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Public Attitudes to Science 2014

Main Report

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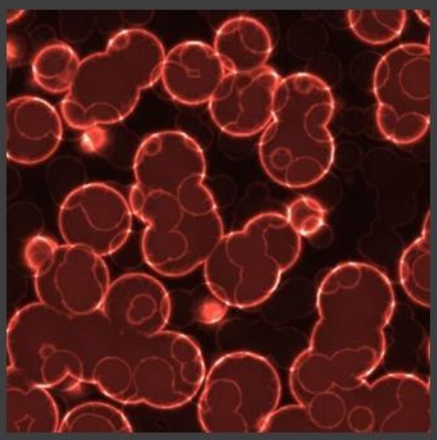

Department for Business, Innovation & Skills

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

Foreword

David Willetts MP

I am pleased to present Public Attitudes to Science 2014, the fifth in this series of studies, which for the first time, enables some trends to be tracked as far back as 1988.

As you will see, this study uses a more innovative approach, using research from online communities and social media listening, as well as the traditional face-to-face survey of the UK public. I recognise that digital technology has a significant role to play in opening up policymaking and welcome a greater understanding of how this can be used to communicate science.

In my role as Science Minister, I am very pleased to see that the UK public overwhelmingly think that science is important and take an interest in it. In fact, there has been a gradual long-term increase in agreement of this, with the public appearing much more interested in science today than they were in 2000 and before. However, alongside this, there is a public appetite to hear more information, which our engaging “Day of Discovery” successfully proved. I was delighted to hear that most participants took the spontaneous opportunity to talk with scientists about their work and research and also reflected on their own science journey and how science, in its broadest form, has influenced their lives.

I hear the message that there is a strong desire to find out about potential new developments in science and technology before they happen, not afterwards. This is great news, and is an important message for all of us involved, be it industry, the research sector or the Government. This research also helps to build our attitudinal evidence of some of the *Eight Great Technologies*, which will help us make better policy decisions and ensure these important technologies are developed in a responsible way that meets the needs of business and society.

This leads me to consider the pace of change. Although this remains an area of public concern, I am encouraged to read that long-term trends show the public is more at ease with science and the pace of change, influenced in part by a new younger generation who have played a big part in shifting attitudes and tend to be very interested in science.

On this note, I encourage you to make use of the research and the raw survey data available to improve our public engagement with science for future generations.

David Willetts MP, Minister for Universities and Science

Acknowledgements

Ipsos MORI would foremost like to thank the members of the public who took part in the surveys, as well as the general public participants and scientists who were involved in the various strands of qualitative research. We would also like to thank Alice Taylor-Gee and colleagues at the British Science Association for running the Public Attitudes to Science blog, as well as the contributors to the blog. Finally we would like to thank Karen Folkes and Kerry Seelhoff at the Department for Business, Innovation and Skills, and members of the Public Attitudes to Science 2014 steering group for their input throughout the study.

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Summary

Summary

Public Attitudes to Science (PAS) 2014 is the fifth in a series of studies looking at attitudes to science, scientists and science policy among the UK public. The study was conducted by Ipsos MORI, in partnership with the British Science Association, on behalf of the Department for Business, Innovation and Skills and the Economic and Social Research Council. It employed a mix of methodologies, including:

- a representative survey of 1,749 UK adults aged 16+ and a booster survey of 315 16-24 year-olds, which were carried out from 15 July to 18 November 2013[1]
- face-to-face qualitative research with a general public audience to further explore issues raised by the survey data
- online qualitative research and social listening to explore how people find out about and discuss science online.

In addition to this report, an infographic showing the key findings from the study has also been published.[2]

The state of public attitudes in 2014

The public continue to see science as important

The UK public continue to see science as beneficial to society. Four-fifths (81%) agree that science will make people's lives easier, and over half (55%) think that the benefits of science outweigh any harmful effects – very few (16%) disagree with this latter point of view.

People are overwhelmingly positive about the contribution science makes to the UK economy, in terms of growth, international competitiveness and future prosperity. For example, three-quarters (76%) think scientific research makes a direct contribution to economic growth in the UK, and nine-in-ten (91%) agree that young people's interest in science is essential for our future prosperity.

Many also value the contribution it has made to their own lives. Half (51%) think the science they learnt at school has been useful in their everyday lives, while three-quarters (76%) think this of the maths they learnt at school.

Recognising these impacts, the public continue to support government funding of science. Eight-in-ten (79%) agree that, even if it brings no immediate benefits, scientific research which advances knowledge should be funded by the Government. Two-thirds (65%) also *disagree* that this funding should be cut because the money can be better spent elsewhere.

People are overwhelmingly positive about the contribution of science to the UK economy

[1] The main survey used a probability sampling approach while the 16-24 year-old booster survey used a quota sampling approach.
[2] This is available on the Ipsos MORI website, at: http://www.ipsos-mori.com/pas2014.

Scientists and engineers are highly respected

The public's overall perceptions of scientists and engineers are also strongly positive. Nine-in-ten think that scientists (90%) and engineers (88%) make a valuable contribution to society and eight-in-ten (83%) agree scientists want to make life better for the average person.

People tend to hold slightly different expectations for scientists than for engineers. The traits people consider to be most important for scientists are honesty (chosen by 45%), ethical behaviour (38%) and open-mindedness (33%). For engineers, creativity (48%), open-mindedness (35%) and honesty (33%) are considered the most important traits to possess.

Generally, scientists and engineers are meeting these expectations. Both are viewed on balance as creative, interesting and open-minded people. Most also see them as honest and ethical, though less so for scientists than for engineers.

Traits less commonly attributed to scientists and engineers are good communication skills and openness. Four-in-ten (40%) say scientists are poor at communicating and three-in-ten (28%) think this about engineers. Five-in-ten (50%) consider scientists to be secretive, while three-in-ten (31%) say this about engineers.

Despite this, scientists and engineers are highly trusted figures overall, although trust is still linked to the institutions that they work for, as per previous PAS studies. For instance, nine-in-ten (90%) trust scientists working for universities to follow any rules and regulations, while six-in-ten (60%) say this about scientists working for private companies.

At the same time, people still have concerns about the independence of scientists. Three-quarters (77%) think this independence is often put at risk by the interests of funders, while two-thirds (66%) specifically feel that scientists are too dependent on business and industry for funding.

People do not know much about how scientists work

Although around seven-in-ten feel they know what scientists (68%) and engineers (73%) do, other findings suggest that there are still common misconceptions about how scientists carry out their work. While a large majority (82%) understand that it is normal for scientists to disagree, a third (35%) still think that scientists adjust their findings to get the answers they want. Only a third (34%) *disagree* that scientists adjust their findings, with another one-in-three (31%) undecided or neutral about this.

The concept of peer review in science also seems not to be widely understood, or is treated with scepticism by some. Three-in-ten (29%) think scientific research is never or only occasionally checked by other scientists before being published.

The public also lack awareness of how scientific research is funded, particularly outside of government funding. When asked unprompted who

Scientists and engineers are seen on balance as creative, interesting and open-minded

funds science in the UK, while seven-in-ten (70%) mention the Government, just over a third (36%) mention private companies and just under two-in-ten (17%) say they do not know.

People are interested in knowing more about science

The UK public overwhelmingly think it is important to know about science. Over eight-in-ten (84%) agree that science is such a big part of our lives that we should all take an interest, and seven-in-ten (72%) agree that it is important to know about it in their daily lives.

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More people do not feel informed (55%) than feel informed (45%) about science, and scientific research and developments – this has typically been the case since 2005. Against this backdrop, there is an appetite for hearing more about science – only six per cent say they see and hear too much information about science, while half (51%) think they see and hear too little.

People especially want to hear directly from scientists. Six-in-ten (58%) think that scientists currently put too little effort into informing the public about their work, while five-in-ten (53%) think that scientists should be rewarded for doing so. Seven-in-ten (68%) would particularly like scientists to talk more about the social and ethical implications of their research.

Public involvement is important

There is an overwhelming desire for regulators, government and scientists to engage in dialogue with the public. Seven-in-ten (69%) think that scientists should listen more to what ordinary people think. Even more feel that the Government should act in line with public concerns about science (75%), and that regulators need to communicate with the public (88%).

At the same time, it should be recognised that not everyone wants to be involved. Over four-in-ten (43%) say that they would like to know the public are involved in the decisions made about science issues, but do not want to be involved personally, while a further quarter (24%) have no interest in public involvement as long as scientists are doing their jobs. This does leave three-in-ten (29%) who claim they would like to at least have more of a say – this represents around 15 million UK adults.

Moreover, people still recognise the need for expert input, and do not necessarily want the general public alone to be tasked with making decisions. Seven-in-ten (70%) agree that “experts” and not the public should advise the Government about the implications of scientific developments.

How have attitudes evolved over time?

Attitudes in two particular areas have changed markedly since 2011, when the previous PAS study was conducted:

- Generic trust in scientists and engineers appears to have increased, regardless of the institutions they work for. Alongside this, the proportion who feel they have no option but to trust those governing

science has increased (from 60% to 67%), which suggests this increasing trust may also be an *increasingly resigned* trust, presenting a challenge for those looking to engage the public in decision-making.

- Perhaps in light of the more optimistic economic climate in which PAS 2014 takes place relative to previous years, attitudes towards science's economic impact and support for government funding of science have improved. The proportion *strongly* agreeing that scientific research directly contributes to UK economic growth has risen (from 23% to 28%), as has the proportion strongly *disagreeing* that government science funding should be cut because the money can be better spent elsewhere (from 23% to 30%).

PAS 2014 also highlights how attitudes to science in the UK have become considerably more positive over a much longer period of time:

- More now think the benefits of science outweigh the harmful effects than 25 years ago (55% agree, versus 45% in 1988).
- People are now more comfortable about the pace of change – just a third (34%, versus 49% in 1988) now agree that science makes people's lives change too fast.
- Fewer now see a conflict between science and faith – just three-in-ten (30%, versus 44% in 1988) now think we depend too much on science and not enough on faith.
- More now agree that it is important to know about science in their daily lives (72% agree, versus 57% in 1988).

Typically, the data show that these long-term trends are not just due to people's attitudes changing as they have got older. More often, they can be attributed to the emergence of a new younger generation, who tend to have more positive views than older generations, and particularly to be more comfortable with the pace of change.

How do people engage with science today?

Traditional media is still important

Most people still find out about science most regularly from traditional media. Six-in-ten (59%) say TV is one of their most regular sources of information on science and a quarter (23%) say print newspapers are one of their most regular sources. By contrast, under two-in-ten (15%) say online newspapers or news websites are one of their two most regular sources.

The online qualitative research found TV and newspapers to be particularly passive sources, through which participants found out about science even when they were not actively looking for science stories or information. On the other hand, the internet was, among these online participants, a far more common source when they were actively seeking out information on science issues. Within this, there was no pattern in how participants chose their

59%

say TV is one of their most regular sources of science information

online sources – some had specific websites that they trusted, and some would check multiple sources, but others would simply look at the higher-ranking pages on Google.

There is low trust in science journalism

While large numbers say they get most of their information on science from television news programmes or newspapers, most people are critical of the reporting of science. Seven-in-ten (71%) think that the media sensationalises science – a consistent concern since the 2000 study.

Linked to this, they tend to make negative assumptions about the journalists who write science stories. Over half (55%) think these journalists only occasionally hold relevant qualifications in science, while one-in-five (19%) think this is never the case. Half (50%) also think journalists only occasionally check that findings are reliable before writing about them, while 15% think this never happens.

The face-to-face qualitative research highlighted the difficulty of changing these perceptions, as participants thought sensationalism was an inherent part of all journalism. Nonetheless, it was suggested that trust could be increased by more articles that debate the pros and cons of particular technologies, rather than taking singular viewpoints. They also suggested making layperson-friendly versions of journal articles available, and liked the idea of blogs written or approved by scientific organisations.

How people discuss science online depends on various factors

The findings of the social listening research suggest that social media can be an effective way to communicate science, provided that the messages come from those who are seen as having scientific authority. Politicians generally lacked credibility in conveying these messages, unless people felt they had the backing of scientific organisations.

Science topics with a humorous slant, visual appeal, or a public health element also appear more likely to reach a wider social media audience. Participants in the online qualitative research noted that they would typically only share science stories through social media if they met at least one of these criteria.

However, the social listening shows that the marker of high-quality scientific debate among the public online is not necessarily how many people are talking about an issue. For the horsemeat scandal, the widespread online conversation largely lacked science content. In the case of animal research and the badger cull, science was typically cited to shore up ethical or political arguments, rather than to inform.

People treat science activities as part of a wider range of cultural activities

In the past year, two-thirds (67%) have undertaken a science-related leisure or cultural activity, such as a visit to a nature reserve (40%), a zoo or aquarium (39%), a science museum (23%) or a science and discovery

centre (13%). Just three per cent say they attended a science festival, suggesting these remain a relatively niche activity

The two-thirds who have undertaken a science-related activity are also more likely to have taken part in a non-science related cultural activity over the same period, such as a visit to an art gallery, another non-science related museum or a literature festival. This indicates that there is a single group of people who typically go to all sorts of cultural activities, whether science or arts-related, rather than two different sets of people who immerse themselves either in science or in arts-related cultural activities.

Women appear to play a particularly important role in informal science learning

Attitudes to specific science topics

While people do not on balance feel informed about science as a whole, this does change when it comes to specific topics. Of the specific science and social science topics explored in the survey, people feel relatively well informed about climate change, vaccination, renewable energy, economics, and animal research. Most do not feel informed about nuclear power, genetically modified (GM) crops, clinical trials, stem cell research, nanotechnology or synthetic biology.

Similarly, while people on balance think the benefits of science outweigh any harmful effects, this also becomes less clear-cut when it comes to these specific topics. While more still think the benefits outweigh the risks than vice versa for each of these topics, a sizable minority (28%) say the risks outweigh the benefits for GM crops, animal research and nuclear power, suggesting these topics remain particularly contentious.[3]

How do attitudes differ within the population?

PAS 2011 identified six segments with different attitudes to science that exist among the UK public. While these segments are still relevant in 2014, this latest PAS study reiterates the important differences in attitudes among the more basic subgroups of gender, age and affluence:

- Women are less likely than men to feel informed about science and often feel less confident in engaging with it. When it comes to studying and working in science and engineering, women tend to be less positive. This gender divide may develop before adulthood, with far fewer young women than young men participating in science or engineering clubs at school.

  At the same time, it should be acknowledged that women appear to play a particularly important role in informal science learning. People are more likely to go with their mother rather than their father to science-related leisure or cultural activities, and women themselves are more likely to take others with them rather than going alone.

[3] PAS 2014 also explored attitudes to four specific science topics in more detail, namely big data and energy-efficient computing, agri-science and food security, robotics and autonomous systems, and emerging energy technologies. These topics, while not covered in this summary, are covered in detail in Chapters 11-14 of the Main Report.

- Young adults aged 16-24 tend to be more neutral in their attitudes to science. They are less likely to think that the benefits of science outweigh any harms, and are somewhat less positive about the economic contribution or government funding of science. At the same time, they are less critical of science reporting and seem less concerned about what scientists might do behind closed doors, or how they are funded.

  They also have different media habits to their parents. A quarter (24%) of 16-24 year-olds say online newspapers or news websites are one of their most regular sources of information about science, while one-fifth (21%) say this of social networking websites. Nevertheless, even among this age group the importance of traditional media as an information source should not be overlooked.

- Those who are less affluent tend to feel less well informed about science and are less likely to feel they know what scientists do. Perhaps as a result they tend to feel more concerned about the speed of development and the conflicting information they see.

  This group also present a particular challenge for those attempting to involve the public in decision-making – while the less affluent are typically the strongest advocates for involving the public, they tend to be among the most cynical about public consultations, and among the least likely to want to get involved themselves.

Conclusions

PAS 2014 shows that the UK public are as enthusiastic about science as they ever have been, with attitudes to science having come a long way over the past 25 years. While many of the findings reinforce existing research, there are a variety of new insights around the use of traditional and online media, the role of women in informal science learning, the impact of emerging younger generations and the way science is viewed as a cultural activity. The study also poses questions and challenges around trust in science and willingness to get involved in decision-making, which might be further explored in future research.

Introduction

1 Introduction

This report presents the findings from a programme of quantitative and qualitative research carried out as part of Public Attitudes to Science (PAS) 2014, a study of attitudes among the UK public. The research was conducted by Ipsos MORI, in partnership with the British Science Association (BSA), on behalf of the Department for Business, Innovation and Skills (BIS) and the Economic and Social Research Council (ESRC).

In addition to this report, an infographic showing the key findings from the study has also been published.[4]

1.1 Background and context

The importance of science in society

In his 2012 speech[5] to the Royal Society, the UK Chancellor of the Exchequer, George Osborne, underlined the important contribution that science makes, not only to the UK economy, but also to society. This wider contribution is recognised through the Government's Science and Society programme, led by BIS in consultation with its stakeholders.[6]

The vision of the Science and Society programme is that all citizens share in the development and contribution of science to UK culture, quality of life, sustainable economic development and growth, and feel a sense of ownership about the direction of science and technology in the UK. Two aspects underpin this vision: the belief that everyone has an opportunity to contribute to the relationship between science and society, through education, communication, public engagement and debate; and a commitment to listening to and learning from the expertise and insight of the different communities who are engaged.

The Public Attitudes to Science studies

The UK Charter for Science and Society[7] calls for public policy and debate to be enhanced by more extensive and purposeful engagement with all sectors of society, with the views of the public being considered alongside evidence from scientists and engineers. The PAS studies are one of the main ways in which BIS monitors the views of the public, and can assess the achievements of the Charter.

PAS 2014 is the fifth in this series. It continues to measure and build on the trends uncovered in the four previous studies:

[4] This is available on the Ipsos MORI website, at: http://www.ipsos-mori.com/pas2014.
[5] The text of this 9 November 2012 speech is available on the gov.uk website, at: https://www.gov.uk/government/speeches/speech-by-the-chancellor-of-the-exchequer-rt-hon-george-osborne-mp-to-the-royal-society.
[6] More information on the Science and Society programme can be found on the programme website, at: http://scienceandsociety.bis.gov.uk/.
[7] The UK Charter for Science and Society is available on the gov.uk website, at: https://scienceandsociety.blog.gov.uk/.

- Public Attitudes to Science 2011
- Public Attitudes to Science 2008
- Science in Society (2005)
- Science and the Public (2000).

As with the previous studies, a steering group oversaw the development of PAS 2014. Group members were drawn from government departments and other public bodies, academics, scientific bodies and industry associations. A full list of steering group members is in Appendix A.

PAS 2014 also featured a study blog, hosted by the BSA. As well as helping to disseminate the findings, the blog has enabled scientists and science communicators to comment on the study while it has been taking place.[8]

Important developments since Public Attitudes to Science 2011

There have been many developments in science policy, science communication and indeed in science itself since PAS 2011 was published in May 2011. A significant development in science policy was the allocation of an extra £600 million in funding towards *Eight Great Technologies*, which were outlined in a 2013 speech and report of the same name by David Willetts, UK Minister for Universities and Science. Beyond this, there have been several widely-covered science news stories and a wave of new science-related TV programmes.

Table 1.1 outlines some of the major developments, news stories and TV programmes. This is not intended to be a comprehensive list, but a small snapshot of the science stories and programmes that may have influenced or framed attitudes, especially to the specific topics explored in PAS 2014.

[8] The PAS 2014 blog can be found on the BSA website, at: http://www.britishscienceassociation.org/blog?field_section_term_tid=624.

Table 1.1 – timeline of major developments since Public Attitudes to Science 2011

Year	Month	Event
2012	May	Genetically modified (GM) wheat crop trial begins at Rothamsted Research
	July	Discovery of Higgs boson reported
	August	Curiosity Rover lands on Mars
	October	Ash dieback recorded in UK countryside
	November	Swansea measles epidemic begins
		First series of Dara O'Briain's Science Club on BBC Two
2013	January	*Eight Great Technologies* speech by David Willetts
		Frozen beef-burgers in UK supermarkets revealed to contain horsemeat
		Wonders of Life series starts on BBC Two
	February	Chelyabinsk meteor crashes in Russia
	April	BBC Horizon programme on big data
	June	Speech on GM crops by Owen Paterson, Secretary of State for Environment, Food and Rural Affairs
	July	Swansea measles epidemic declared over
		BBC Horizon programme on fracking to extract shale gas
	August	Badger cull begins in Somerset and Gloucestershire
	September	UN Intergovernmental Panel on Climate Change declares 95% certainty that humans are the dominant cause of global warming
		Speech by George Osborne introducing tax breaks for shale gas extraction
	October	Badger cull in Somerset and Gloucestershire extended
	December	Release of *Brown Report* on treatment of animals at Imperial College London

1.2 Research objectives

The study had several wide-ranging objectives, covering many aspects of people's attitudes to science, including:

- what people think about science, scientists and UK science policy, and why they think this
- people's confidence in science regulation and policymaking
- how people find out about science, and how the development of social media has impacted on this
- views on public involvement in decision-making on science issues
- how science is pursued as a leisure or cultural activity
- how attitudes have changed over time, including how the six attitudinal segments identified in PAS 2011 have evolved
- how UK attitudes compare to those in other countries (where comparable data are available).

As before, the study also looked at attitudes towards specific science topics, chosen by BIS and the PAS 2014 steering group. The survey explored how informed people feel about several specific topics, and whether people think the benefits outweigh the risks in each case. Beyond this, four emerging areas of science and technology – three of which were from the list of *Eight Great Technologies* – were selected for a more detailed examination of public attitudes:

- big data and energy-efficient computing
- agri-science and food security
- robotics and autonomous systems
- emerging energy technologies (offshore wind farms, fracking to extract shale gas, and carbon capture and storage).

These four topics are covered in their own chapters (Chapters 11-14) in this report.[9] The big data chapter (Chapter11) is also supplemented with findings from a public dialogue exploring attitudes to administrative data linking, which took place alongside the PAS research in late 2013. The dialogue was

[9] The survey questions covered in these chapters were asked of around a quarter of the main sample, who were randomly selected. While the findings are still representative of the UK public, it should be remembered that margins of error are higher than for questions covered in the rest of the report.

carried out by Ipsos MORI on behalf of the ESRC and the Office for National Statistics.[10]

1.3 Methodology

PAS 2014 employed a mix of quantitative and qualitative methodologies, including:

- a main face-to-face survey of 1,749 UK adults aged 16+, which was carried out from 15 July to 18 November 2013 using a probability sampling approach
- a booster face-to-face survey of 315 16-24 year-olds carried out over the same period using a quota sampling approach, so that the attitudes and behaviour of young adults could be compared and contrasted with those of the overall population
- social listening, tracking how various science topics were discussed online – findings from this strand are covered in Chapter 5, and have also been published as five separate topic-specific reports[11]
- four waves of online qualitative research with members of the Ipsos MORI Connects online community to explore in more depth the attitudes and behaviours of those who are already online
- eight follow-up face-to-face observational interviews with members of the online community, observing how they sought out science-related information online
- a Day of Discovery workshop with 106 members of the general public in London on 11 January 2014 to further explore issues raised by the survey data.

