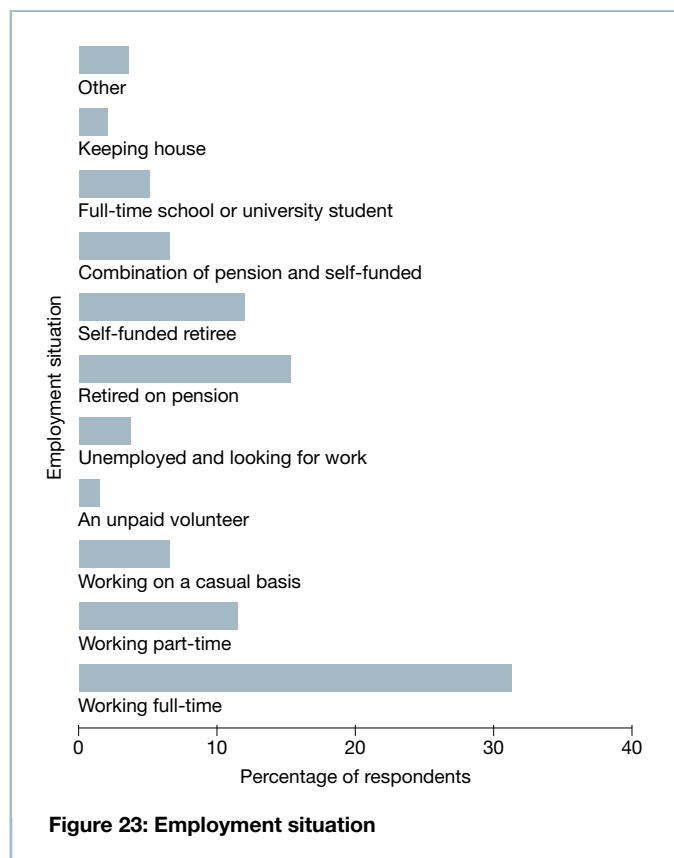


We asked respondents with post-secondary, science-related qualifications (that is: Trade/apprenticeship, Other TAFE/Technical Certificate, Diploma, Bachelor Degree, or a Postgraduate Degree) to indicate what their main science-related field of study was.

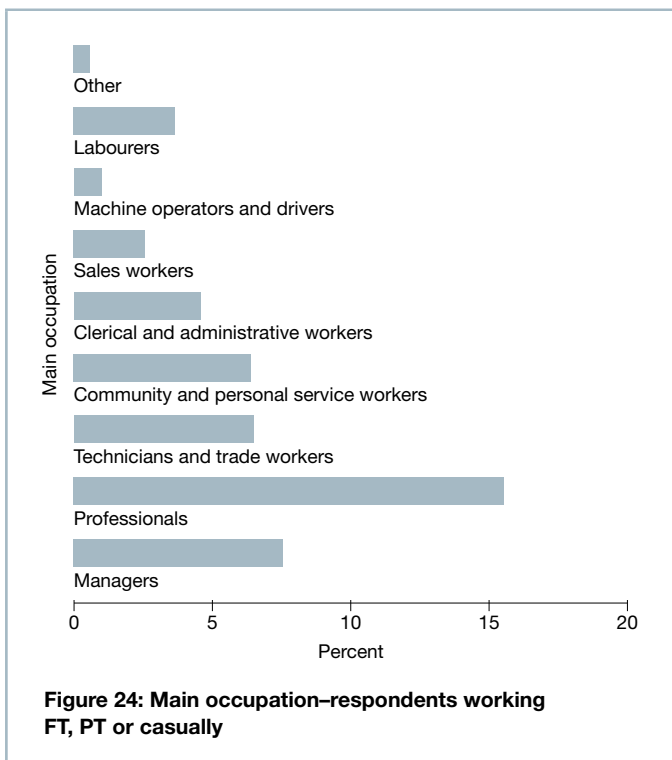
Figure 22 reveals that among the 382 people who met this condition, the most common field of science study was 'medical and health sciences' (108 people) followed by 'engineering' with 74 people.

Employment

As can be seen in Figure 23, the most common employment category was 'Working full-time' (n=376 or 31.3%), followed by 'retired or on a pension' (n=184 or 15.3%), 'self-funded retiree' (n=144 or 12%) and then 'working part-time' (n=138 or 11.5%). A detailed breakdown of this measure is available in the supplementary document *Australian Beliefs and Attitudes Towards Science: Data Tables*.



The breakdown of main occupations of respondents who reported they were working full-time, part-time or on a casual basis (n=625) is presented in Figure 24.



CONTACT US

ANU College of Physical and Mathematical Sciences

The Australian National University
Peter Baume Building #42A
Linnaeus Way
Acton ACT 2621 Australia

T 02 6125 0498
E cpas@anu.edu.au
W cpas.anu.edu.au

CRICOS Provider #00120C