Data from the main survey are weighted to be representative of the UK adult population profile. Data from the boost survey were combined with interviews from the main survey to create an overall dataset of 510 16-24 year-olds, which was then weighted to represent the UK 16-24 age group profile. All findings relating to 16-24 year-olds or 16-17 year-olds in this report are taken from this combined dataset.

PAS 2014 moves the main survey from quota sampling to a probability sampling approach for the first time. This was done to ensure that the findings are as robust as possible, and to give added assurance of their reliability to those who use the data. It serves to bring the PAS series in line with other respected public opinion surveys such as the *Wellcome Trust Monitor*. In addition, it allows for comparisons to surveys conducted before

[10] A full report from this public dialogue is due to be published in 2014 as: Cameron, Pope and Clemence (2014) *Dialogue on Data: Exploring the public's views on using linked administrative data for research purposes*, Economic and Social Research Council, and Office for National Statistics. This will be available on the ESRC website, at: http://www.esrc.ac.uk/public-engagement/.

[11] These are available on the Ipsos MORI website, at: http://www.ipsos-mori.com/pas2014.

the PAS studies began – the comparability of PAS 2014 to these surveys and to the earlier PAS surveys is discussed further in the next section.[12]

A separate Technical Report has been published with the full technical details of the surveys and qualitative research. This includes a copy of the questionnaire, the response rate for the main survey and a demographic profile of those who participated in each qualitative research strand.[13]

1.4 Interpretation of the data

How to interpret the survey findings

It should be remembered that the survey findings are based on a sample of UK adults, rather than the entire population. Therefore, results are subject to sampling tolerances, and not all differences are statistically significant. Throughout this report, only differences that are statistically significant at the 95% level of confidence are commented on.[14] Appendix B provides a guide to statistical reliability.

The report sometimes refers to "net" scores. These represent the balance of opinion on attitudinal questions and are a particularly useful way of comparing results across a number of issues. For example, if 40% agree and 25% disagree, the "net agree" score is +15.

Where percentages do not sum to 100%, or to net scores, this may be due to computer rounding, or when questions allow multiple answers. An asterisk (*) within a chart denotes any value less than half a per cent but greater than zero.

How to interpret subgroups

The following should be noted when interpreting the different subgroups referred to throughout the report:

- Social grades are used to explore whether attitudes differ by affluence. The grades range from A to E. this report typically refers either to people in the two most affluent social grades (ABs) or the two least affluent (DEs). Definitions of the social grades are available in Appendix C.

- When findings differ by ethnicity and it is clear from the data that differences relate to a particular ethnic group (e.g. Asian or black people), that group is highlighted, rather than ethnic minorities overall.

[12] As part of the PAS 2014 blog, Tim Silman, one of the authors of this report, has written a blog post on the British Science Association website, further explaining the move from quota sampling to probability sampling: http://www.britishscienceassociation.org/blog/pas-2014-adopting-gold-standard.
[13] This available on the Ipsos MORI website, at: http://www.ipsos-mori.com/pas2014.
[14] Strictly speaking, tests for statistical significance apply only to samples that have been selected using probability sampling methods, so would not apply to the 16-24 year-olds sample. However, in practice, it is reasonable to assume that these tests provide a good indication of the margins of error on quota samples as well.

When differences do not clearly relate to a particular group, this distinction is not made.

- Those with children at home are defined as those who have children aged 15 or under living with them.

The science knowledge quiz

The survey included a science knowledge quiz intended to measure people's basic scientific literacy. This comprised nine true-or-false questions. Based on their scores on the quiz, people have been split into three subgroups which are referred to throughout the report. Those who answered four or fewer questions correctly were classified as "low" scoring, those who answered five to seven questions correctly were classified as "medium" scoring and those answering eight or nine questions correctly were classified as "high" scoring. This follows the exact same questions and classification approach used in other surveys in the UK and elsewhere, including the *Wellcome Trust Monitor*.[15]

The Public Attitudes to Science segments

PAS 2011 observed six segments with different attitudes to science that exist among the UK public:

- Confident Engagers tend to have the most positive attitude towards science of all the segments, and have relatively few concerns about scientists, regulators, or the relationship between the Government and science. However, they are concerned about how the media reports science and the media's influence on science policy.

- Distrustful Engagers are highly enthusiastic about science but tend to be less trusting of scientists, regulators and the Government. Consequently, they tend to think the public should play a larger role in decision-making and are less satisfied with leaving this to "experts".

- Late Adopters did not enjoy science at school, but have become more interested in it as adults, and now want to have more of a say in decision-making. Their interest tends to be linked to their environmental and ethical concerns, so they tend to be more engaged with specific issues such as climate change and genetically modified crops.

- The Concerned tend to have a more religious or spiritual outlook on life and consequently have stronger views on the limitations of science. They support Government efforts to consult the public on science, but have concerns about whether scientists themselves take the findings of these consultations on board.

[15] It should be noted that, based on these knowledge scores, the PAS 2014 main survey sample does appear to be somewhat more knowledgeable than the sample achieved in the 2013 *Wellcome Trust Monitor* (Wellcome Trust/Ipsos MORI). In PAS 2014, 31% got a high score, compared with 24% in the 2013 Monitor.

- The Indifferent tend to be older, often retired people. They are not especially negative or worried about science, but tend to think science is not for people like them, so are less interested in finding out about it or in getting involved in decision-making.

- Disengaged Sceptics have typically found science overwhelming since school, and do not feel informed about it today. They are often concerned about the speed of development in science, so tend to favour a conservative approach to regulation, and one that takes the public's views into account. However, they are less confident in getting involved themselves.

PAS 2014 retained questions from the 2011 survey in order to map the 2014 sample to this existing segmentation.

Where appropriate, this report comments on the segments as subgroups – this is only done for questions that were not used to define the segments in the first place (and where significant differences between segments would be expected). Chapter 10 also looks more specifically at how these segments have evolved since the 2011 survey.

Comparisons to previous studies

Where possible, the PAS 2014 survey findings are compared to those in previous studies, to look at changes in attitudes over time. As well as making comparisons to the four previous studies in the PAS series, PAS 2014 also includes questions taken from two earlier surveys, so that changes over a much longer period of time can be observed:

- the 1996 British Social Attitudes Survey

- the 1988 Public Understanding of Science survey, conducted on behalf of the Economic and Social Research Council.

Although the 2014 survey has been designed to be comparable to previous waves, and should provide a good indication of the direction in which public attitudes have moved over the last 25 years, it is important to acknowledge the various changes to the research design between studies, which may have affected the results.

The 2014 questionnaire has been designed to maintain the question order from the 2011 survey as much as possible, so as not to introduce new biases. However, it is not necessarily consistent with the pre-2011 surveys and, generally speaking, there have been several variations in the order of questions between waves. The instances where this is likely to have impacted on trends are pointed out in the report.

As aforementioned, the PAS 2014 main survey used a probability sampling approach. While this approach makes the survey comparable to the 1996 and 1988 surveys (see Table 1.2), it means that, strictly speaking, differences observed between the 2014 data and the earlier quota sample

surveys could be due to the different samples achieved, rather than due to an actual change in attitudes over time.

Nevertheless, it should be noted that on most indicators, the findings from PAS 2014 are unchanged from those in PAS 2011. Moreover, where differences are observed, these often reflect a gradual change over the course of several study years, rather than a one-off shift. Taken together, these observations provide some reassurance that PAS 2014 data remain broadly comparable to previous waves, despite the change in sampling approach. By the same token, they also help to reinforce the reliability of the PAS 2011 findings.

There are also other relatively minor design differences between surveys, highlighted in Table 1.2. A number of different organisations have carried out the PAS surveys using a different set of interviewers, and the surveys have moved from paper to computer (CAPI) interviewing, which may have affected the answers recorded at unprompted questions. Also, the earlier surveys were conducted in Great Britain only, as opposed to the UK (i.e. including Northern Ireland), and did not encompass 16-17 year-olds, although the impact of these minor differences are likely to be negligible at the overall level.

Table 1.2 – survey approaches of Public Attitudes to Science studies and earlier studies

Year	Interviewing organisation	Sampling approach	Survey mode	Achieved sample
2014	Ipsos MORI	Probability	CAPI	1,749 UK adults (16+)
2011	Ipsos MORI	Quota	CAPI	2,103 UK adults (16+)
2008	TNS	Quota	CAPI	2,137 UK adults (16+)
2005	MORI (now Ipsos MORI)	Quota	Paper	1,831 UK adults (16+)
2000	Harris Research	Quota	Paper	1,839 British adults (16+)
1996	NatCen	Probability	CAPI	3,662 British adults (18+)
1988	NatCen	Probability	Paper	2,009 British adults (18+)

How to interpret qualitative findings

Where findings from the qualitative research strands are referred to, these are intended to provide further context for the survey findings, as well as insight into *why* people may hold certain views, rather than be statistically representative. While these findings cannot be generalised and considered to represent all UK adults, those taking part in the qualitative research were recruited to quotas which ensured that a wide range of people with different

views were included. A demographic profile of participants in the qualitative research is included in the separately published Technical Report.

It should especially be remembered that the online qualitative research was conducted with participants who, by their nature, are predisposed to find out about science online. Indeed the intention of this strand of the research was to explore *how* people find out about science online, but it cannot say how common this behaviour is.

Throughout the report, verbatim quotes from qualitative research participants are used. These are again not intended to be statistically representative. They are intended to illustrate the themes and findings explored throughout the report.

How people see science

2 How people see science

This chapter looks first at what science means to the UK public. It then explores people's hopes and concerns about science, both generally and with regards to several specific science topics. It also examines the extent to which religion influences attitudes to science.

Key findings

- People most commonly associate science either with biology, chemistry or physics, or with the various outputs of scientific research. They seem less likely to view it as a way of thinking, with relatively few spontaneously mentioning things like ideas, innovation or experiments.
- Half the public think science and engineering are different things. Compared to science, people are somewhat less likely to see jobs in engineering as interesting and more likely to think of it as a dying industry. Nevertheless, seven-in-ten do still see jobs in engineering as interesting.
- As in 2011, the UK public overwhelmingly see science as beneficial and think that it will make people's lives easier. Nonetheless, there are certain specific science topics that still tend to be more contentious, such as genetically modified (GM) crops, animal research and nuclear power.
- On balance, people do not appear to see any conflict between science and faith. There are some indications that strong religious beliefs are associated with less supportive attitudes towards science, but this is not clear-cut, with other indicators showing no relationship between religious beliefs and attitudes to science.

2.1 What is science?

Spontaneous notions of science

When asked unprompted, people most commonly associate science with biology, chemistry or physics (28%). Far fewer mention any other specific disciplines, such as engineering (4%) or any social sciences (2%). While the focus on natural science might be expected given that this is how science is taught at school, this association has not always been so strong – in 2005, biology, chemistry or physics were only mentioned by 15%, with laboratories being the most common response (at 19%).[16]

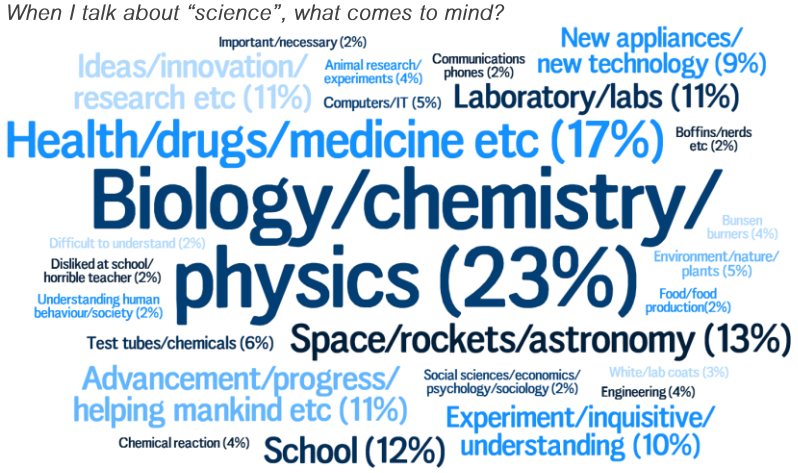
[16] While a similar question was also asked in 2011, this asked what people associated with "the sciences", so is not directly comparable to 2014.

Several other answers focus on the outputs of science, as can be seen in Figure 2.1. Within this, the most common answers are around health and medicine (17%), reflecting the strong relationship people see between science and medicine. Relatively few spontaneously associate science with a way of thinking, mentioning things like ideas or innovation (11%) or experiments (10%). Broadly, none of these proportions have changed since 2005.

This is not to say people have a narrow definition of science. A quarter (23%) give three or more answers to the question, suggesting a broader understanding of science. Confident Engagers in particular stand out based on how varied their answers are, with three-in-ten (30%, versus 23% overall) giving three or more answers. By contrast, those from the Concerned and the Indifferent segments, who tend to be less engaged with science generally, are most likely to either give a single answer, to say they do not know, or to give no answer at all.

Figure 2.1 – what people associate with science

Q. *When I talk about "science", what comes to mind?*



Base: 1,749 UK adults aged 16+
N.B. word clouds are illustrative of data, not statistically representative; only codes registering 2% or more are shown

There are small but consistent differences by gender. Men are somewhat more likely than women to spontaneously mention space (16% versus 11%), advancement and progress (12% versus 9%), and new appliances or technologies (11% versus 7%). Women tend to focus more on school (14%, versus 10% of men) and are more likely to spontaneously say they disliked science at school (3% versus 1%).

Proximity to the subject appears important, as it was in 2011. Young adults are more likely to mention biology, chemistry or physics, particularly those aged 16-17 (60% say this), likely reflecting their more recent experience of science at school. Those with children at home are also somewhat more likely to associate science with school (15% mention this, versus 10% of those without children).

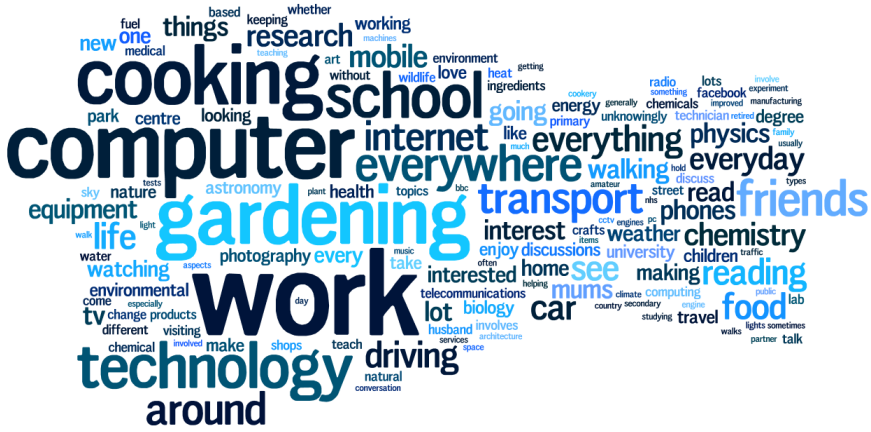
Finally, where people get their information may also shape their answers. Tabloid newspaper readers are more likely than broadsheet readers to associate science with health and medicine (19% versus 13%) and less

likely to raise broader themes such as ideas or innovation (9%, versus 14% of broadsheet readers) and new appliances or technologies (8% versus 12%). They are also more likely to give a single answer (50%, versus 38% of broadsheet readers). At the other end, those who get most of their science information from the radio – who also tend to be more affluent – are far more likely than average to give more than one answer (62%, versus 49% overall), suggesting they typically have a broader view of science.

Where does science enter people's lives?

Participants in the online qualitative research were asked how they came into contact with science in their everyday lives. The findings, as represented in the word cloud in Figure 2.2, suggest that people do, on reflection, recognise how science permeates through many aspects of their lives.

Figure 2.2 – how people come into contact with science in their everyday lives



Source: 432 members of the Ipsos MORI Connects online community

The various links people made between science and their everyday lives fitted into several broad themes:

- the technology and innovations that people used day-to-day, such as computers, the internet, satellite navigation, or mobile phones
- the sense of wonder and fascination people got from things like nature, the countryside and the stars at night
- science news stories that people heard or read about, and discussed with friends and family
- the science people's children learnt at school
- science in the workplace, for people working in IT, engineering, healthcare, teaching or technical roles – this was not only if people personally worked in these fields, but was also relevant to those who had family or friends in these kinds of jobs.

The discussions highlight that people's engagement with science is not just about what they do personally, but also strongly influenced by those around them, for example whether they have friends who are interested in discussing science stories, family members who worked in science or children who studied science.

Participants thought the technologies they used and their interaction with nature and the outdoors were avenues through which they could be engaged with science. Many also thought science could be linked to their existing interests and hobbies, such as gardening, cooking or sports, and that the language of science, in terms of "experiments" and "chemistry" was already used in these contexts.

"I make wine and beer which is a chemistry of sorts."
Online community participant

"We talk about our experiments with cake and biscuit recipes."
Online community participant

However, many acknowledged that they would not typically be conscious of these links, and had not really thought about science in these contexts before. This ties in with findings from the Day of Discovery workshop, where some participants, mainly from outside of the Confident Engagers segment, said that they might have been better engaged with science from an early age if they could see how it was already a part of their existing interests.

"Science, it's a bit daunting, but science is everything isn't it? At school, if they had said that cooking is science, then science would have been accessible."
Day of Discovery workshop participant

Science versus engineering

A recent report by the National Foundation for Educational Research (2013b) highlighted the importance of making clear links across and between science, technology, engineering and maths (STEM) subjects in order to encourage more young people to study them. In this context, PAS 2014 explores whether the adult public see science and engineering in particular differently.

Half the public (48%) think science and engineering are different things, as Figure 2.3 illustrates. Young adults aged 16-24 are especially likely to think this (55% agree, versus 48% overall), which suggests that getting younger age groups to see the two subjects in a similar light may remain a challenge. Nonetheless, among all adults, the proportion disagreeing (31%) has increased since 2011 by seven percentage points, suggesting that more people are starting to see similarities in the two subjects than before.

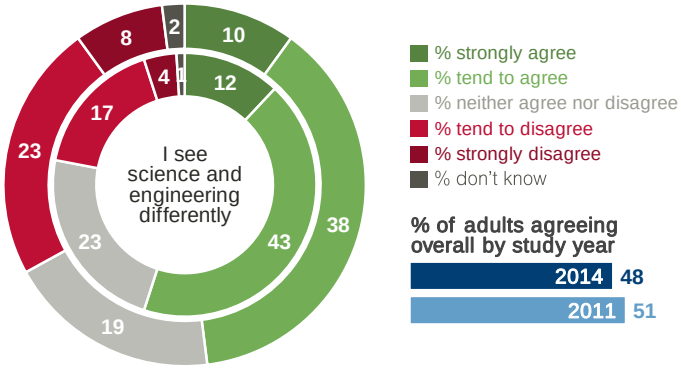
Figure 2.3 – whether people see science and engineering differently

Science is everything isn't it? At school, if they had said that cooking is science, then science would have been accessible.

Day of Discovery workshop participant

Q. To what extent do you agree or disagree with the following statement?

Outer donut: all adults aged 16+
Inner donut: 16-24 year-olds



Bases (for 2014): 1,749 UK adults aged 16+; 510 16-24 year-olds

Men are more likely than women to *disagree* that they see science and engineering differently (37% disagree, versus 25% of women) – this gender divide is also present among young adults aged 16-24. Those from ethnic minorities are more likely to disagree than white people (40% versus 30%). In addition, people who are educated to a higher level (42%) and those with a high science knowledge score (39%) are also more likely than average (31%) to disagree.

Among the segments, those most likely to see science and engineering as similar things are the Confident Engagers (46% disagree, compared with 31% overall) and Distrustful Engagers (42% disagree), as might be expected. Disengaged Sceptics are most likely to see them as different (63%, versus 48% overall).

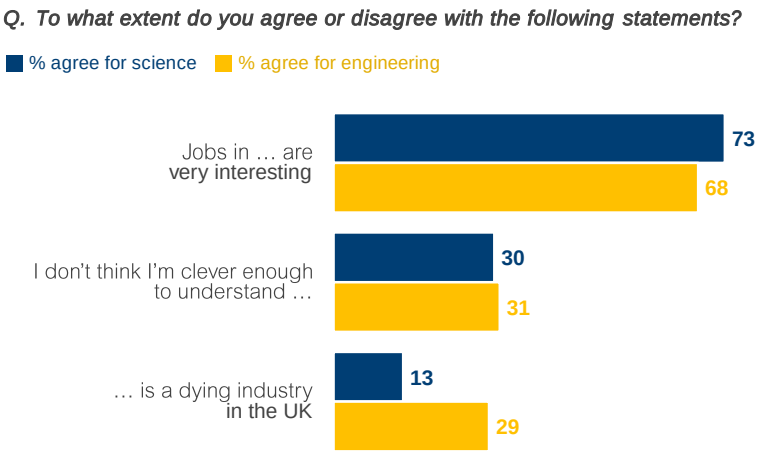
Once again, proximity to science and engineering is an influence. Those who work as or work with scientists or engineers are more likely to disagree (43%, versus 31% on average). Those who have taken part in a science-related leisure or cultural activity over the previous year are also more likely to disagree than those who have not (34% versus 26%), which suggests public engagement activities may be important in shaping how people view topics like engineering.

How do science and engineering differ?

Figure 2.4 gives insight into *how* people see science and engineering as being different. The survey showed the statements relating to science to half the sample, while the other half were shown equivalent statements relating to engineering.

While there is no overall difference in how accessible people think either subject is, more think jobs in science are interesting (73%, versus 68% for jobs in engineering), and people are more likely to say that engineering is a dying industry (29%, versus 13% for science). All these differences potentially reflect that people view the engineering industry somewhat more negatively than they view the science sector.

Figure 2.4 – how people see science and engineering differently



Bases: 858 UK adults aged 16+ asked about science; 891 asked about engineering

Attitudes to careers in science and engineering are explored again in more detail in Chapter 8.

2.2 Hopes and concerns about science

Current hopes and concerns

The UK public overwhelmingly see science as beneficial, with four-fifths (81%) agreeing that science will make people's lives easier, as Figure 2.5 illustrates. Just over half (55%) also think that the benefits of science outweigh any harmful effects. These scores are unchanged since 2011.

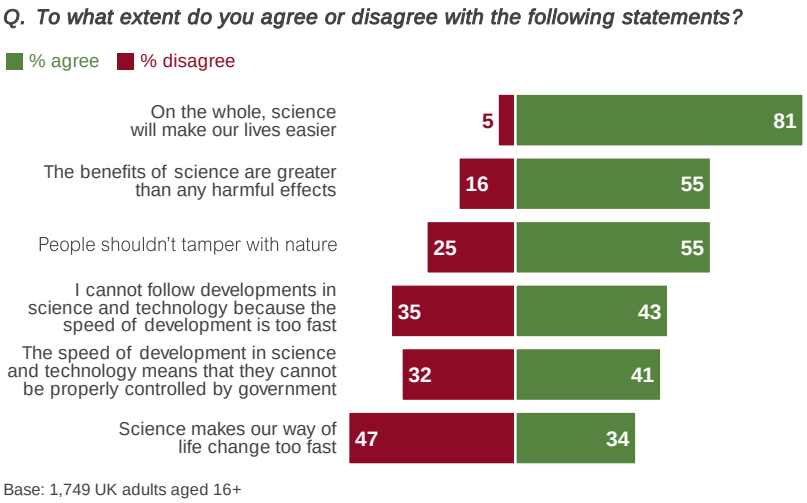
At the same time, people continue to harbour the same concerns that they expressed in 2011, particularly around the pace of change (although these concerns are still less prevalent than they once were, explored later in this section). Around two-fifths agree that the speed of development in science and technology is too fast to follow (43%) and means that they cannot be properly controlled by government (41%). A third (34%) think "science makes our way of life change too fast". There are also still concerns about tampering with nature, with over half (55%) saying people should not do this.

55%

think the benefits of science outweigh any harmful effects

Where there have been changes over time in these attitudes, these are discussed later in this section (in Figure 2.6).

Figure 2.5 – overall hopes and concerns about science



There are differences by age group, with older people aged 65 and above being more likely to think the benefits of science are greater than any harms (68%, versus 55% on average), and young adults aged 16-24 tending to be more neutral about this (34% neither agree nor disagree, versus 26% overall). On the other hand, older people tend to be more concerned about the speed of development – those aged 65 and over are more likely to agree that they cannot follow science and technology because of the speed of development (65%, versus 43% overall), that government cannot properly control science because of this (57% versus 41%) and that science makes our way of life change too fast (49% versus 34%).

International comparisons

On these indicators – both hope and concerns – the UK public are generally in line with or more positive than many other developed countries. *Special Eurobarometer 401* (European Commission, 2013) found that two-thirds (66%) of EU citizens thought "science and technology make our lives easier, more comfortable and healthier", with the UK public being somewhat more likely than average to agree (71%). A survey of the Australian public (Ipsos Australia, 2013) found that, on balance, they agreed the benefits of science outweigh any harms, but also that people should not tamper with nature, in line with the PAS 2014 UK results.

More recent data from Ipsos MORI's online *Global Trends Survey* (conducted in September 2013, publication forthcoming) suggests that people in the UK may be more accepting of the pace of change than others. They were more likely to *disagree* (45%) than those in the US and Australia

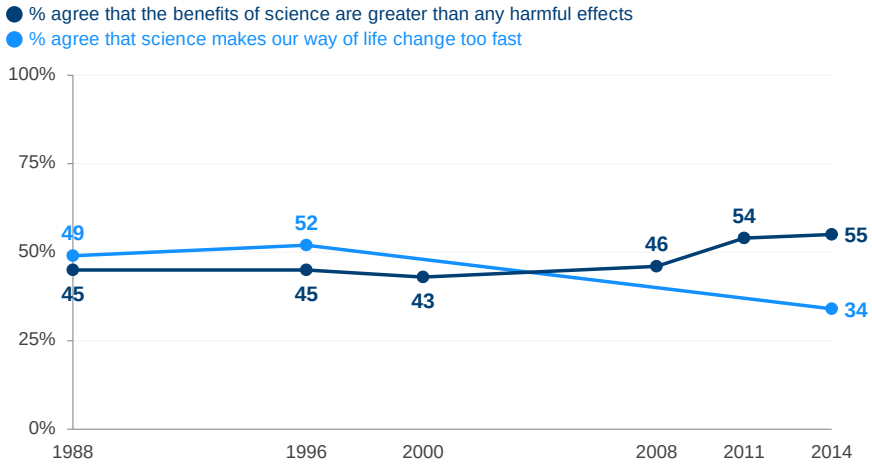
(40% respectively) that they "cannot keep up with science and technology because the speed of development is too fast".[17]

However, comparisons suggest that the UK public are more sceptical about the benefits of science than their US counterparts. The US *Science and Engineering Indicators 2014* (National Science Foundation) notes that surveys of the US public from 1979 to 2012 have typically shown that seven-in-ten think that the benefits of scientific research outweigh the harmful effects. In the 2012 US General Social Survey, half (50%) thought they *strongly* outweighed the harmful effects. While the question wording is not directly comparable to PAS 2014, the results suggest the US public appear to be more strongly supportive of scientific research generally.

Long-term trends

As indicated by Figure 2.6, people have become less concerned about the potential harmful effects of science over time, particularly in the last decade or so. Similarly, they are less concerned than they were 25 years ago about science making our lives change too fast.

Figure 2.6 – hopes and concerns about science over time



Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

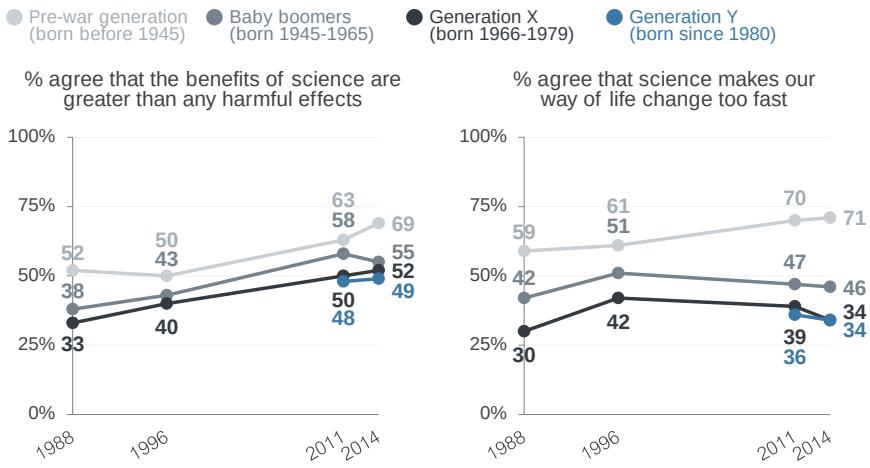
Figure 2.7 charts how these attitudes have differed since 1988 by generation, supplementing the age-subgroup analysis noted earlier. It suggests that people's attitudes do not simply change as they get older and are introduced to new science – their attitudes are also strongly tied to the era in which they were born. Younger generations have generally been more sceptical of the benefits of science relative to any harmful effects, but also more comfortable with the pace of change.

All generations taking part in the 1988 survey have since become more positive about the benefits of science. However, each generation has reacted differently to the pace of change brought about by science. Even

[17] The Global Trends Survey and PAS 2014 both record a different level of disagreement at this question. This is most likely to be due to differences in the data collection method (face-to-face versus online), so the two surveys are not directly comparable.

though fewer people overall think that "science makes our way of life change too fast" than in 1988, this downward trend seems to stem from the emergence of Generation Y, born from 1980 onwards, rather than from older generations relaxing their views over time. In fact, the pre-war generation are now *more* likely to agree with this, suggesting they in particular have become more alienated from developments in science and technology over time.

Figure 2.7 – hopes and concerns about science by generation



Bases: c.150+ adults per generation per wave

2.3 Science and religion

Existing evidence on the relationship between religion and attitudes to science is mixed. Some studies have shown that those who are more strongly religious tend to have more negative views of specific science topics (see for example Allum et al., 2012, and Scheufele et al., 2009). However, a 2009 survey by the Pew Research Center in the US showed that even those who had strongly religious beliefs were not anti-science, and the majority of this group did not see science as conflicting with their beliefs.

Much of the research to date has focused on the US population. PAS 2014 attempts to provide some UK-specific findings on this issue.

Views on the origins of life

Allum et al. (2012) suggest that views on the origins of life are a good indicator of strength of religious belief. PAS 2014 finds that two-fifths (41%) in the UK believe in evolution, agreeing that "humans and other living things evolved over time by natural selection, in which god played no part", while a further quarter (26%) think this happened as "a process guided by god". One-fifth (19%) take a more creationist viewpoint, saying that "humans and other living things were created by god and have always existed in their current form".

These results are consistent with a 2009 British Council/Ipsos MORI survey of the UK public, highlighting that views on this topic tend to be stable over time – something also noted in the 2013 *Wellcome Trust Monitor* (Wellcome

Trust/Ipsos MORI).[18] A survey by the Pew Research Center (2013b) found that around three-in-ten people in the US believe that "humans and other living things have existed in their present form since the beginning of time", which suggests that, by comparison, the UK public are less likely than those in the US to have a creationist view.

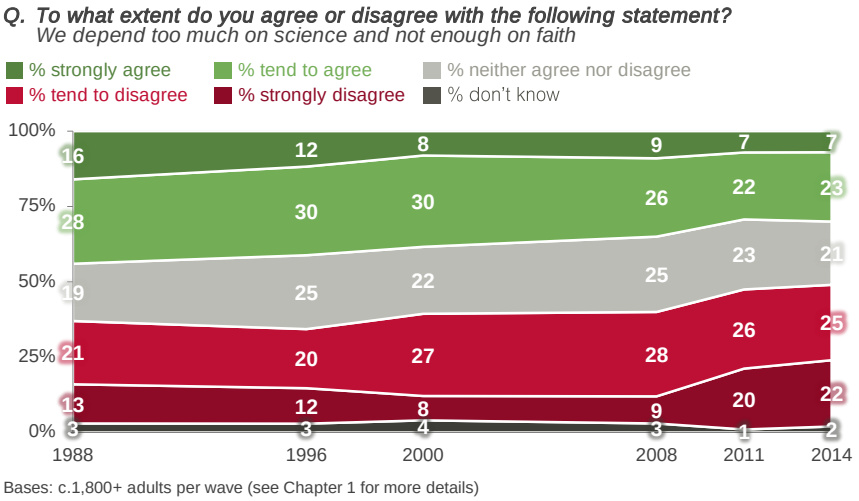
There are some initial indications that strong religious beliefs are associated with less supportive attitudes towards science, but these findings are not clear-cut. The fifth of the UK public who have a more creationist viewpoint are less likely to think that science will make people's lives easier (72%, compared with 81% overall). They are more likely than average to say that people should not tamper with nature (68% versus 55%) and that science makes our lives change too fast (48% versus 34%). Nevertheless, they are just as likely as average to say that the benefits of science are greater than any harmful effects.

Is there a conflict between science and faith?

On balance, people do *not* think "we depend too much on science and not enough on faith" – three-in-ten (30%) agree, while almost five-in-ten (47%) disagree. This appears to be different to the average EU citizen, with *Special Eurobarometer 401* (European Commission, 2013) finding that EU citizens were more likely to agree than disagree (39% versus 32%).[19] Findings are more in line with Australia, where again fewer agreed than disagreed with the statement (22% versus 48%; Ipsos Australia, 2013).

As Figure 2.8 shows, UK attitudes to this topic have changed considerably over time. In 1988 and 1996, more agreed than disagreed with the statement.

Figure 2.8 – attitudes to science and faith over time



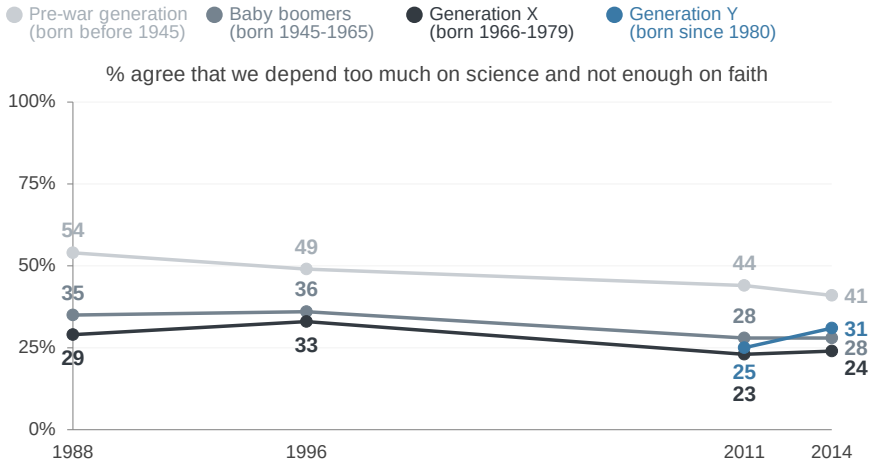
Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

[18] Results for this question are not directly comparable to the *Wellcome Trust Monitor* since the PAS 2014 question wording includes an extra answer option: "I have another view on the origins of species and development of life on earth", which nine per cent of people choose.
[19] It should be noted that *Special Eurobarometer 401* also found a different result from PAS 2014 for the UK public on this question (36% agree versus 34% disagree). This difference may in part reflect the different sampling approach of the Eurobarometer surveys.

There are evident generational differences on this topic, as Figure 2.9 illustrates. Once more, there are strong differences between the pre and post-war generations, with those born before 1945 being most likely to think we depend too much on science and not enough on faith. The data also suggest the youngest generation potentially have more conservative attitudes than their parents towards science and faith – this in fact mirrors other Ipsos MORI generational analysis, which has shown the youngest generation to have more conservative attitudes to other topics like welfare spending (see for example the Demos report by Duffy et al., 2013).

Moreover, while agreement among the overall population has decreased over time, the youngest generation are in fact *more* likely to agree that we depend too much on science and not enough on faith than in 2011 (31%, versus 25% in 2011). It remains to be seen whether this upward trend continues in later studies.

Figure 2.9 – attitudes to science and faith by generation



Bases: c.150+ adults per generation per wave

2.4 Attitudes to specific science topics

As noted in Chapter 1, the four specific science topics chosen for in-depth exploration in PAS 2014 are discussed separately in their own chapters. Nevertheless, as in previous years, the survey includes various questions about other specific topics, which are looked at in this section.

Risks and benefits of different areas

As shown earlier in this chapter, people on balance think the benefits of science outweigh any harmful effects. The survey also explores the perceived risks and benefits of specific areas of science. These questions are only asked of those who have heard of each of these areas before.

Figure 2.10 indicates that, as in 2011, certain topics – specifically GM, animal research and nuclear power – tend to be more contentious, with a sizable minority (28%) saying the risks outweigh the benefits for each of these. By contrast, vaccination – a topic often perceived as contentious in media stories – is in fact overwhelmingly supported by the public, with over

four-fifths (84%) saying the benefits outweigh the risks. This relatively untroubled attitude to vaccination was also found in the 2013 *Wellcome Trust Monitor* (Wellcome Trust/Ipsos MORI), in which eight-in-ten (79%) said that vaccines carried a fairly low risk, or no risk at all, of serious side-effects.

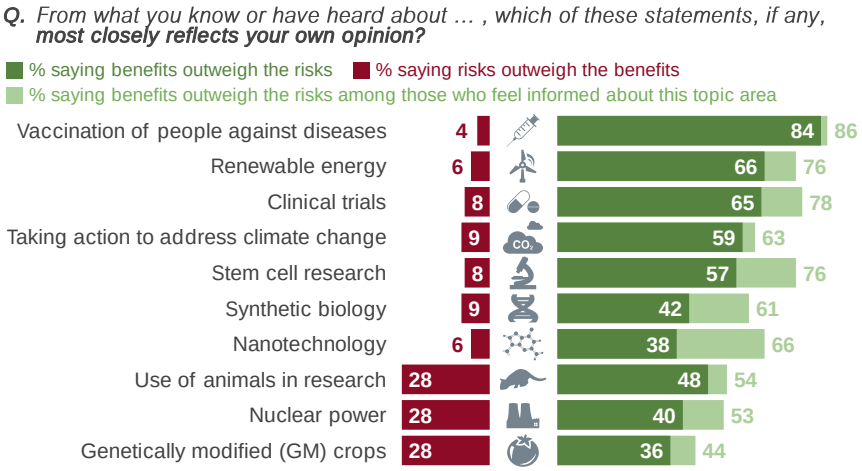
84%

say the benefits of vaccination outweigh the risks

The survey also asks how informed people feel about each of the topics in Figure 2.10 (something discussed in more detail in Chapter 4 – see in particular Figure 4.5). When looking at perceived risks and benefits among those who feel informed, there is a broad relationship between feeling informed about a particular area of scientific research and being more favourable to that area, as the light green bars in the chart indicate. This particularly seems to be the case for areas that are less commonly known about, such as stem cell research, synthetic biology and nanotechnology.[20]

However, this relationship does not always hold. Among those who feel *very* well informed about GM crops, perceptions of risks and benefits are more polarised – within this subgroup, more think the benefits outweigh the risks (47%, versus 36% overall) and more also think the risks outweigh the benefits (40%, versus 28% on average). Furthermore, with most of the other topics, among those who are well informed, the proportions saying the risks outweigh the benefits are no different from average. This suggests simply getting more information on a topic does not necessarily change the views of those who are already against research into that area.

Figure 2.10 – perceived risks versus benefits of specific science topics



Bases: c.1,000+ adults who have heard of each respective topic area; 140+ who feel informed about each respective topic area

As in 2011, men and women have different views. Men are more likely to say the benefits outweigh the risks for each topic except clinical trials and vaccination, where the genders are equally matched – and where women tend to feel more informed than men (as discussed further in Chapter 4). Women are typically more likely than men to say they do not know about the risks and the benefits on each topic, with the exception of animal research, where they object more strongly than men (32% think the risks outweigh the benefits, versus 24% of men).

[20] At this question, people were given basic definitions of synthetic biology and nanotechnology.

These gender differences also exist to an extent among young adults aged 16-24, but the opinions of young men and young women are more closely matched across more topics, including vaccination, clinical trials, climate change, synthetic biology and GM.

There are also differences *between* age groups, with 16-24 year-olds more likely than average to think the risks outweigh the benefits when it comes to animal research (37%, versus 28% overall), nuclear power (33% versus 28%) and clinical trials (14% versus 8%). This is in spite of this age group feeling more informed than average about the use of animals in research, again highlighting that more information might sometimes polarise views rather than simply making them more positive.

As in 2011, certain segments are more likely than others to have concerns related to particular areas of science. Disengaged Sceptics – who tend to be more overwhelmed by science generally – are more likely than average to say the risks outweigh the benefits for a wide range of issues, including GM crops, animal research, nuclear power, vaccination and nanotechnology. Late Adopters, perhaps related to their environmental concerns, are also more likely than average to say this about GM crops and nuclear power.

As discussed in the previous section, other research has shown a negative relationship between religious belief and favourability towards certain technologies or areas of scientific research. PAS 2014 finds that there is typically no difference in attitudes either based on how frequently people attend religious services, or based on their views of the origins of life (which might be considered to measure strength of religious belief). In other words, those with strongly religious beliefs appear to perceive the risks and benefits of these various topics in the same way as others.

Finally, given that there were several cases of measles outbreaks recorded in Wales in 2012-13, regional differences in attitudes towards vaccination might be expected. However, a regional breakdown shows that attitudes in Wales are no different from the average. Those in London do stand out as being far more neutral about the risks and benefits of vaccination – two-in-ten (21%) say the risks and benefits are about the same, compared with just nine per cent overall. However, this is partly likely to reflect the more ethnically diverse population in London, since people from ethnic minority backgrounds are generally more neutral about the risks and benefits of vaccination (17% are neutral, versus 8% of white people).

GM crops remain contentious, along with animal research and nuclear power

What makes genetically modified crops, animal research and nuclear power more contentious?

The online qualitative research provides some indicative insights into why GM crops, animal research and nuclear power are still particularly divisive relative to the other topics asked about in the survey. Participants were asked what they would most like to know from scientists working in each of the areas in Figure 2.10. Their answers suggest that for these three topics especially, people are often unsure whether scientists have looked at alternative solutions, or assume they have not. For GM crops and nuclear power, safety and impacts on health are commonly mentioned concerns. In

the case of animal research, some people also have a strong moral objection, which is not the case with the other topics.

Views on GM crops are covered further in Chapter 12, which looks at these attitudes as part of the wider issue of food security.

Changes over time

It is worth noting that GM crops received widespread media coverage just before the PAS 2014 survey fieldwork, following a speech by Owen Paterson MP on the topic in June 2013. As aforementioned, there was also sporadic coverage during fieldwork of the measles outbreaks in Wales, putting the focus back on the MMR vaccine. At the same time, animal research also underwent particular scrutiny with the *Openness in Animal Research* public dialogue taking place, although this was covered less by the mainstream media.

In spite of the increased coverage of these issues, the overall scores shown in Figure 2.10 are generally unchanged from 2011 (where comparisons are possible), with one exception – fewer people think the benefits of renewable energy outweigh the risks than in 2011 (down seven percentage points to 66%).

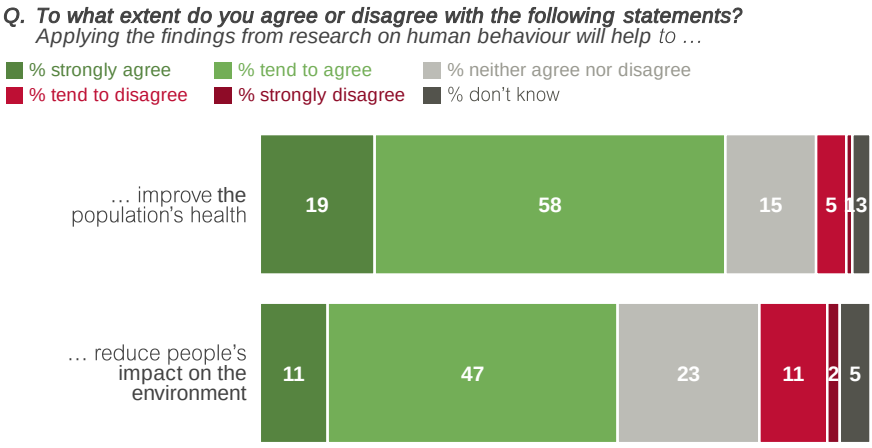
It is worth noting that the 2008 British Social Attitudes survey asked people whether they agreed or disagreed that "on balance, the advantages of GM foods outweigh any dangers". This found that more disagreed than agreed (35% versus 21%). While this is not directly comparable to the PAS 2014 question wording, this does give an indication – alongside other research such as the 2012 British Science Association survey[21] – that opinion to GM crops has softened somewhat over time, though ultimately they remain contentious for many.

Behaviour research

Two new questions in PAS 2014 also look specifically at attitudes to behaviour research. As Figure 2.11 indicates, the majority of people appear to see behaviour research as beneficial both for healthcare (77%) and for the environment (58%). However, a quarter (23%) neither agree nor disagree that this type of research will help to reduce people's environmental impact, suggesting many are sceptical about what behaviour research is able to achieve in this area.

Figure 2.11 – perceived benefits of behaviour research

[21] This survey found that fewer people were concerned about GM food in 2012 than in 2003. It was published on the British Science Association website, at: http://www.britishscienceassociation.org/national-science-engineering-week/gm-public-opinion-poll-2012.



Bases: 858 UK adults aged 16+ asked about the environment; 891 asked about health

Men are more likely than women to agree with each statement. Women are instead more likely to remain neutral, neither agreeing nor disagreeing.

Young adults aged 16-24 are also more likely to agree that this research will help to reduce people's environmental impact (66% agree, compared with 58% overall).

How people view scientists and engineers

3 How people view scientists and engineers

Nine-in-ten think scientists and engineers make a valuable contribution to society

This chapter looks at people's opinions of scientists and engineers. It covers whether people see these professions in a positive light overall, and the specific positive or negative traits people associate with them. It also looks at whether people understand what scientists and engineers actually do in their work.

Key findings

- The traits people consider to be most important for scientists to have are honesty, ethical behaviour and open-mindedness. For engineers, creativity, open-mindedness and honesty are considered the most important traits to possess.
- Generally, scientists and engineers are meeting these expectations. The public see them as creative, interesting and open-minded individuals, and continue to think that they make a positive impact on society.
- At the same time, many view both professions, more so scientists, as poor communicators and as secretive, even if they are broadly seen as honest individuals.
- These more negative perceptions of scientists may stem from a lack of awareness of how scientists carry out their work – even though most people think they have a good understanding of this, there is still uncertainty and scepticism about how scientific research is produced.

3.1 Do people value scientists and engineers?

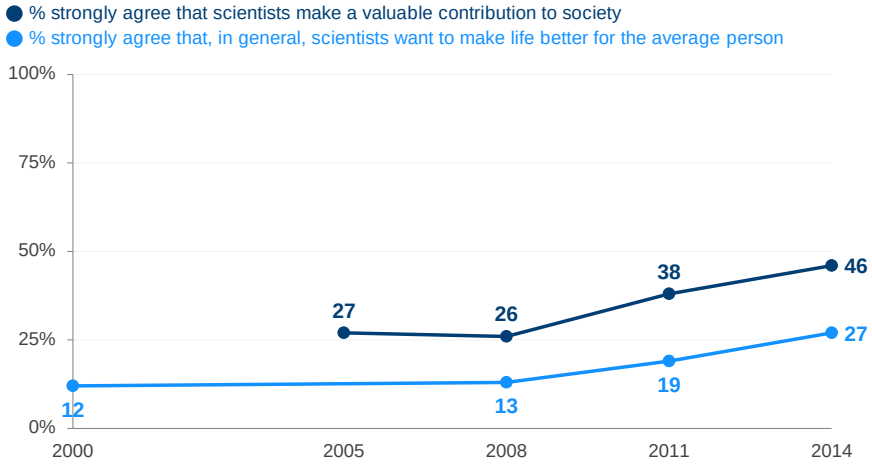
The public's overall perceptions of scientists and engineers are overwhelmingly positive. Nine-in-ten think that scientists (90%) and engineers (88%) make a valuable contribution to society and eight-in-ten (83%) agree scientists want to make life better for the average person.

Moreover, as Figure 3.1 shows, perceptions of scientists have improved over time. This is most evident when focusing on those who *strongly* agree that scientists make a valuable contribution (up from 27% in 2005 to 46% in 2014)[22] and that they want to improve life for the average person (up from 13% to 27% since 2008).

[22] There are no trend data for the equivalent question about engineers, which is new for PAS 2014.

The UK public seem to stand out with their ongoing high regard for scientists. While not directly comparable, the Pew Research Center (2013a) found that just 65% of the US public thought scientists "contribute a lot to society's wellbeing", and that this was down from 70% in 2009. A similar proportion (63%, versus 64% in 2009) said this about engineers.

Figure 3.1 – overall perceptions of scientists over time



Bases: c.900+ adults per wave (see Chapter 1 for more details)

As in 2011, some of these overall perceptions are linked to socio-demographic characteristics. Men, the more affluent (ABs) and those educated to a higher level all more likely than average to agree that scientists and engineers make valuable contributions to society. The youngest adults, aged 16-17, seem to be less aware of the contributions that scientists and engineers make, since they are more neutral than average on both these statements. In contrast, the idea that scientists want to make life better for people appears to be near-universally acknowledged, with little difference in agreement across subgroups.

People's overall opinions of scientists are also linked to how engaged they are with science. Those who feel informed about science and those who have attended a science-related leisure or cultural activity in the previous year are each more likely than average to *strongly* agree with both the statements about scientists.

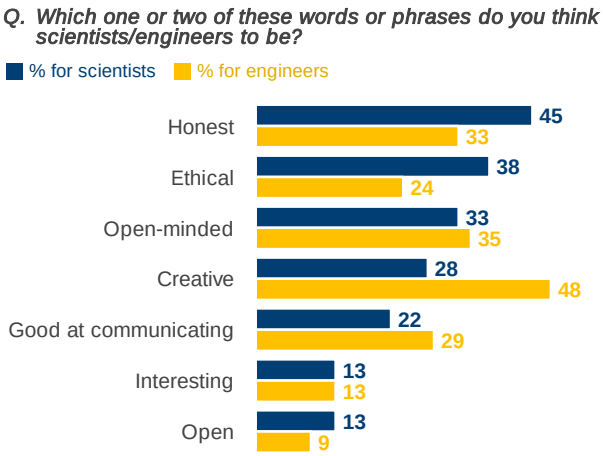
3.2 What should scientists and engineers be like?

As Figure 3.2 highlights, the traits people consider to be most important for scientists are honesty (chosen by 45%), ethical behaviour (38%) and open-mindedness (33%). Open-mindedness (35%) and honesty (33%) are also among the most valued traits for engineers to possess. Creativity and communication skills are considered less important for scientists than for engineers, with creativity in fact being the most commonly valued trait for engineers (chosen by 48%).

The perception that communication skills are relatively less important for scientists may in fact run contrary to the reality, with developments such as

the 2010 *Concordat for Engaging the Public with Research* increasing the emphasis placed on scientists to communicate their research to the public.[23]

Figure 3.2 – top one or two traits considered most important for scientists and engineers



Bases: 858 UK adults aged 16+ asked about scientists; 891 asked about engineers

More men than women consider creativity to be one of the most important traits, both for scientists (35%, versus 22% of women) and engineers (54% versus 42%). Women instead place a much stronger emphasis on ethical behaviour both for scientists (44%, versus 30% of men) and engineers (29% versus 19%). This gender difference is also present among young adults aged 16-24.

3.3 What are scientists and engineers like?

Figure 3.3[24] shows, along the horizontal axis, the net scores when people are asked to rate scientists and engineers on each of the attributes from the previous section. For example, the proportion saying scientists are open (37%) *minus* the proportion saying they are secretive (50%) is the openness net score (-13).

From this, it seems that scientists and engineers are meeting people's expectations of them. Scientists and engineers are viewed on balance as creative, interesting and open-minded people. Most also see them as honest and ethical, though less so for scientists than for engineers. Even when looking solely at the opinions of those who prioritise these traits above others, these scores are typically unchanged.

Traits less commonly attributed to scientists and engineers are good communication skills and openness, although these were also viewed as slightly less important traits to have. Scientists receive particularly low scores here, with four-in-ten (40%, versus 28% for engineers) saying they are poor

Women place more emphasis on scientists' and engineers' ethical behaviour than men

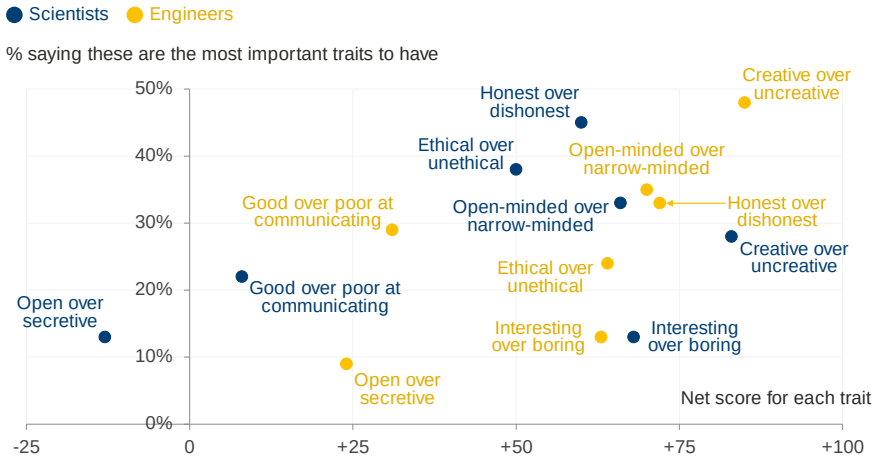
[23] The *Concordat for Engaging the Public with Research* can be found on the Research Councils UK website, at: http://www.rcuk.ac.uk/documents/scisoc/ConcordatforEngagingthePublicwithResearch.pdf.
[24] It should be noted that the vertical axis for Figure 3.3 only goes up to 50%, so that the findings can be shown more clearly.

at communicating and five-in-ten (50%, versus 31% for engineers) considering them to be secretive.[25] Even among those who know scientists among their friends, family or work colleagues, four-in-ten consider them to be poor communicators (40%) and secretive (41%).

Previous qualitative research looking at public perceptions of climate scientists has also shown that the UK public commonly think of scientists as poor communicators (Shuckburgh, Robison and Pidgeon, 2012 report for the Living with Environmental Change Partnership). Moreover, these findings are in spite of a probable increase in science communication activity over last decade or so – a 2006 Royal Society report found that 74% of scientists working in academia had undertaken a public engagement activity in previous year, which was an 18 percentage point increase since 2000. Taken together with the PAS 2014 findings, this suggests the perception of scientists as poor communicators is a deeply embedded stereotype that will require a considerable cultural shift to counter.

These findings also show that honesty and openness are not the same things. Even among the 71% who say scientists are honest, over four-in-ten (44%) also consider them to be secretive. These different dimensions of trust in science are covered further in Chapter 6.

Figure 3.3 – words or phrases associated with scientists and engineers



Bases: 858 UK adults aged 16+ asked about scientists; 891 asked about engineers

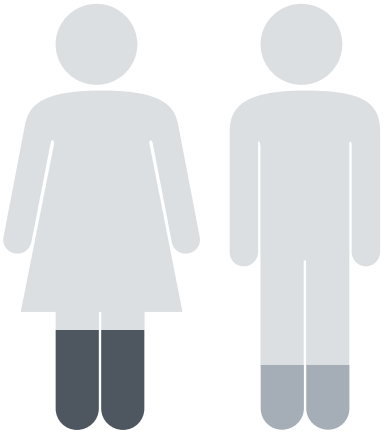
Once more there are age and gender differences, particularly when it comes to perceptions of engineers. Younger adults aged 16-24 are less likely than average to find engineers interesting (+49 versus +63). Women are less likely than men to consider either profession interesting, though this difference is much starker for engineers (+46, versus +80 for men) than for scientists (+60, versus +77 for men) – these gender differences also appear to be present among young adults.

The segments conform to type here. The Indifferent are less likely than average to find scientists interesting and more likely to see them as narrow-

[25] These percentage scores are not shown in Figure 3.3, which shows net scores.

minded. Disengaged Sceptics are more likely to see scientists as secretive and dishonest. Finally Distrustful Engagers are more likely to think scientists are poor communicators.

Those who have engaged in a science-related leisure or cultural activity in the previous 12 months are more likely to find scientists interesting, honest and ethical compared to the average. This again highlights how public engagement activities may help to shape people's views of scientists.



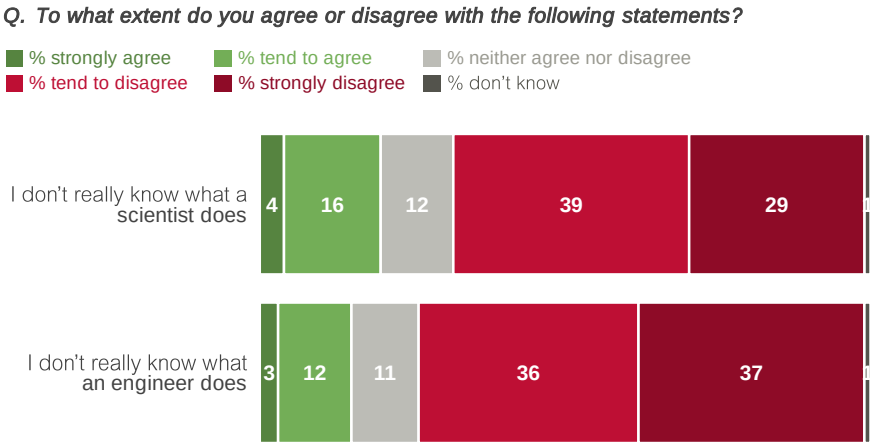
Women are more likely than men to say they do not know what scientists do

3.4 What do scientists and engineers do?

Some of the misconceptions about what scientists and engineers are like may arise from a lack of awareness of how they go about their work. Nevertheless, around seven-in-ten think they do know what scientists (68%) and engineers (73%) do, as Figure 3.4 indicates. Of course, this still leaves sizable minorities who feel they do not know what scientists (20%) or engineers (15%) do.

The proportion strongly *disagreeing* that they do not know what an engineer does has gone up since 2011 (from 29% to 37%), suggesting people feel more aware this than before. This is consistent with results from the 2012 (FreshMinds Research/EngineeringUK) *Engineers and Engineering Brand Monitor*, which found that knowledge of engineers' work had increased since 2011, both among young people and adults.

Figure 3.4 – whether people feel they know what scientists and engineers do



Bases: 858 UK adults aged 16+ asked about scientists; 891 asked about engineers

Once again, there are differences by gender and social status. Women and the less affluent, who are both less likely to think scientists make a valuable contribution to society, are also more likely than average to say they do not know what scientists do (24% of women and 33% of those in social grades DE agree, compared with 20% overall). The gender gap is also present among young adults aged 16-24.

Those aged 16-17 are among the most likely to *strongly* agree they do not know what an engineer does (12% say this, versus 3% overall). Again, this mirrors the results of both the 2013 (IFF Research/EngineeringUK) and 2012

(FreshMinds Research/EngineeringUK) *Engineers and Engineering Brand Monitors*, which both found that younger age groups feel they know less about the profession.

Looking at the segments, the Concerned and the Indifferent are most likely to feel they do not know what either scientists or engineers do. This highlights the particular challenge of engaging these segments, and the need to pitch the science at the right level for them.

35%

think scientists adjust their findings to get the answers they want

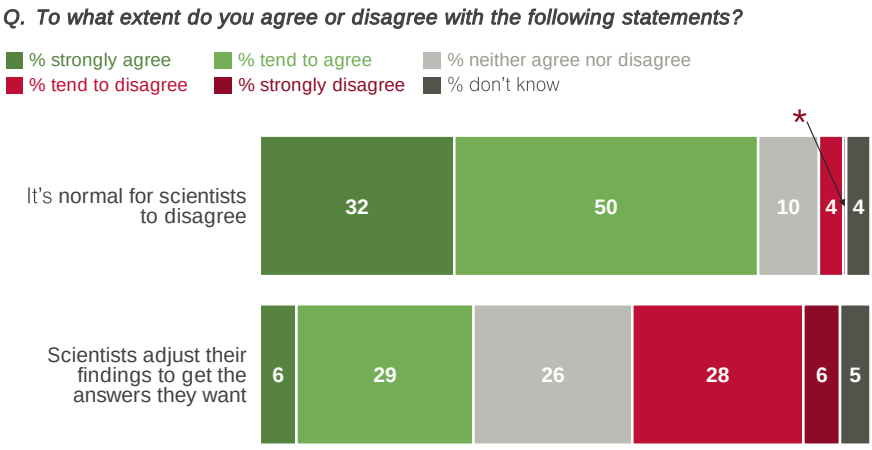
Perceived versus actual understanding of how scientists work

Of course, perceived knowledge of how scientists go about their work is not the same as actual knowledge. PAS 2011 found that people generally did not know about the processes that scientists went through, even when they had heard about the outcomes and applications of scientific research.

Figure 3.5 shows that there are still widely held misconceptions about how scientists work. While a large majority (82%) understand that it is normal for scientists to disagree, a third (35%) still think that "scientists adjust their findings to get the answers they want". Moreover, only a third (34%) *disagree* that scientists adjust their findings, with another one-in-three (31%) undecided or neutral about this. These are ongoing concerns, not having changed since 2011.

The concept of peer review in science also seems not to be widely understood, or is treated with scepticism. Three-in-ten (29%, not shown in Figure 3.5) think scientific research is never or only occasionally checked by other scientists before being published. Again, this highlights that while people may *feel* they know what scientists do, there is still a large level of uncertainty, and sometimes scepticism, about how scientific research is produced.

Figure 3.5 – perceptions of how scientists work



Base: 1,749 UK adults aged 16+

The survey suggests misconceptions may be linked to where people get their information on science, with tabloid newspaper readers being more likely than broadsheet readers to agree that scientists adjust their findings

(40% versus 27%). On the other hand, while those with more direct exposure to scientists via friends, family or work colleagues might be expected to agree less strongly with this statement, it is notable that even a quarter (27%, compared with 35% on average) agree – this indicates how far-reaching this perception is.

Do people want to know how scientists work?

The qualitative findings suggest that changing the misconceptions people have about how scientists work will be difficult. While participants at the Day of Discovery workshop were keen to talk to the scientists who were present, they mainly wanted to ask them about the results of their research, rather than about how they went about their work. Moreover, some participants were open about not being interested in what scientists did day-to-day, despite being interested in the outputs of their work.

At the same time, some participants did acknowledge that the public might not hear enough about how scientists work. Where participants did have questions about this for the scientists present, these were often around funding, and the demands placed on scientists by their funders – attitudes to funding are discussed further in Chapter 9.

"We should be shown more how scientists work. It's a mysterious subject."
Day of Discovery workshop participant

"Does the person who funds the research influence the results?"
Day of Discovery workshop participant

Finding out about science

4 Finding out about science

think it is important to know about science in their daily lives

This chapter explores people's interest in science, how they find out about it and how informed they feel.

Key findings

- People overwhelmingly think that science is important and take an interest in it.
- On the whole, people still tend to get most of their science news from traditional media such as television and print newspapers. However, online sources, including news websites and social networks are becoming more widely used and are more regular information sources among young adults. Going online is also typical for people *actively* seeking out information on science.
- As in 2011, people on balance do not feel informed about science generally, although the extent to which people feel informed is much more varied when it comes to specific topics in science. Nanotechnology and synthetic biology continue to be topics about which the vast majority of the public do not feel informed.
- Very few people think they see and hear too much science information, and half think they see and hear too little, suggesting an appetite for more information. At the same time, most people feel capable of understanding this information.
- While the public are more comfortable with the pace of change than they were two decades ago, the speed of development and specialisation of science are ongoing challenges for science communicators, with people on balance feeling that these make science and technology harder to follow.

4.1 Interest in science

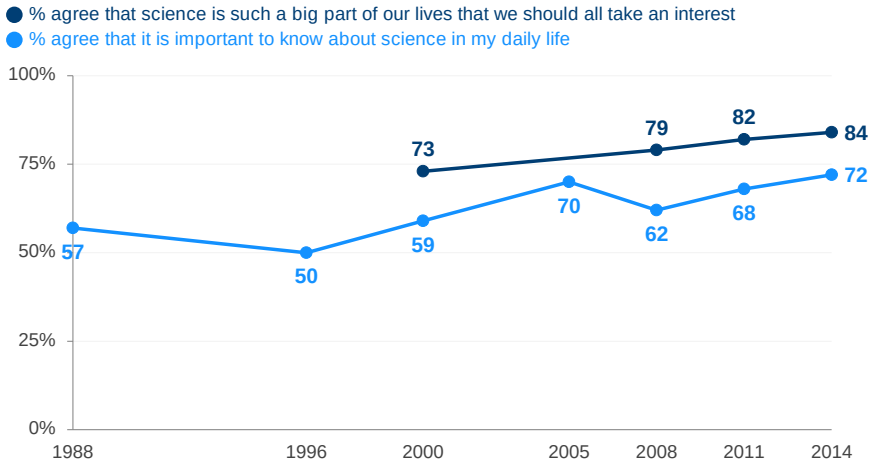
The UK public overwhelmingly think that science is important and take an interest in it. Over eight-in-ten (84%) agree that "science is such a big part of our lives that we should all take an interest" and seven-in-ten (72%) agree that it is important to know about it in their daily lives. The gap between agreement with these two statements does suggest that, as in 2011, while some consider science as important, they do not necessarily see it as personally relevant.

The proportions *strongly* agreeing with each statement have increased since 2011. Just under two-fifths (37%, compared with 25% in 2011) strongly agree that everyone should take an interest in science, and a quarter (24%, compared with 17% in 2011) strongly agree that knowing about science is

important in their daily lives. As Figure 4.1 highlights, this appears to be part of a more gradual long-term increase in agreement, with the public appearing much more interested in science today than they were in 2000 and before.

Moreover, as the more recent *Special Eurobarometer 401* (European Commission, 2013) has shown, people in the UK tend to be more interested in developments in science and technology than the average EU citizen. Interest levels were higher than in Germany and Ireland, and on a par with those in France.

Figure 4.1 – interest in science over time



Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

More affluent groups tend to be more interested in science, with those from social grades AB being more likely than average to agree with both statements. Broadsheet readers, who themselves tend to be more affluent, are also more likely to agree with both statements than tabloid readers.

Those with high knowledge scores are also more likely than average to agree with both these statements, linking knowledge and understanding of science to interest in it. More broadly, people educated to a higher level are more interested in science than average on both these indicators, though those with science or engineering-related degrees are more likely than those with arts-related degrees to *strongly* agree that knowing about science in their daily lives is important (49% versus 32%).

Young adults are less likely than average to think that everyone should take an interest in science (78%, versus 84% on average) but are *more* likely to agree that it is important in their daily lives (81%, versus 72% on average), suggesting that they particularly see it as personally relevant.

Has interest increased across generations?

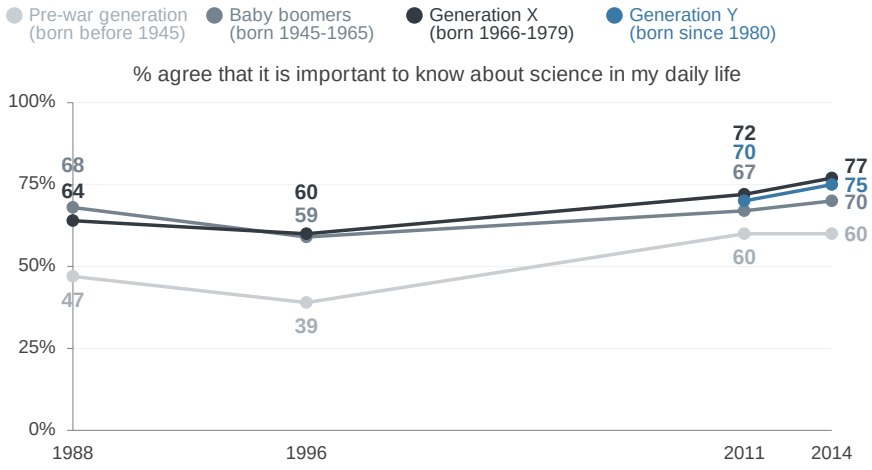
As was seen in Chapter 2, the long-term shifts in attitudes over the last 25 years are not solely due to individuals having become more positive over time. As Figure 4.2 outlines, while all three older generations' interest in science in their daily lives has increased compared to 1996 levels, the

changes to the overall level of agreement over time are also due to the emergence of a new younger generation, Generation Y (born from 1980 onwards), who tend to be very interested in science.

It is also worth noting that while the public as a whole are more interested in science in their daily lives today than they were 25 years ago, this is not the case for everyone. For the Baby Boomers (born between 1945 and 1965), their level of interest has merely returned back to where it was in 1988.

More recent changes also indicate that, while most people's interest in science in their daily lives has increased over the last three years, this is not really the case for the pre-war generation. It remains to be seen whether they continue to move apart in their attitudes from the post-war generations.

Figure 4.2 – interest in science by generation



Bases: c.150+ adults per generation per wave

4.2 How do people get their information?

Most regular science information sources

Since PAS 2011, the use of the internet and of social media in general has increased substantially. Office for National Statistics figures show that 4.3 million more British adults used the internet on a daily basis in 2013 compared to in 2011.[26] The Ipsos MORI *Tech Tracker* survey found in mid-2013 that half (50%) of all British adults used social media.[27]

Despite these overall changes in general media usage, PAS 2014 finds that most people still find out about science most regularly from traditional media, such as television and print newspapers. As Figure 4.3 indicates, three-fifths (59%) say TV is one of their two most regular sources of information on science, either in the form of TV news programmes (42%) or non-news programmes (26%). A quarter (23%) say print newspapers are one of their most regular sources. While not directly comparable (due to differences in

59%

say TV is one of their most regular sources of science information

[26] The *Internet Access – Households and Individuals, 2013* statistical bulletin is available on the Office for National Statistics website, at: http://www.ons.gov.uk/ons/dcp171778_322713.pdf.
[27] The 2013 Q2 *Tech Tracker* is available on the Ipsos MORI website, at: http://www.ipsos-mori.com/researchspecialisms/ipsosmediact/customresearch/technology/techtracker.aspx.

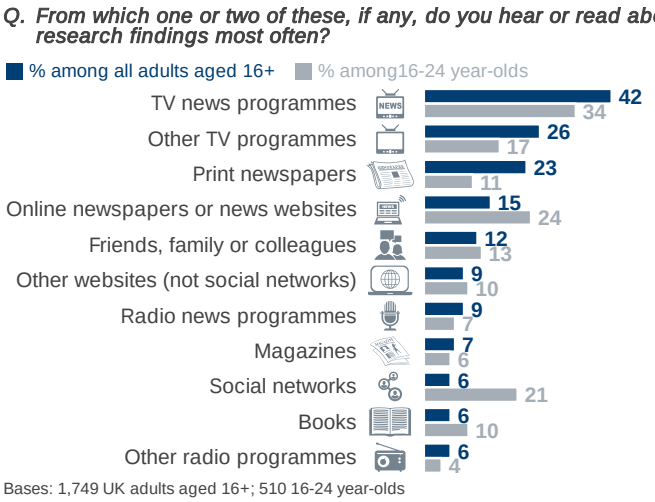
answer options), it is worth noting that these were also the most commonly used information channels in the 2011 survey.

Among all adults, under two-in-ten (15%) say online newspapers or news websites are one of their two most regular sources of science news – this is the most commonly mentioned online source. Within this relatively small group of people, seven-in-ten (69%) mention using the BBC News website, while a quarter (27%) say they use Google News. The two daily newspaper websites mentioned most frequently are the Guardian and Mail Online (both by 13%).

The dominance of traditional media in the UK is even starker when compared to how people in the US get most of their information about science. The 2012 US General Social Survey (covered in National Science Foundation, 2014) found that a third (32%) of US citizens used TV as their primary source of information about science, and that online newspapers were more likely to be primary sources of information than print newspapers in the US (27% versus 6%).

In the UK, while the overall findings still show a tendency towards traditional offline media, this is somewhat less the case among young adults. As Figure 4.3 highlights, the 16-24 age group are more likely to say online newspapers or news websites (24%, versus 15% overall), as well as social networking websites (21%, versus 6% overall), are among their most regular sources of information on science. Around one-in-ten 16-24 year-olds (12%) specifically mention Facebook as one of their most regular ways of finding out about science, and six per cent mention Twitter.

Figure 4.3 – people's most common sources of information about science



As was the case in 2011, women are more likely than men to mostly find out about science from friends, family or colleagues (14% versus 9%) while men are more likely than women to get most of their information from online newspapers (18% versus 13%). More generally, PAS 2014 finds that men are more likely than women to have an online source as one of their two

most regular sources of information on science (25% mention an online source as one of their top two sources, versus 20% of women).

Education and affluence both appear to be linked to preferred information sources for science. Those from higher social grades and with higher levels of education are more likely to get most of their information from newspapers, both print and online, as well as in scientific journals than the average, while those with fewer qualifications and the less affluent tend to get most of their information from TV.

Those from the Indifferent segment are more likely to say most of their information about science comes from TV news (53%, versus 42% overall), suggesting they are more passive receivers of science-related information. Confident Engagers (23%), Distrustful Engagers (22%) and Late Adopters (20%) are all more likely than the average (15%) to say most of their information comes from online newspapers or news websites. In addition, Confident Engagers are more likely to pick out magazines as one of their top sources (14%, versus 7% overall), and Late Adopters are more likely than average to mention social networks (13%, versus 6% overall).

Communicated versus engaged science information sources

Participants in the online qualitative research were asked about how they came into contact with science. Echoing survey findings, they typically mentioned TV and radio as their most common sources of "communicated science information", i.e. information about science that gets pushed out to people through the media and other communications. Participants said they often heard or saw science news stories not because they sought them out, but through their regular consumption of TV and radio.

"The TV is in your face most of the time and it's usually presented in layman's terms so it's easy to understand."
Online community participant

Many also named newspapers and the internet as their main sources of "communicated science information", often mentioning the BBC News website as having particularly good science coverage. They reflected that science stories were displayed more prominently on that website than on other news sites, which means they are more likely to stumble upon them while browsing.

Participants also discussed "engaged science information", i.e. information that is actively sought out by people when they want to know more about a topic. They generally went online to find this kind of information, for example following up stories that they had already heard or seen in the news elsewhere.

It should of course be noted that these online community participants are already predisposed to go online. Nevertheless, the use of the internet when actively seeking out information is documented elsewhere – the 2013 *Wellcome Trust Monitor* (Wellcome Trust/Ipsos MORI) found that TV and newspapers were the most common passive sources of information on

medical research, while the internet was most commonly used when people were actively looking for this information.

How do people seek out science information online?

The ways in which people look for science-related information online was explored in an online discussion group with 15 members of the online community and in the eight face-to-face observational interviews conducted with community members.

Even the participants who were most confident and enthusiastic about science had little idea of any specific or specialised online science information sources that existed. Therefore many relied heavily on Wikipedia and other sources that appeared high up in Google search results – sources which may not always be accurate or give a balanced view.

Often, participants just chose the very first link that they found after a basic search. Indeed, in the observational interviews, some older participants did not distinguish between sponsored and non-sponsored Google search results.

Others tend to search a term, but then find a trusted site within the results that appear. Many cited the BBC News site again here, as well as the Guardian website. Many used Wikipedia – they saw it as the simplest way of gaining some initial information and a general overview of a science topic, but also for seeking more depth if interested. Some believed Wikipedia science articles were usually written by lecturers on the topic, who were keen on disseminating information, so it could be considered trustworthy. By contrast, others treated Wikipedia with suspicion, as they thought it was just a collection of other people's opinions.

Those who were in general more sceptical about science and the information they saw and heard about it said that they tended to Google a topic and follow up four or five of the most common sources to try to gain a rounded understanding of the topic, and avoid just seeing one biased source.

"I wouldn't know what websites to trust. I just look at a few to see if they have the same info."
Online community participant

However, even among this group, the observational interviews showed that few really evaluated the websites they were using for information. Looking credible and having a name that seemed legitimate was often seen as good enough.

Some participants used more sophisticated sifting processes to reach what they saw as the best sources, which they generally considered to be the sources that were most closely affiliated with scientific organisations or non-commercial organisations. One participant sought the latter out by finding sites ending in ".org", while others found reliable sources on a more ad-hoc basis.

I wouldn't know what websites to trust. I just look at a few to see if they have the same info.

Online community participant

"I just sift through links to see which ones are from reputable institutions, like university sites for example."
Online community participant

Those who were more confident and interested in science also tended to use initial findings to find out the name of the scientist or institution who worked on the topic, and to look for more information in this way.

Few participants used or trusted social media sites as sources of science information. Those who used social media at all tended to point out that few of their friends or people they followed talked about science or referred to science news stories on these sites. Even when this did happen, participants thought that tweets or Facebook posts lacked depth and did not provide a great deal of detail about a topic. Others thought that the unregulated nature of these sites and the fact that anyone can post about science meant that they were useless as sources.

Finally, a few participants, despite being members of an online community, were still strongly of the opinion that internet sources were inherently less credible than offline ones, and that a book by a reputable author and publisher was the best way to find out more about a science topic.

4.3 Feeling informed

How informed are people about science generally?

More people do not feel informed (55%) than feel informed (45%) about science, and scientific research and developments – this has typically been the case since 2005, as Figure 4.4 illustrates.[28] It is worth noting that this balance of opinion changes among those who think it is important to know about science in their daily lives (53% of this group feel informed, while 47% do not). Therefore, those who are interested in the subject do feel more informed, but ultimately there are still a large number of people who think science is important to them personally but do not feel informed about it.

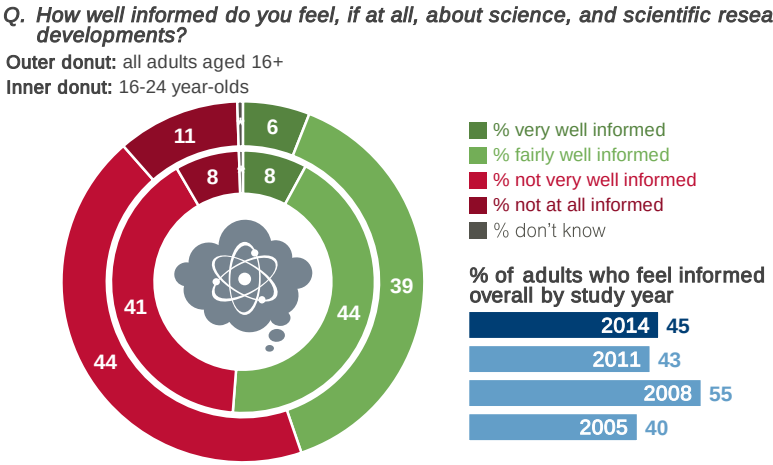
As Figure 4.4 also shows, young adults tend to feel more informed than the average (51% feel informed, versus 45% overall). Here, it is worth noting that young adults are no more or less likely than others to score highly on the science knowledge quiz, which highlights that feeling informed about science is not just about being knowledgeable (although the two are correlated).

A similar question to this was asked in *Special Eurobarometer 401* (European Commission, 2013). This found that the majority of EU citizens do not feel informed about science, suggesting the UK is by no means unusual

[28] While the 2008 finding is very different from the surrounding years, it is worth noting that the 2008 questionnaire featured this question much later on, meaning respondents were more primed on various aspects of science before answering. This makes the finding for that year less comparable.

in this respect. Moreover, the UK public were found to feel more informed than average, with scores higher than in France, Ireland and Germany.[29]

Figure 4.4 – whether people feel informed about science generally



Bases (for 2014): 1,749 UK adults aged 16+; 510 16-24 year-olds

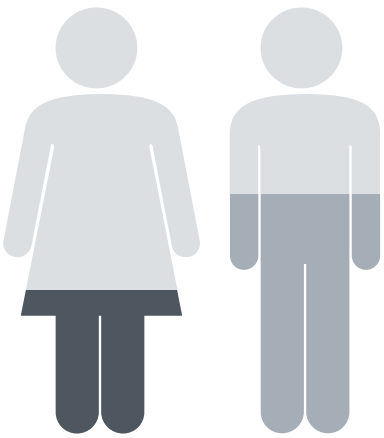
More affluent people tend to feel more informed. Half (51%) of ABC1s feel informed, compared to a third (35%) of C2DEs.

Similarly, better educated people also tend to feel more informed, though there are large differences depending on the field people have studied. On balance, arts or social-science graduates are more likely to feel informed than not informed, but a large proportion still do not feel informed (56% feel informed, versus 44% who do not). As might be expected, for science or engineering graduates, the gap between the proportions feeling informed or not is much larger (82% feel informed, versus 18% who do not).

As was the case in 2011, women are much less likely to feel informed than men (34% versus 56%) – the same difference exists among young women and men aged 16-24.

There are also large differences in how informed people feel according to where they tend to get their information. Broadsheet readers are more likely to feel informed than tabloid readers (62% versus 42%). Six-in-ten of those get most of their science-related news from books (60%, versus 45% on average) or from online newspapers or news websites (58%) feel informed. Those who get most of their news about science from TV tend to feel less well informed (40%, versus 45% overall), which perhaps also reflects that this group includes more of the Indifferent segment.

Finally, people who have done a science-related activity in the last year (49%) are more likely to feel informed than those who haven't (36%), which



Women are still much less likely to feel informed about science than men

[29] It should be noted that *Special Eurobarometer 401* also found a different result from PAS 2014 for the UK public on this question (it found that 56% of people in the UK felt informed). This is likely to reflect differences in the question wording, meaning that results are not directly comparable to PAS 2014.

suggests that encouraging greater engagement with science could help people feel more informed.

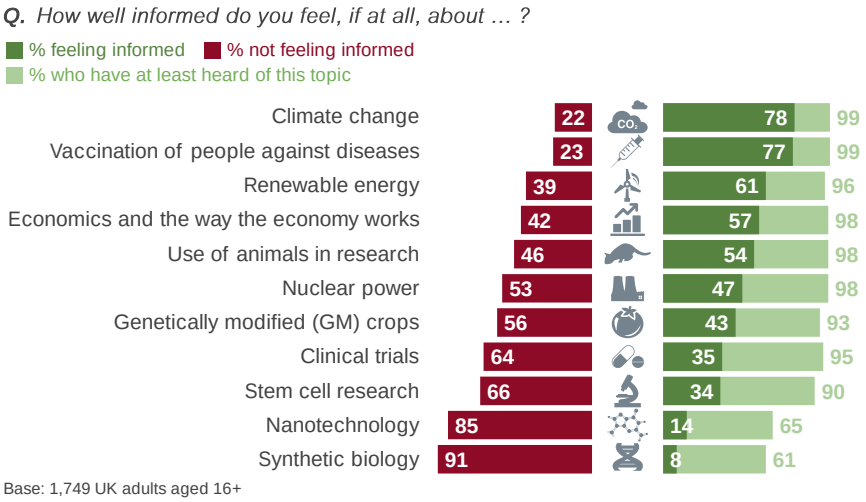
How informed are people about specific topics?

While people do not on balance feel informed about science as a whole, this does change when it comes to specific topics. While at least six-in-ten have at least heard of each of the specific topics asked about in the survey, shown in Figure 4.5, they do not, on balance, feel informed about nuclear power (-6 net informed), genetically modified (GM) crops (-13), clinical trials (-29), stem cell research (-32), nanotechnology (-71) or synthetic biology (-83). The particularly low net scores for the latter two topics may reflect that these emerging technologies are not yet seen to be playing a large part in people's lives.[30]

As pointed out in Chapter 2, GM crops and the measles outbreak in Wales had a relatively high level of media coverage in the run up to PAS 2014 fieldwork. In spite of this, the survey finds that how informed people feel about each of the topics asked about (where trend data are available) has not changed since 2011.[31]

Data from both *Wellcome Trust Monitor* surveys also suggests awareness of GM crops and stem cell research has not changed over the last few years. The 2013 (Wellcome Trust/Ipsos MORI) Monitor found that eight per cent had not heard of the term "GM or genetically modified" before, while the 2009 (Butt et al.) Monitor found that seven per cent had not heard of stem cells before – both similar to the PAS 2014 findings.

Figure 4.5 – whether people feel informed about specific science topics



Base: 1,749 UK adults aged 16+

As with feeling formed about science as a whole, the less affluent (DEs) tend to feel less well informed about almost all of the specific science topics

[30] Again it should be noted that these are net scores, i.e. the proportion who feel informed *minus* the proportion who do not feel informed. For example, 47% feel informed about nuclear power, while 53% do not feel informed about this, so the net informed score is -6.
[31] There are no trend data for "economics and the way the economy works" as this was phrased simply as "the way the economy works" in the 2011 survey.

asked about than average, with the exception of synthetic biology, about which most people regardless of affluence tend not to feel informed.

Young adults aged 16-24 are more likely than average to feel informed about various topics, including animal research, renewable energy and nanotechnology. They are less likely than average to feel informed about economics, vaccination and clinical trials, perhaps reflecting that they have not had as much experience with these areas as other, older adults.

Differences by gender are mixed. Men feel more informed than women about GM crops, renewable energy, nanotechnology, economics, climate change, synthetic biology and nuclear power, while women feel more informed than men about vaccination. On the other issues asked about, both men and women tend to feel equally well informed. Broadly, these gender differences also exist among the 16-24 age group.

People who say they are scientists or engineers themselves tend to feel more informed than average about energy technologies, and also the lesser understood topics of nanotechnology and synthetic biology. However, for the remaining topics, they are generally no more informed than the average, highlighting that even the most scientifically-minded people are perhaps unlikely to feel informed about all topic areas.

Does feeling informed mean being informed?

While people may *feel* informed about the topics in Figure 4.5, this does not necessarily mean they *are* informed of the realities. For example, people who say they feel *very well* informed about the use of animals in research are still on balance not aware that all medicines in the UK must be tested on animals before being made available to people – five-in-ten (49%) think this is not the case, while just four-in-ten (39%) think it is.

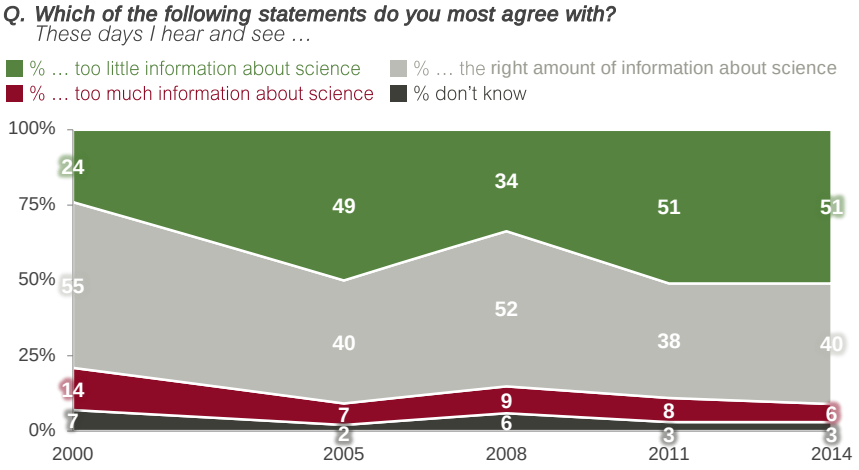
It is also worth recognising that people who feel informed have not necessarily heard scientifically accurate information. For example, of those who feel informed about climate change, over one-in-ten (13%) still believe that human activity does not have a significant effect on the climate.

Are people overwhelmed by the amount of information?

As Figure 4.6 indicates, very few people think they see and hear too much information about science. Only six per cent say this, while half (51%) think they see and hear too little, suggesting there is still an appetite for hearing more about science among much of the public. These scores are consistent with those found in 2011, with the desire to hear more about science still higher than it was in 2000.

think they see and hear too little about science

Figure 4.6 – whether people think they hear too much or too little about science over time



Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

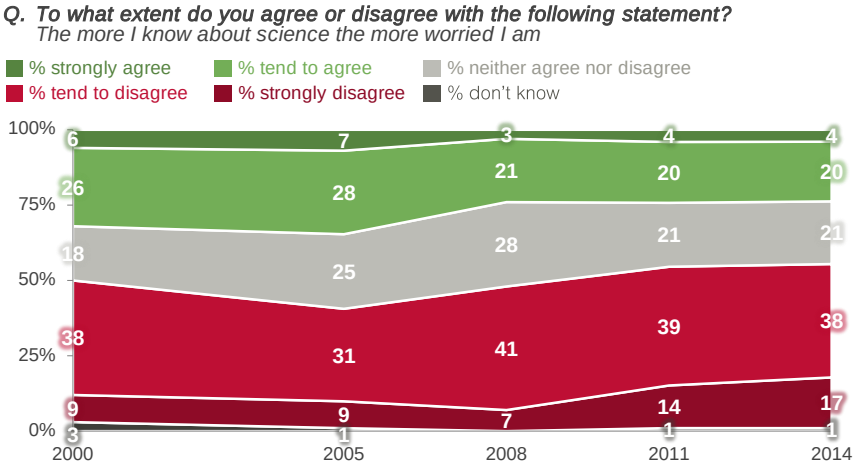
In addition, most people do not think that hearing more about science makes them more concerned. Figure 4.7[32] shows that just over half (54%) disagree that the more they know about science, the more worried they are. However, a quarter (24%) agree, suggesting there are still a sizable number of people who would not necessarily appreciate more information. Again, this is consistent with the 2011 score, though this sentiment has broadly decreased since 2000.

It is important to note that even among the people who agree that hearing more makes them more worried, just one-in-ten (11%, versus 6% overall) think they hear and see too much about science, and half (50%, in line with the average) think they hear and see too little. This suggests that even though they might have concerns about what they hear, most of this group still want to be kept informed.

In addition, it is worth noting that those who are most likely to agree with this statement are those who do not feel informed (29% agree, versus 18% of those who feel informed). This suggests that it tends to be those who currently feel that they do not know much about science who often hold this view, rather than those who have heard a lot about science and have therefore become concerned.

[32] It should be noted that for Figure 4.7, the agree scores are in green (as throughout this report), even though the statement might be perceived as negative.

Figure 4.7 – whether people think hearing more about science makes them worry more



Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

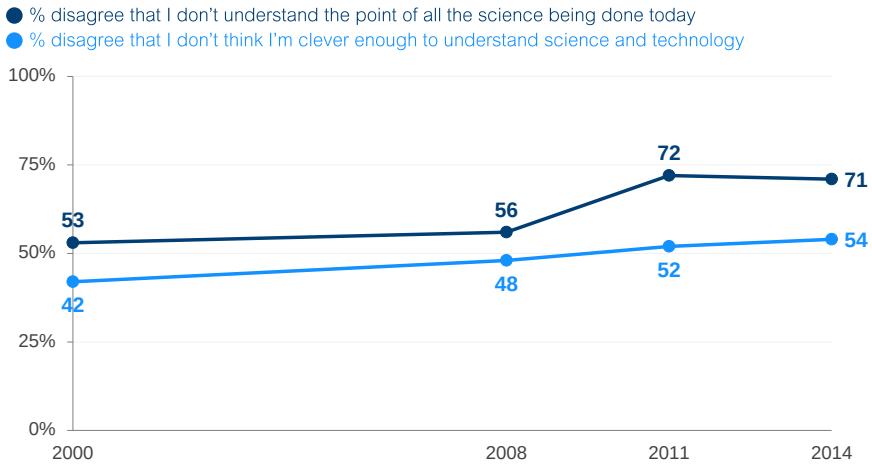
Women (29%) and religious people (31% of those who regularly attend religious services) are more likely than average (24%) to say that the more they know, the more worried they become.

4.4 How confident are people in finding out about science?

Do people feel capable?

While many people say they do not feel informed about science, the findings suggest this is *not* because they do not feel capable of understanding it or accessing information. As was the case in 2011, more people *disagree* (54%) than agree (30%) that they are not clever enough to understand science and technology. They similarly disagree on balance that they are not clever enough to understand engineering (54% disagree, versus 31 % agreeing, not shown in Figure 4.8). In addition, seven-in-ten (71%) disagree that they "don't understand the point of all the science being done today". Broadly, disagreement with both these statements has increased over time, as Figure 4.8 reflects.

Figure 4.8 – whether people feel capable of engaging with science over time



Bases: c.850+ adults per wave (see Chapter 1 for more details)

As might be expected, the groups of people who tend to feel less informed about science are more likely to say they do not feel clever enough to understand science and engineering. Women are more likely than men to agree for both science (35% versus 24%) and engineering (40% versus 24%).

Similarly, people who are less affluent are more likely than average to agree. Half of those from social grades DE think they are not clever enough to understand science and technology (47%, versus 30% overall) or engineering (53%, versus 31% overall).

There are also differences by age. Young adults (18%) are less likely to agree that they are not clever enough to get science and technology than the average (18% agree, versus 30%) while people aged 75 and over are more likely to agree (62%). However these age differences are not apparent for engineering.

People of Asian origin are more likely to say they are not clever enough to understand engineering (49% agree, versus 31% overall), whereas they are no different from the average when talking about science and technology.

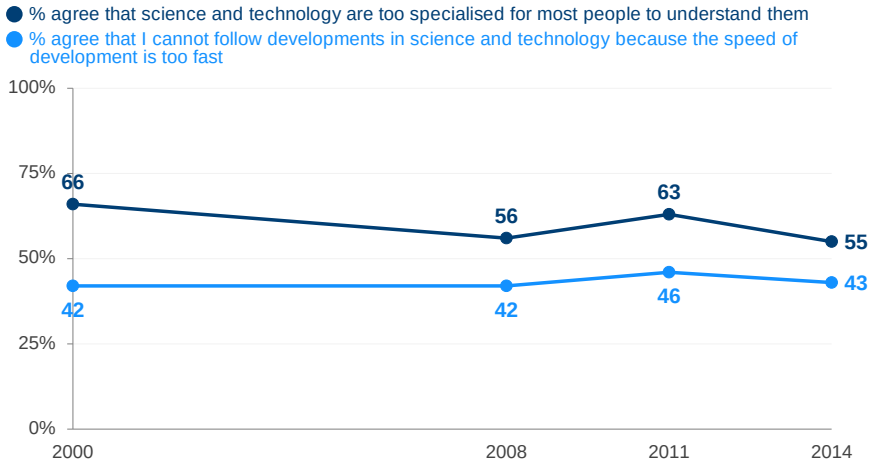
The speed of development and specialisation of science

Although people on balance think they are capable of understanding science and technology and the science being done at the moment, the speed of development and complexity of science are an ongoing challenge for science communicators. More people agree (43%) than disagree (35%) that they "cannot follow developments in science and technology because the speed of development is too fast", and, as Figure 4.9 shows, this has been a relatively consistent concern since 2000. Similarly, more agree (55%) than disagree (28%) that "science and technology are too specialised for most people to understand them", though this attitude is less prevalent than it was in 2011 (agreement is down eight percentage points from 63%).

The speed of development and complexity of science are an ongoing challenge for science communicators

Of course, it should be remembered that while some still find it difficult to keep up with the speed of development and specialisation of science, the public as a whole are generally more comfortable with the pace of change than they were two decades ago. This is particularly the case for younger generations, as pointed out in Chapter 2.

Figure 4.9 – whether people think the speed of development and specialisation of science makes it harder to follow, over time



Bases: c.850+ adults per wave (see Chapter 1 for more details)

In terms of the speed of development and specialisation of science, the subgroups who are more likely to be concerned are similar to those seen throughout this chapter. The less affluent are more likely to think that the speed of development in science and technology makes it difficult to keep up (57%, versus 43% overall) and that science and technology are too specialised for most people to understand them (69%, versus 55% overall).

It is worth highlighting that a large minority of those with a science-related degree (26%) and those who say they work as scientists or engineers themselves (31%) also agree that the speed of development makes science and technology too difficult to follow (compared with 43% overall), suggesting that even for the most qualified it can be challenging to keep up.

Discussing science in a digital age

5 Discussing science in a digital age

An objective of PAS 2014 was to explore how people find out about science online, not only in terms of how people search for information online (which is covered in Chapter 4), but also in terms of how they discuss and share science stories online. This chapter explores these latter aspects, covering findings from the online qualitative research and the social listening. As noted in Chapter 1, these methodologies were chosen to explore in more depth the attitudes and behaviours of those who are already online.

Key findings

- The level of online conversation about science-related topics is relatively low compared with other topics discussed online.
- In general, peaks in online conversations about science tend to follow offline events, press releases or public announcements.
- Traditional news sources still matter online. Conversations about science-related topics on social media often consisted simply of links to established online newspapers or news websites, such as the BBC News website, with limited added commentary.
- Widespread online conversations about science-related topics are not always high-quality scientific discussions. Discussions often involve people with strong partisan views, and science is often used to shore up ethical or political arguments, not to inform.
- Politicians are seen to lack credibility in online scientific debates unless they have the backing of respected organisations. By contrast, scientists, particularly those with official positions, appear to be seen as uncontroversial authority figures online.
- Science stories are more likely to be shared online if they are funny, are visually interesting, have a public health element, or are more generally topical. However, sharing stories online will not always lead to people engaging with the science topic at hand.

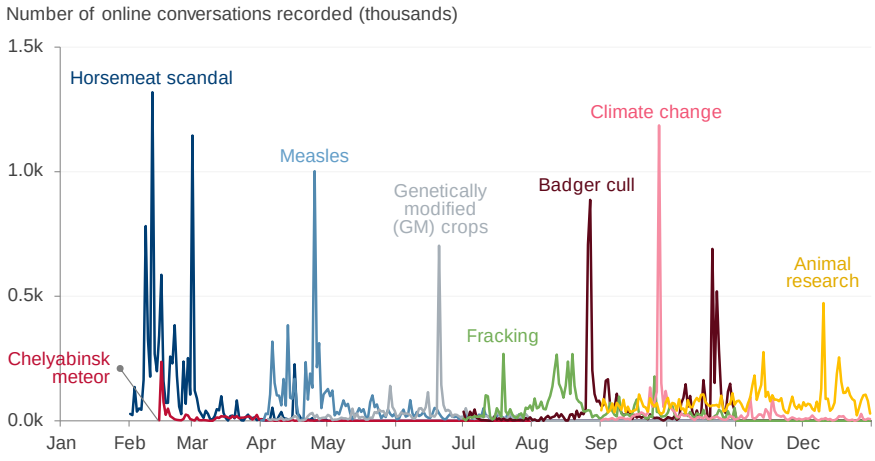
5.1 How do people discuss science online?

The social listening tracked online conversations about two big science-related news stories in each quarter of 2013, i.e. eight topics in total. These included the horsemeat scandal, the Chelyabinsk meteor crash in Russia, measles and the Swansea measles epidemic, genetically modified (GM) crops, fracking to extract shale gas, the badger cull, climate change and animal research.

What is the level of online conversation about science?

Figure 5.1 shows the level of conversation throughout the year for each of the eight topics. For this exercise, "conversation" included traditional online news sources (i.e. online newspapers or news websites), as well as mentions on Twitter, on blogs and on forums.[33]

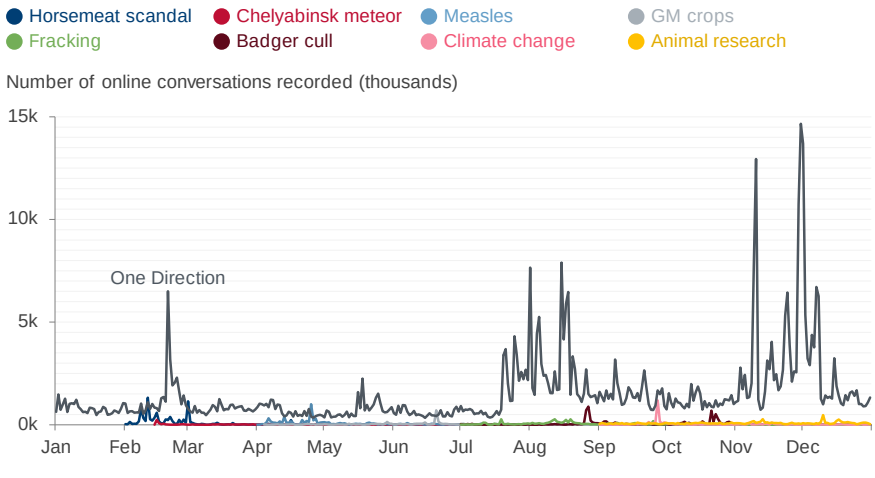
Figure 5.1 – the levels of online conversation for various science topics



Source: Ipsos MORI

Figure 5.2 compares the level of online conversation on these eight topics to that about One Direction, the boy band.[34] This shows that the overall level of online conversation about science-related topics is relatively low.

Figure 5.2 – how the level of online conversations about science compare to other topics



Source: Ipsos MORI

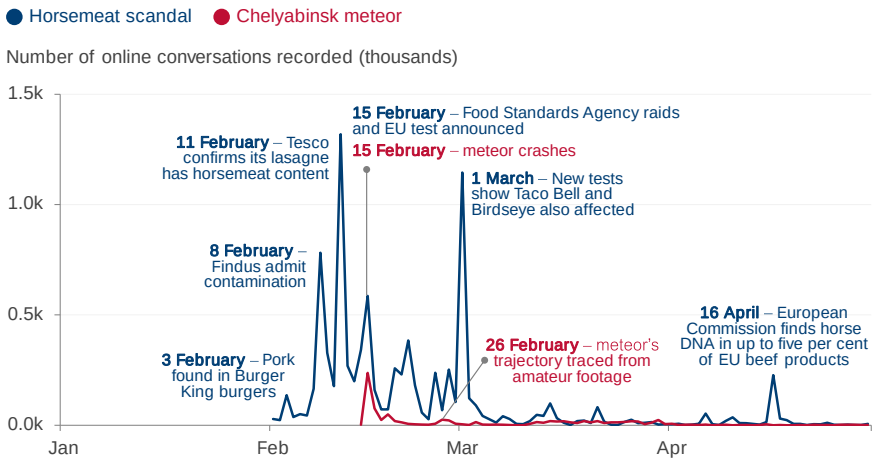
[33] More technical details on the scope of the social listening can be found in the separately published Technical Report, available on the Ipsos MORI website, at: http://www.ipsos-mori.com/pas2014.

[34] This topic, while obviously not comparable in subject matter, was chosen as a major online conversation topic that can be measured with very specific search terms.

What triggers online conversations about science?

In general, for all eight topics, peaks in online conversation have tended to follow key offline events, press releases or public announcements. Figure 5.3 demonstrates this for the horsemeat scandal and the Chelyabinsk meteor. Peaks in conversation for the horsemeat story followed each new revelation of contamination, while the meteor story only had one large peak, on the day of impact, with a smaller subsequent peak on 26 February when amateur footage tracing the trajectory of the meteor was posted online.

Figure 5.3 – triggers of online conversations about the horsemeat scandal and Chelyabinsk meteor



Source: Ipsos MORI

The other topics similarly had offline events that sparked online reactions:

- Owen Paterson's speech on genetically modified (GM) crops (June)
- the Balcombe anti-fracking protests (July to August), the government announcement of tax breaks for fracking to extract shale gas, and Caroline Lucas MP's prosecution announcement (both in September)
- the beginning (August) and extension (October) of the badger cull
- the release of the fifth UN Intergovernmental Panel on Climate Change (IPCC) report (September)
- the release of the *Brown Report* on the treatment of animals used in research at Imperial College London (December), following allegations by the British Union for the Abolition of Vivisection (BUAV).

However, outside of the *Brown Report*, the online conversations about animal research appeared to be less tied to offline events and instead represented an ongoing ethical debate and consumer discussion, with individuals regularly discussing how to avoid consuming products that had been tested on animals.

What influences the content and duration of online conversations about science?

Table 5.1 outlines *how* each of these science topics was discussed online, in terms of their content and duration, and the key insights from this.

Table 5.1 – Social listening findings and learning

Topic	What the online discussions involved	Key insights
Horsemeat scandal	• Most of the internet traffic on horsemeat came from traditional online news sources, but the story really took off on Twitter, with many peaks in Twitter conversation following each new revelation. • The science of the story took second place to humour and people shared jokes, rather than facts.	• The involvement of well-known supermarkets, the lack of serious public health implications and the taboos around eating horsemeat all drove an extended, humorous online conversation.
Chelyabinsk meteor	• The internet traffic came primarily from traditional news sources and had one main peak, just after the meteor impact. • Scientists and scientific organisations, such as the European Space Agency and the Science Museum in London, helped to widely distribute factual information online through Twitter.	• The serious consequences (i.e. the death toll) and relatively low public understanding about meteor science may help to explain why this story quickly fizzled out. • Scientists and scientific organisations were seen as authority figures who knew the facts.
Measles	• Twitter posts made up the largest proportion of internet traffic, mainly through organisations (e.g. local councils) and people tweeting official public health messages. • The volume of public health announcements also increased the proportion of traffic coming from traditional online news sources.	• This topic shows how, *in certain contexts*, online conversation can boost government attempts to spread scientific or public health messages (in this case around MMR vaccination). • The lack of offline coverage by traditional media may help to explain why anti-vaccination conversation was relatively low online.
GM crops	• Internet traffic on GM crops came predominantly from Twitter. • Owen Paterson's speech led to two very partisan debates on Twitter, one about scientific authority and the other about the social and ethical implications of GM. • Organisations or individuals seen to have authority on either side of the debate were frequently retweeted. This included the EU Chief Scientist, Anne Glover, and the Science Media Centre.	• This shows how contentious topics that are typically dormant online can are easily become active after new announcements or new findings are reported offline. • There appears to be a low level of trust in politicians and low respect for their scientific authority online. By contrast, scientific advisers (e.g. Anne Glover) appear to be much better trusted.
Fracking to extract shale gas	• The online conversation was dominated by partisan voices on Twitter, with both sides of the debate citing "science" and "scientists" to support their views. • Compared to the other topics, there was also a relatively high volume of more detailed conversation in online environmental and local area forums.	• This shows that discussions about the science among those who feel well informed can still lead to highly partisan online conversations – both sides in the fracking debate claimed that the science was on their side, and there was little interaction between opposing sides.
Badger cull	• The online conversation was dominated by intensely partisan discussion on Twitter, mostly against the badger cull. Much of this was led by passionate individuals, rather than organisations. • Online conversations were frequently linked to critical comment pieces from traditional offline and online news sources.	• Traditional media coverage, both online and offline, as well as offline political announcements can still be very influential in driving online conversations. • For this topic, the online debate was sometimes hampered by a lack of clarity on the science.

Topic	What the online discussions involved	Key insights
Climate change	• Conversation was dominated by traditional online news coverage of the IPCC report. • Debates on the existence of man-made climate change featured across many non-science related forums and blogs, and were highly polarised. • While many cited scientific evidence, people also disputed the backgrounds and independence of the experts being cited.	• This topic was the only one that led to a vigorous public discussion of the science behind the story. However, science tended to be used to back up predetermined attitudes, rather than to facilitate an evidence-based discussion.
Animal research	• Unlike the other topics explored, there appears to be a baseline level of regular online conversation about animal research. • Campaigning organisations such as BUAV dominated the online conversation, which was almost entirely against animal research. • Conversations also often had a consumerist slant, with people asking for recommendations for products that had not been tested on animals.	• This shows that the scientific element of a debate can be lost when strongly held ethical values are also at stake. In this case, the one-sided nature of the debate was possibly exacerbated by the lack of involvement of working scientists in the discussion.

Taken together, these findings have important implications for policymakers and science communicators attempting to engage the public online:

- Traditional news sources still matter online. Conversations about the horsemeat scandal, the Chelyabinsk meteor and climate change were all dominated by articles on established online newspapers or news websites, in particular the Guardian and the BBC News website. Many of the conversation on social media consisted simply of links to these sites with limited added commentary.

- Discussion of science issues online often takes place among the pre-engaged, who already hold strong views. Even the most animated Twitter debate is unlikely to reach many people who are not already interested, though topics which have a humorous slant (as with the horsemeat scandal), visual appeal (the Chelyabinsk meteor), or a public health element (measles) are more likely to be discussed among a wider audience.

- The intensely partisan and sometimes almost-entirely one-sided nature of much on the online debate about science issues may represent a missed opportunity for science communication. For example, the conversations about animal research focused almost entirely on the arguments against animal suffering, with little contribution from scientists who use animals in their research.

- However, a widespread online conversation about a science-related issue is not always the marker of high-quality scientific discussion. Where people in online conversations cited scientific evidence, it was usually to shore up ethical or political arguments, rather than to inform, or present a balanced picture of all the research on an issue.

- The messenger matters. Many of the debates around some of the more contentious topics, like GM and the badger cull, boiled down to discussions of scientific authority. People argued over what this actually meant as well as who possessed it. There is no consensus on authoritative sources, but there is a widespread view that politicians lack credibility in scientific debates unless they have the backing of respected organisations. By contrast, scientists, particularly those with official positions, are often seen as uncontroversial authority figures online.

5.2 How do people share science stories online?

One piece of the online qualitative research focused on how participants shared science stories and information in their peer groups. This involved 17 members of the Ipsos MORI Connects community who were regular users of social networking websites.

The way participants shared science stories reflected how they shared non-personal information generally. Participants described giving significant thought to their intended audience before they shared non-personal

information, and treated posting anything to a social network as akin to a public speech. Therefore, considerations around what a particular post would say about their social identity, and the perceived interests of their audience, would both have a big impact on what they posted.

"I don't like to clog up my friends' Facebook and Twitter feeds by sharing and posting everything. I like to find things that are a bit different and of interest, so people notice them more."
Online community participant

I don't like to clog up my friends' Facebook and Twitter feeds. I like to find things that are a bit different and of interest, so people notice them more.

Online community participant

The types of information they shared (not necessarily science-related information) fitted into several categories:

- **Relevant only to me**
  This kind of information was not shared because, while it was interesting and engaging for the individual, they were unsure if a wider audience would find it relevant or interesting.

- **About me and my activities**
  This kind of information was shared with close friends and family, either via email or on Facebook.

- **Relevant to audience**
  This was information that the sharer knew would be relevant to the particular person or people they shared it with, and served to build or maintain a personal relationship with them.

- **Funny, visually interesting or topical**
  This was the most commonly shared type of information. Participants spoke about posting things that they knew would fascinate or interest their friends, and of taking care to post things that grabbed their attention, either because they were humorous, or visually interesting, or sometimes because they were topical. For example, one participant said she regularly posted information about beautiful photos of nature that she found while browsing.

- **Geeky information**
  This kind of information was related to a specific hobby or interest that the sharer might not have in common with family and friends. Participants sometimes shared these stories on social networks such as Facebook, but more often these were the kinds of things they would share on specific topic-related forums – these sometimes included science-related forums.

For many, science-related information fell into one of the latter three categories, and so in most cases would only be shared if it was funny, visually interesting or topical.

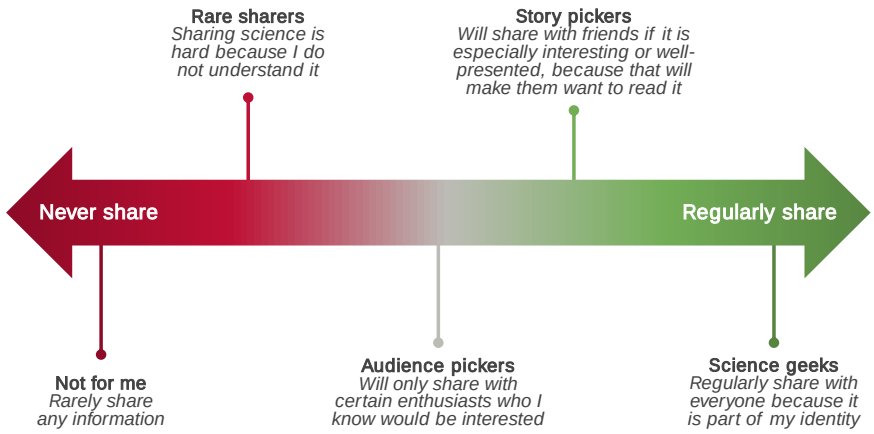
It should be noted that, despite using these sites every day, some participants still said that they rarely shared *any* information on social networks, preferring instead to email. These users treat social networks

more like another form of passive media, and were only likely to come across science stories online when their friends posted them.

***"To be honest, I've not shared any** science stories at all online. I rarely read the news and it will take a friend to upload a story that has particular interest to me before I click on a link."*
Online community participant

In these discussions about sharing people typically fell somewhere on a spectrum, from the aforementioned passive users who rarely shared any information online, through to the people who considered themselves to be geeky, so would regularly share stories, including science stories, to help craft their online social identity. This spectrum of social network users is shown in Figure 5.4.

Figure 5.4 – a spectrum of social network users based on how they share science-related information online



Source: Ipsos MORI

One of the tasks given to participants was to start on online conversation about robots. Some participants on the left hand side of the spectrum in Figure 5.4 struggled with this at first, but quickly found themselves enjoying the task – it provided a way to connect with friends, and got them thinking about how advances in robotics might benefit their lives.

"I thought it might feel a bit silly just randomly coming out with 'robots', but actually I really enjoyed it and so did mum."
Online community participant

Information that allowed them to see modern robots in action, such as Honda's website for their humanoid robot, ASIMO, were particularly good at sparking conversations, especially with younger family members, which again suggests that science stories are more likely to be seen as sharable if they are funny, visually interesting or topical.

However, it should be remembered that online sharing of science stories will not always lead to people engaging with the science topic at hand. Where

participants had shared science-related information online before, outside of the robot task, this had typically lead to others commenting that the posts were cool or interesting, then moving on, rather than starting a conversation about the issues.

Trust and confidence in science

6 Trust and confidence in science

In Chapter 2, it was shown that many people consider scientists to be both "honest" and "secretive" at the same time. This highlights that there are many different dimensions to trust, and that honesty, ethical behaviour and transparency are very different things. This chapter explores the different dimensions of trust in science, including trust in scientists, science reporting and in regulation.

Key findings

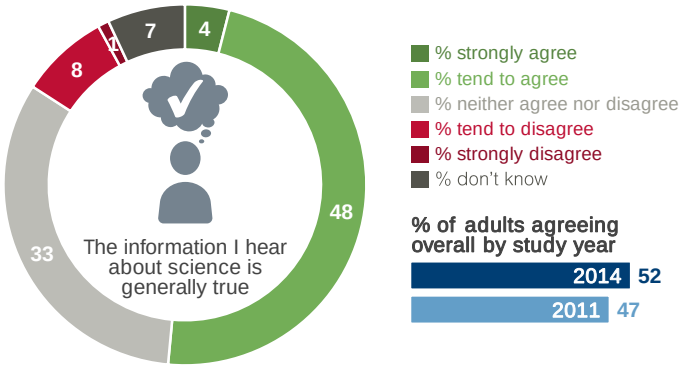
- Half think the information they hear about science is generally true. Trust in this information is often implicit – many people have no specific reason for trusting it. However, hearing things from scientists directly rather than from journalists seems to engender greater trust.
- This may be linked to negative perceptions of media reporting of science. Seven-in-ten think the media sensationalises science, and many doubt the scientific qualifications and rigour of journalists who write about science.
- While these concerns do not necessarily stop people from feeling informed or even from trusting what they hear, it does leave some groups, particularly those with low science knowledge scores, confused about the conflicting information they see and hear.
- Trust in regulation is complex. Scientists are highly trusted to follow regulations and to consider the risks, more so than in 2011. However, even those who trust scientists in this way have concerns about the *effectiveness* of government regulation. There are also wider concerns about how industry and the media are regulated, over and above scientists.
- Awareness of regulation does not necessarily lead to trust in scientists and their work. The latter seems more linked to the perceived intentions of scientists than to confidence in regulation.

6.1 Trust in information generally

As can be seen in Figure 6.1, half (52%) think that the information they hear about science is generally true. This generic trust has increased slightly since 2011 (by five percentage points from 47%). As in 2011, one-third (34%) are undecided on this question, suggesting there is once again a sizable minority who are sceptical about what they hear.

Figure 6.1 – whether people think the information they hear about science is generally true

Q. To what extent do you agree or disagree with the following statement?



Base (for 2014): 1,749 UK adults aged 16+

Among adults overall, men are more likely to agree than women (57% versus 46%), with the latter more likely to be neutral on this point (36% neither agree nor disagree, versus 29% of men). However, this gender difference does not exist among 16-24 year-olds, where young men's and young women's views tend to be similar.

Those from ethnic minorities are also more likely to *strongly* agree than average (10%, versus 4% overall).

Feeling informed about science is also associated with greater generic trust – six-in-ten (58%) of those who feel informed agree, compared with just under five-in-ten (47%) of those who do not feel informed. Of course, the direction of this relationship is not certain – it may be that people who are more trusting tend to feel more informed *because* they believe what they see and hear about science.

It is also important to note that those who do not feel informed are *not* more distrusting. Instead, they are more likely to say they do not know if what they hear is true (10% say this, versus 3% of those who feel informed). Similarly, those with low science knowledge scores are more likely than average to say they do not know (14%, versus 7% overall). This suggests that lack of understanding may lead to confusion more than to distrust in science.

Does trust depend on where people get their information?

The overall findings are unchanged regardless of whether people typically get their information about science through online channels or through offline ones in general. When looking more specifically, two channels stand out:

- Those who get most of their information from books are particularly likely to think what they hear about science is true (14% strongly agree, versus 4% overall).

- Those who say most of their information comes from scientific journals are more likely to disagree that the information they hear is true (17%, versus 9% overall). While this latter difference may seem counterintuitive, it may reflect the particularly high standards for information among this group, as they are very likely to work with scientists, or to be scientists themselves.

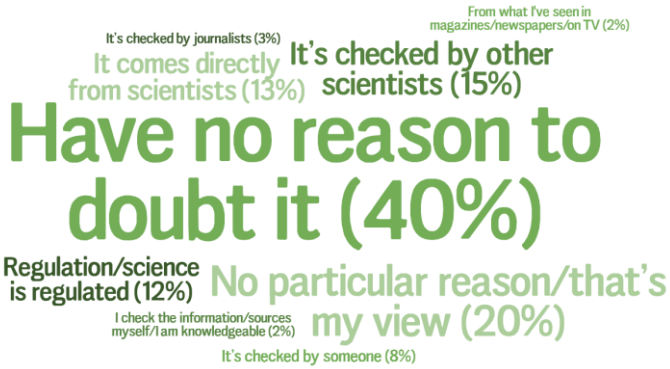
Why do people trust information or not?

Many people lack specific reasons for saying they trust what they hear about science, suggesting that trust is to a large extent implicit. Among those who agree that what they hear is generally true, two-in-five (40%) say they have no reason to doubt it, and one-in-five (20%) have no particular reason for their answer when asked unprompted, as Figure 6.2 shows.[35]

The more specific responses given highlight the important role played by scientists themselves, as well as by regulators, in engendering trust. Among the most common responses are that information is checked by scientists (15%), or comes directly from scientists (13%), or that there is regulation (12%).

Figure 6.2 – reasons people say the information they hear about science is generally true

Q. Why do you agree that the information you hear about science is generally true?



Base: 924 adults who agree that the information they hear about science is true
N.B. word clouds are illustrative of data, not statistically representative; only codes registering 2% or more are shown

Among those who say that the information they hear is generally not true, the reasons given are often the reverse of those seen in Figure 6.2. Once again, as Figure 6.3 shows, there are a group of people who have no specific reason, and appear to have a general tendency to distrust what they hear. Beyond this, some distrust seems to rest on information not being checked, or not coming directly from scientists.

However, contrasting these two questions suggests that there are differences between trust and distrust. Whereas *trust* in information is

[35] While this question was asked in PAS 2011, changes to the coding approach mean that direct comparisons between the individual answer categories in 2014 and 2011 are not possible. This also goes for the equivalent question for those who disagree that the information they here about science is generally true.

frequently associated with the direct involvement of scientists and rarely with the involvement of journalists, *distrust* appears to be more commonly associated with journalists and the media.

71%

think the media sensationalises science

Figure 6.3 – reasons people say the information they hear about science is generally not true

Q. Why do you disagree that the information you hear about science is generally true?

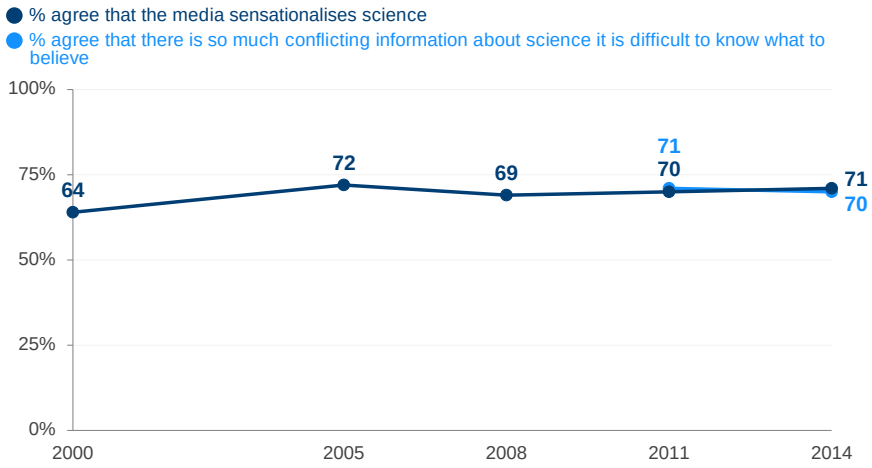
Base: 154 adults who disagree that the information they hear about science is true
N.B. word clouds are illustrative of data, not statistically representative; only codes registering 2% or more are shown

6.2 Trust in media reporting

People have ongoing concerns about the reporting of science, as Figure 6.4 indicates. Seven-in-ten agree that "the media sensationalises science" (71 %) and that "there is so much conflicting information about science it is difficult to know what to believe" (70%). These scores are consistent with those found in previous years.

It is nevertheless worth contrasting these findings with trust in information about science generally (discussed in the previous section). While most agree that the media sensationalises science when prompted on the issue, very few give this as a specific reason for disbelieving what they hear about science. Moreover, even among those who think the media sensationalises science, the proportion saying that the information they hear is generally true is no different from the average. This suggests that general perceptions of media sensationalism may ultimately have little impact on whether people believe what they see and hear.

Figure 6.4 – perceptions of science reporting over time



Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

Young adults aged 16-24 seem less concerned about media reporting as a whole. They are less likely to agree that the media sensationalises science (58% agree, versus 71% overall) and are more likely to *disagree* that conflicting information about science makes it difficult to know what to believe (16% disagree, versus 12% overall).

Beyond age differences, people with high science knowledge scores (79%), those who feel informed about science (76%), the more affluent (79% of ABs) and those educated to a higher level (80%) are all more likely than average (71%) to think the media sensationalises science. Conversely, people with low science knowledge scores (76%), those who do not feel informed about science (77%), the less affluent (75% of DEs) and women (73%) are more likely than average (70%) to feel confused by the conflicting information about science.

Sources of information also matter. Broadsheet readers are less likely than tabloid readers to be confused by conflicting information (61% versus 74%) but more likely to perceive media sensationalism (79% versus 69%). Those who say most of their information about science comes from science journals or from the radio are also more likely than average to agree that the media sensationalises science (83% and 78% respectively, versus 71% overall).

The subgroup differences at these questions indicate that people approach the issue of media sensationalism in science in two different ways. One group, who are more likely to be more affluent and more educated, tend to see media sensationalism as a problem for science but not one that stops them from feeling informed or from seeking out different information channels, such as the radio, or scientific journals. The other group, who are more likely to be women and less affluent, are more personally affected by the way science is reported, tending to be left more confused by what they see as conflicting information.

Assumptions about science reporting

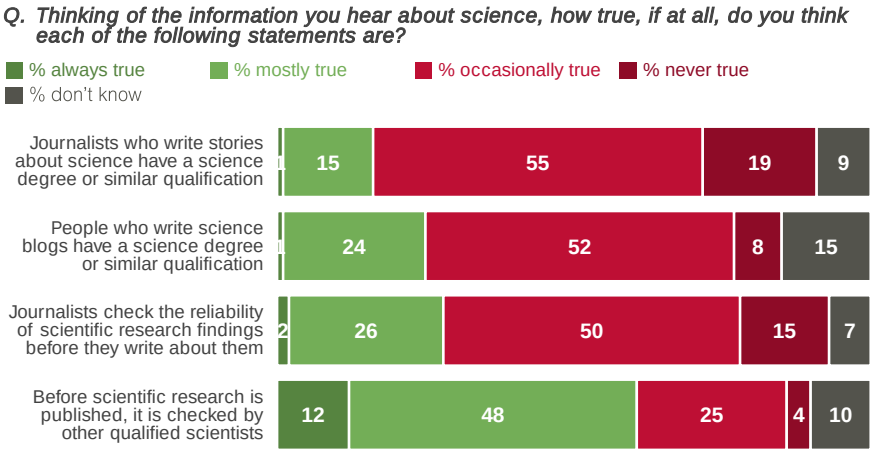
As Figure 6.5 highlights, people tend to make negative assumptions about science reporting, especially when it comes to journalists. Over half (55%) think journalists writing science stories only occasionally hold relevant qualifications in science, while one-in-five (19%) think this is never the case. Half (50%) also think journalists only occasionally check that findings are reliable before writing about them, while 15% think this never happens.

People are more likely to think that authors of science blogs are qualified than think this of journalists. A quarter (25%) think this is always or mostly true about science bloggers, compared with just 16% saying this about journalists.

In further contrast to journalists, the majority (61%) think it is always or mostly true that scientists check each other's work before publication. This may help to explain why hearing about findings directly from scientists seems to engender greater trust.

It is worth noting that these findings are not unusual, and may say more about trust in journalists generally, rather than trust in science journalists specifically. The Ipsos MORI *Trust in Professions* surveys have regularly found journalists to be among the least trusted professionals "to tell the truth".[36]

Figure 6.5 – the assumptions people make about how science is reported by scientists, journalists and science bloggers



Base: 1,749 UK adults aged 16+

There are no consistent differences by sources of information and, on balance, people tend to be sceptical about the qualifications and rigour of science journalists regardless of where they get most of their information about science from.

However, there is some indication that those who get most of their information about science online tend to be more sceptical than others.

[36] Trend data from the Ipsos MORI Trust in Professions surveys are available on the Ipsos MORI website at: http://www.ipsos-mori.com/researchpublications/researcharchive/poll.aspx?oItemId=15.

Those who get most of their information specifically from online newspapers or news websites – the most common online source of information about science – are more likely to think journalists writing science stories are only occasionally qualified, or never qualified (84%, compared with a 75% average) and are more likely to think this about science bloggers as well (68%, compared with 60% overall).

Young adults also tend to make slightly different assumptions about media reporting. They are typically less sceptical about the qualifications of journalists writing about science (22% think they are always or mostly qualified, versus 16% overall), and about the qualifications of science bloggers (29% think they are always or mostly qualified, versus 25% overall).

Those educated to a higher level also tend to be more sceptical about the qualifications and rigour of science journalists and the qualifications of science bloggers. However, there are further differences within this subgroup based on the *type* of education people have had. People with an arts-related degree are typically more likely to believe that those who write about science are qualified to do so – a quarter (24%, versus 16% of all graduates) think journalists in this area are always or mostly qualified, and a third (33%, versus 24% of all graduates) think this about science bloggers.

No groups are especially likely to challenge the idea that scientific research is checked by other qualified scientists before publication. Nonetheless, those with low factual science knowledge scores are less certain of this (24% say they do not know if scientists check each other's work, compared with 10% overall).

Can trust in science reporting be improved?

The qualitative research highlights the considerable challenge of improving perceptions of science reporting, even if the reporting itself improves. Participants at the Day of Discovery workshop tended towards resignation when discussing how the media reports science. They saw sensationalism as inherent in all journalism, with the need to entertain and limited article space taking precedence over scientific completeness or accuracy.

"Things can get 'sexed up' just to get attention and then it becomes a runaway train."
Day of Discovery workshop participant

"I don't trust the media as they don't paint the full picture and can only really give a flavour of the research."
Day of Discovery workshop participant

Many participants thought there were often two sides to a scientific story. They thought it was not possible to get both sides of the story from a single article, so anyone interested in a topic would have to look at a range of media to get what participants saw as the full story.

Nonetheless, some participants did have suggestions on how media reporting of science could be improved, especially on online newspapers or news websites where page space is not an issue. Suggestions included:

- having articles that contained more details on the pros and cons of a science topic or technology, so that the reader could get a more balanced view
- layperson-friendly versions of journal articles that people could read – participants were often aware that scientific research findings were typically published in scientific journals and considered these to be untarnished by media sensationalism, but also felt they were not accessible to those who did not work in science
- layperson-friendly science blogs that were written or approved by scientific organisations – the NHS Choices *Behind the Headlines* blog or the Cancer Research UK science blog might be considered examples of this, although participants did not specifically mention these.

Some participants also suggested that journalists should be like TV weather reporters, who were perceived to be trained meteorologists, so people could be reassured that they were formally qualified and had a good knowledge of the area they were reporting on.

6.3 Trust in scientists

Trust to follow rules and regulations

As Figure 6.6 illustrates, trust in scientists to follow rules and regulations is typically high. Moreover, although trust still varies based on the institutions scientists work for, it has generally increased across the board since 2011 (except for government scientists, where trust is not measurably different from 2011 levels).

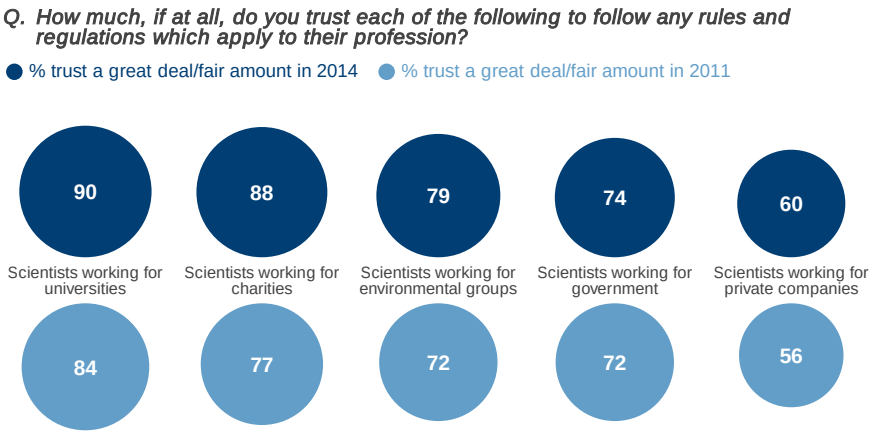
This finding correlates with the 2013 Ipsos MORI *Trust in Professions* survey, which also found that trust in scientists "to tell the truth" had increased since 2011. The high level of trust in scientists recorded in both that survey and in PAS 2014, despite different question wording, suggests that there is a high level of generic trust in scientists, which may tie in with them being widely seen as honest (as discussed in Chapter 2).

Of course, it is important to remember that while trust is broadly linked to institutions, it is not solely about this. Survey research on UK attitudes towards climate scientists (reported in Shuckburgh, Robison and Pidgeon, 2012 report for the Living with Environmental Change Partnership) found that they were typically less trusted than scientists generally, and found that "independent" scientists were most trusted to give correct information on climate change. This suggests more generally that trust in particular scientists strongly depends on framing, and possibly the assumptions this framing creates about vested interests and personalities – for example trust

trust industry scientists to follow rules and regulations

in a scientist will differ if they are introduced as a climate scientist, as a scientist who works for a university, or as a university lecturer.

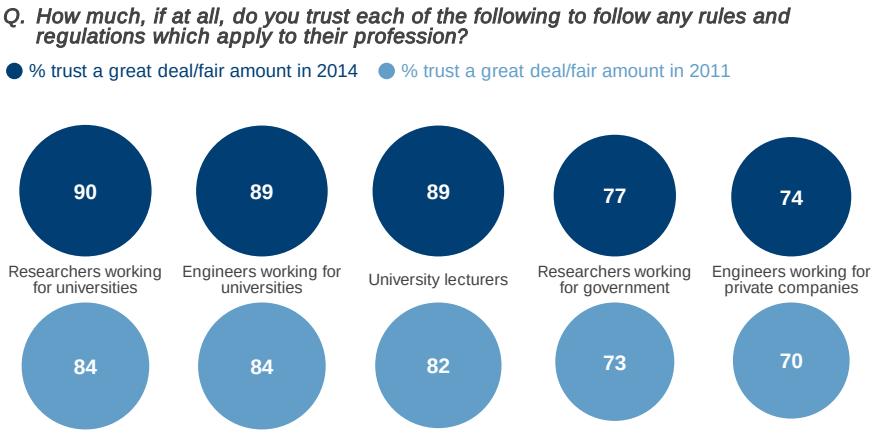
Figure 6.6 – trust in scientists to follow rules and regulations over time



Base (for 2014): 858 UK adults aged 16+

Figure 6.7 shows a similar pattern and similar changes over time for trust in engineers, researchers and university lecturers (all of whom are more trusted to follow rules and regulations than in 2011). Again, trust is dependent on institutions, with those working for private companies or for government typically less trusted.

Figure 6.7 – trust in engineers, researchers and university lecturers to follow rules and regulations over time



Base (for 2014): 891 UK adults aged 16+

People who have a high science knowledge score tend to be more trusting of each profession asked about. In addition, some demographic factors are correlated with trust:

- The less affluent (DEs) are generally less trusting than average of all the different types of scientists.

- Men are more trusting than women of scientists working for government and for universities, and of both types of engineers asked about. Conversely, men are less trusting than women of scientists working for environmental groups. However, once again when looking only at 16-24 year-olds, these gender differences are less discernible and both young men and young women are generally equally trusting.

However, within each of these groups there is still a hierarchy of trust by institution.

Trust in intentions versus trust in competence

The qualitative research suggests that trust in scientists seems to be linked to perceptions of their intentions more than their competence. Participants at the Day of Discovery workshop often judged scientists based on the areas they worked in. Scientists who worked on what participants saw as "useful" science, such as medical research, were assumed to have good intentions, so could be trusted on this basis.

By contrast, participants had little to say about the competence of scientists. They tended to assume that scientists were competent, and that "bad science" was done intentionally and explicitly, for example by rigging results, rather than due to a lack of research skills or through drawing the wrong conclusions from the data. This could mean that when the intentions of scientists are viewed positively, findings are likely to be trusted, even if they are based on faulty science. While not explicitly mentioned by participants, the discredited MMR-autism link might be seen as an example of this.

The focus on the intentions of scientists also helps to explain why trust in scientists working for private companies tends to be lower. Participants generally assumed that scientists who worked for government or universities were not driven by money, so probably had more worthy intentions and were more trustworthy than those working for private companies.

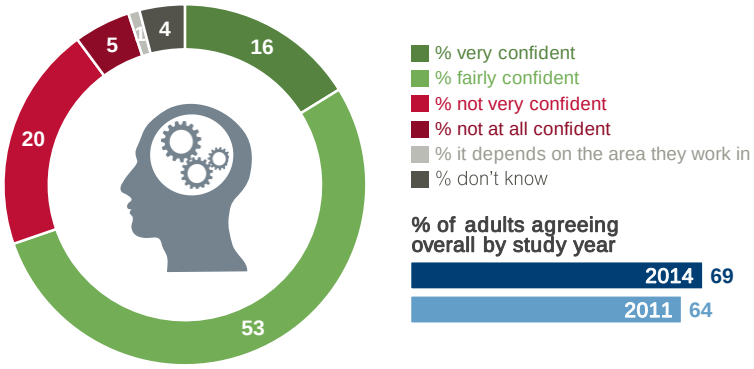
"I think it depends on the individual in whatever area they're working, and their moral code and their ethics. Certain kinds of individuals get drawn to the greater good and work for government on lower pay."
Day of Discovery workshop participant

Do scientists consider the risks?

As can be seen in Figure 6.8, seven-in-ten (69%) are confident that scientists have considered the risks of new technologies before they are used, which is somewhat higher than in 2011 (when 64% were confident).

Figure 6.8 – whether people think scientists consider the risks

Q. How confident, if at all, are you that scientists in the UK have thoroughly considered the risks of new technologies before they are used?



Base: 1,749 UK adults aged 16+

The groups that are generally more trusting of scientists to follow rules and regulations also tend to be more confident that scientists consider the risks. The more affluent are typically more confident (74% of ABs, compared to 69% overall). As was found in the 2011 survey, black people are also less confident than white people (40% not confident, compared to 26% of white people).

Men are more confident than women on this (73% versus 65%). Unlike other indicators of trust in the survey, here this gender difference is also present among young men and women aged 16-24.

Is it enough for scientists to consider the risks?

The qualitative research suggests that confidence that scientists consider the risks related to their work is generally unconscious. Participants at the Day of Discovery workshop had little idea of how scientists might take account of any risks attached to their work, and it was more often a received wisdom that scientists did so. As a result, some participants still had doubts over whether this would be sufficient to prevent problems in the future. Here, some used historic examples of what they saw as scientists "getting it wrong", such as Thalidomide, to bolster their arguments. This highlights how, in the absence of an understanding of how scientists consider any risks, these historic, negative stories continue to have an impact today.

Participants also thought that decisions about risk were not always within scientists' control, but made instead by the institutions they worked for. For example, they wondered whether trials of products destined for human use always received enough funding to be suitably large. They also questioned whether, given the potential profits to be made from scientific advances, private companies took care to test things thoroughly enough to rule out all potential risks. Conversely, some pointed out that some new technologies risked reducing profits for private companies by disrupting the marketplace, and that this could mean that promising advances are abandoned or not properly funded.

"The MRI scanner wasn't invested in because it made things quicker. The money takes away the integrity."
Day of Discovery workshop participant

This might also help to explain the relatively lower trust in scientists working for private companies.

6.4 Awareness of regulation

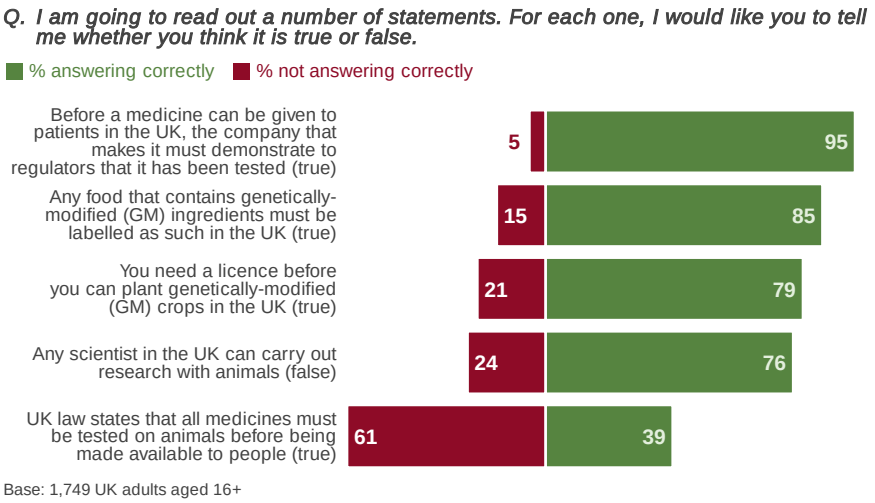
Is science regulated?

The survey also explored whether people think there are specific rules governing areas such as medicine, animal research and genetically modified (GM) crops. These were asked as a series of true or false questions where one response, either true or false, was factually correct. As Figure 6.9 shows, people on balance tend to answer most of these questions correctly, with one exception – only two-in-five (39%) correctly say that "UK law states that all medicines must be tested on animals before being made available to people", while three-in-five (61%) do not answer this correctly.

Of course, correct answers at these questions do not necessarily mean that people were aware of these specific rules beforehand. It may simply reflect that people *assume* regulations are in place. This is something found in many public dialogues on science issues – for example, the public dialogue on health research found that while there was little knowledge of the Health Research Authority's role as a regulator, participants tended to assume upfront that regulation must exist (see Hunn's 2013 report for the Health Research Authority).

These findings also highlight the particularly high number of myths that surround the animal research topic. This is something that was found in the *Openness in Animal Research* (Ipsos MORI, 2013) public dialogue as well.

Figure 6.9 – whether people think there are specific regulations governing science in the UK



Base: 1,749 UK adults aged 16+

People's level of factual scientific knowledge (as measured by the knowledge quiz in the survey) is not necessarily correlated with their knowledge of specific regulations in science. People with high knowledge scores still answer no differently from the average when asked if "UK law states that all medicines must be tested on animals before being made available to people", so answer this incorrectly on balance.

Who regulates scientists?

When asked unprompted, just two per cent say no one sets rules and regulations for UK scientists, again suggesting that people overwhelmingly assume scientists are regulated in some fashion. There is however a sizable group (21%) who say they do not know *who* regulates scientists.

As can be viewed in Figure 6.10, those who do give an answer tend to recognise that the Government and its agencies regulate scientists (62% mention these), but most people cannot think of other types of regulation, for example by ethics committees (5%) or by scientists themselves (11%). Over half (55%) only give a single answer at this question, indicating that the Government is seen as the sole regulator of scientists by many. This pattern of responses is similar to that seen in 2011.

Figure 6.10 – who people think sets the rules and regulations for UK scientists

Q. Who, if anyone, sets the rules and regulations for scientists in the UK to follow when they are doing their job?

Base: 1,749 UK adults aged 16+
N.B. word clouds are illustrative of data, not statistically representative; only codes registering 2% or more are shown

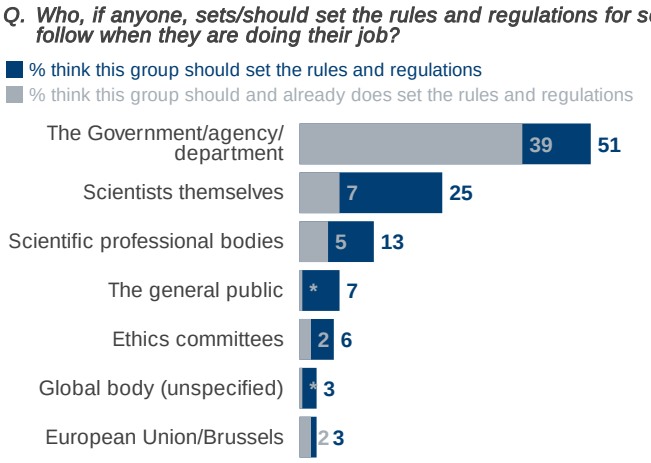
Perceptions of who does regulate are broadly in line with expectations of who *should* regulate. When asked who should regulate scientists, the Government is still the most common answer (mentioned by 51%), as Figure 6.11 shows. However, a much larger proportion say scientists themselves (25%) and their professional bodies (13%) should be the ones to set the rules and regulations. The gap between this and perceptions of what currently happens – the gap between the blue and grey bars in Figure 6.11 – suggests many of the public would like to see scientists and professional bodies have a greater role than they are currently seen to do in this area.

Just two per cent (not shown in Figure 6.11) say that parliament, i.e. politicians, should regulate scientists, which contrasts with the role many

people want the Government to play. This was echoed in qualitative research. Participants at the Day of Discovery workshop explained that they were happy for the Government to have a role, because they thought there were qualified people in government who could make informed decisions on regulation. By contrast politicians, while they could be advised, were generally seen as unqualified and as short-term thinkers.

"Politicians are all about PR and can have kneejerk reactions to things. Because politicians are playing the short-term game for five-year terms, it can have an effect on what they say about science."
Day of Discovery workshop participant

Figure 6.11 – who people think should set the rules and regulations for UK scientists



Base: 1,749 UK adults aged 16+; only codes registering 3% or more are shown

Those groups who generally feel less informed about science also show lower awareness of regulation, and tend to have less developed opinions on the topic. Women are more likely than men to say they do not know who regulates scientists (26% versus 16%), and that they do not know who should regulate scientists (13% versus 8%). These differences are also present among young men and women aged 16-24.

The less affluent (DEs) are also more likely than average to say they do not know who regulates scientists (29%, versus 21% overall) or who should regulate them (19%, versus 11% overall).

6.5 Confidence in regulation

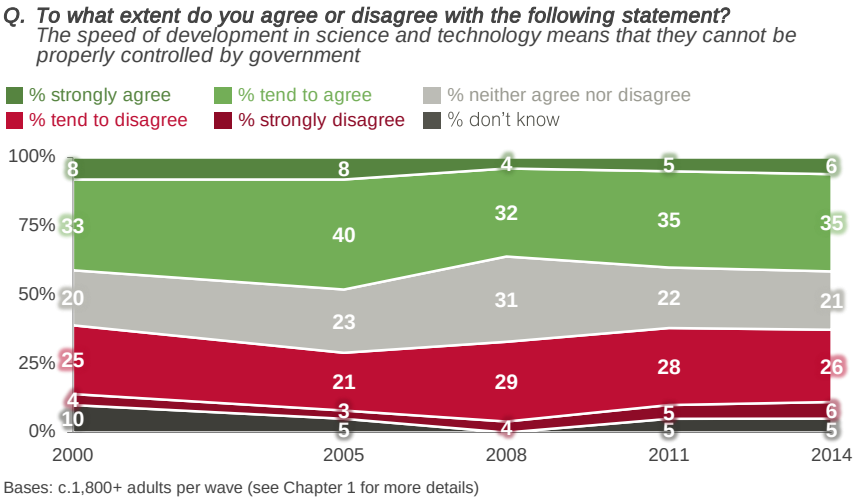
While the public is highly trusting of scientists to follow regulations and to consider the risks of their work, they do not necessarily think that the regulations in place are effective. As Figure 6.12 highlights, historically more have agreed than disagreed that "the speed of development in science and technology means that they cannot be properly controlled by government", and this is no different for PAS 2014 (41% agree, versus 32% disagreeing). More also agree than disagree that "rules will not stop scientists doing what they want behind closed doors" (55% versus 25%, not shown in Figure 6.12).

Because politicians are playing the short-term game for five-year terms, it can have an effect on what they say about science.

Day of Discovery workshop participant

These scores remain unchanged from 2011, suggesting that while trust in scientists has increased, this has not necessarily been due to greater confidence in regulation.

Figure 6.12 – whether people think science and technology can be properly controlled by government over time



Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

While confidence in regulation appears to be broader than trust in scientists, it is still linked to trust. People who do not trust scientists and other researchers to follow the rules and regulations that apply to their profession are more likely than others to agree that the speed of development in science and technology means that they cannot be properly controlled by government and that rules will not stop scientists doing what they want behind closed doors.

Again, the less affluent tend to be less confident, being more likely than average to agree with both statements.

For young adults, these issues seem to be less of a concern. Those aged 16-24 are less likely to think the speed of development in science and technology means that they cannot be properly controlled by government (32%, versus 41% on average) and that rules will not stop scientists doing what they want behind closed doors (45%, compared with 55% on average). However, even among 16-24 year-olds, more agree than disagree with each statement.

Does confidence in regulation engender trust?

The qualitative research suggests that while regulation is important to people, emphasising that individual scientists are regulated does not necessarily build trust. Participants at the Day of Discovery workshop generally assumed scientists were well regulated and that they would stick to the rules and regulations, as would most other professionals.

"Scientists are not special. Every profession has rules."
Day of Discovery workshop participant

Some participants thought a more important issue was the lack of regulation of funders and disseminators of scientific research. They thought that scientists might well be regulated, but that they often lose control once their work got into the hands of the institutions they work for and the media. Participants were less confident that *these groups* were regulated effectively.

Others thought that the intentions of scientists would trump any rules and regulations, so regulations overall were less important. For these participants, trust was more likely to come from knowing that scientists were listening to people and engaging in dialogue, and from understanding the intentions of scientists.

"There are standards and regulations. But a moral education, the moral attitudes of the researcher – these are more important."
Day of Discovery workshop participant

"The politicians, the scientists, they do what they want regardless. They don't listen to us. All they want to do is find the big breakthrough that will make their names."
Day of Discovery workshop participant

There are standards and regulations. But a moral education, the moral attitudes of the researcher – these are more important.

Day of Discovery workshop participant

Public involvement in science

7 Public involvement in science

Since the inception of the Sciencewise Expert Resource Centre in 2007, there has been a particular interest in "upstream engagement" in the UK – that is, finding out people's attitudes and aspirations before major policy decisions are made on science-related issues.[37] This chapter looks at whether and how people want to be involved in decision-making about science, and how people think this fits in with the roles of scientists, government and regulators.

Key findings

- People overwhelmingly think regulators, government and scientists should be engaging in dialogue with the public about science. While this does not always translate into a willingness to be personally involved, there are still three-in-ten who would at least like to have more of a say on science issues.
- Even those who favour more public involvement in science tend to think that "experts" and not the public should advise the Government on science issues, and this view of the role of experts has gradually become more prevalent since 2008.
- Changes over time show a slight decrease in the proportions who think scientists and government should listen to the public, while the proportion who think that there is no option but to trust those governing science has increased, potentially suggesting an increasing sense of resigned trust among the public.
- As in 2011, people on balance do not think the Government is doing enough to consult the public on science. However, this may have much to do with widespread public cynicism about public consultation events, which is not new.
- There remains a desire for scientist to talk more with the public about their work, as in previous years, particularly about the social and ethical implications. Half also think scientists should be rewarded for communicating their work.

7.1 Do people want to be involved?

As Figure 7.1 shows, there is an overwhelming desire for regulators, government and scientists to engage in dialogue with the public. Seven-in-

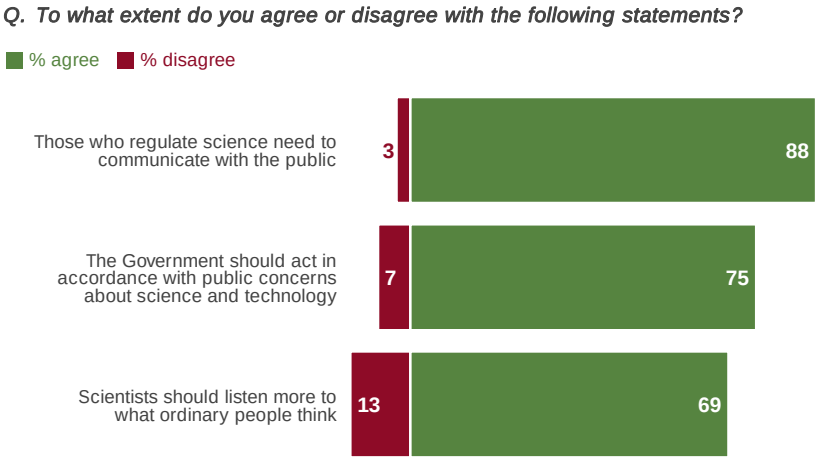
[37] See the Sciencewise Expert Resource Centre website for more information, at: http://www.sciencewise-erc.org.uk/.

ten (69%) think that "scientists should listen more to what ordinary people think". An even greater majority feel that the Government should act in line with public concerns about science (75%), and that regulators need to communicate with the public (88%).

think that scientists should listen more to ordinary people

These findings reflect those of *Special Eurobarometer 401* (European Commission, 2013), which found that two-thirds (64%) of UK citizens felt the public should be involved in decision-making about science, over and above simply being informed. Moreover, this score was higher than the EU average (55%), suggesting the desire for public involvement in the UK is particularly strong.

Figure 7.1 – whether people think regulators, government and scientists should involve the public



Base: 1,749 UK adults aged 16+

Women and the less affluent appear especially keen for the public to be involved. Three-quarters of women (73%, versus 65% of men) agree that scientists should listen more to the public, and eight-in-ten (78%, versus 71% of men) think the Government should act in accordance with public concerns. Those from social grades C2DE are also more likely to think scientists should listen more to the public (77% agree, versus 69% on average).

There is a negative relationship between feeling informed about science and wanting the public to be more involved. Those who do not feel informed about science are more likely to agree both that scientists should listen to ordinary people more (73%, versus 64% of those who feel informed) and that the Government should act in accordance with public concerns (78% versus 72%). This may suggest that a desire for greater public involvement could sometimes stem from not knowing how the public are involved at the moment. However, it is important to note that even among those who feel informed, a sizable majority still desire public involvement.

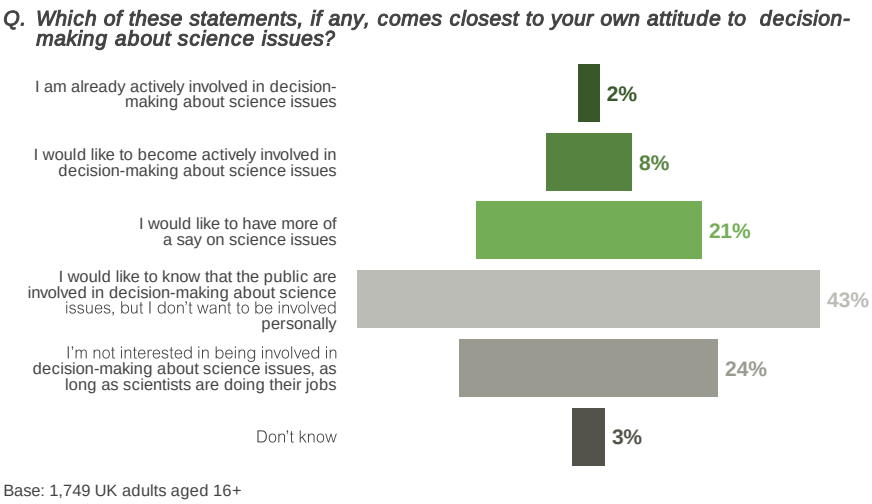
Public versus personal involvement

The desire to see *public* input into decision-making on science issues does not necessarily mean people are willing to get involved themselves. As

Figure 7.2 shows, over four-in-ten (43%) say that they would like to know the public are involved in the decisions made about science issues, but do not want to be involved personally, while a further quarter (24%) have no interest in public involvement as long as scientists are doing their jobs. Nevertheless, this does leave three-in-ten (29%) who would like to at least have more of a say – this represents around 15 million UK adults.

A similar question was asked in PAS 2011, in reference to public consultation on science issues. This found largely the same distribution of results. Moreover, as was pointed out in the PAS 2011 report, this finding chimes with much existing research on involvement in public policy issues – most people generally want to know there are opportunities to get involved, and that others are involved, but do not want to be involved personally.[38] This suggests that while there is a substantial desire for the public's views to be acted on when it comes to science, people do not generally consider it any more or less important than other areas of public policy.

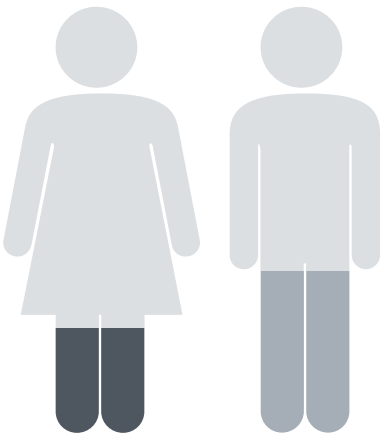
Figure 7.2 – whether people want personal involvement in science decisions



Base: 1,749 UK adults aged 16+

Again, there are differences by gender and social grade, generally inverse to the differences noted for Figure 7.1. Men are more likely than women to say they are already involved or would like to be more involved in decision-making, at least by having more of a say (38% versus 25%), as are the more affluent (41% of ABs say this, versus 31% on average). This represents a challenge for regulators, government and scientists attempting to involve the public, as those who most want the public to be involved tend to be among the least likely to want to get involved themselves.

Confident Engagers are more likely than others to say they are already involved (7%, versus 2% overall) and more likely to want to be more involved (40% want to at least have more of a say, versus 29% on average). Late Adopters are also among the most keen to be more involved (40% want to at least have more of a say). Those segments most likely to say they do



Women are less likely than men to want involvement in decision-making on science issues

[38] See for example the *Audit of Political Engagement 10* (Hansard Society, 2013), which found that 51% of British adults did not want to be involved in national decision-making.

not want to be involved as long as scientists are doing their jobs are the Concerned and the Indifferent (30% and 37% respectively, compared to 24% on average). This presents another challenge for those who want to involve the public, with specific groups, including those who tend to have more concerns about scientists and their intentions, being less likely to make themselves heard.

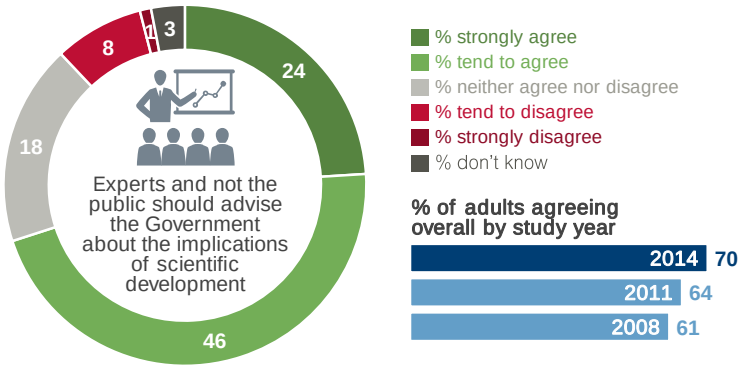
The role of experts

While a clear majority favour more public involvement in science, the public still recognise the need for expert input. Seven-in-ten (70%) agree that "experts" and not the public should advise the Government about the implications of scientific developments. Even those who feel that the Government should act in accordance with public concerns are no more or less likely than others to think this of experts. This also suggests that while people think the public should be involved more broadly, and their views taken into consideration, people feel less certain about the public being asked specifically to advise or make decisions on a course of action.

As Figure 7.3 shows, this view has become more prevalent since 2008 (rising by nine percentage points from 61%).

Figure 7.3 – whether people think experts rather than the public should advise the Government

Q. To what extent do you agree or disagree with the following statement?

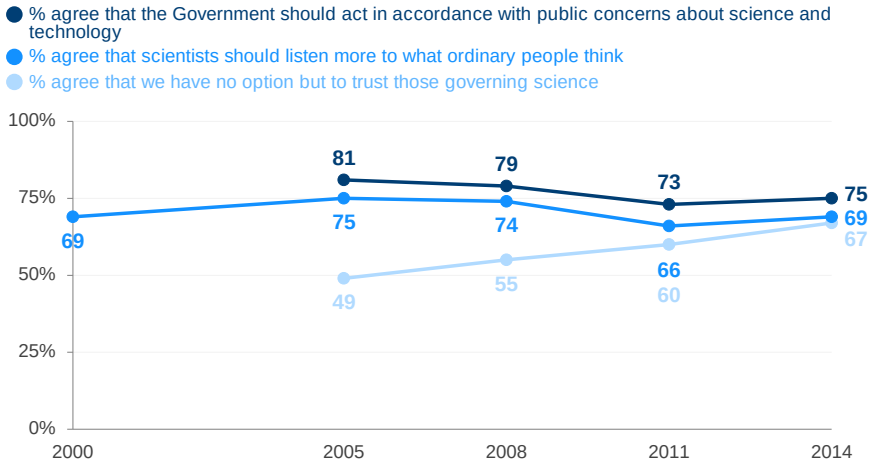


Base (for 2014): 1,749 UK adults aged 16+

Changes over time

Looking at changes over time in these attitudes highlights another potential challenge for those who wish to involve the public. As Figure 7.4 shows, while the desire for government and scientists to involve the public is still high and has not changed significantly since 2011, it is lower than in 2008. Alongside this, the proportion who feel they have no option but to trust those governing science has increased markedly since 2005 (by 18 percentage points from 49%), which potentially suggests an increasing sense of resigned trust among the public, with people feeling less qualified to be involved.

Figure 7.4 – attitudes to public involvement over time



Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

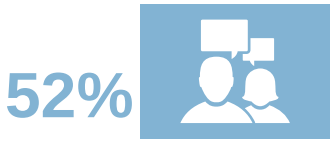
When it comes to this sense of resigned trust, there are again gender differences, with women more likely to agree that there is no option but to trust those governing science (73%, versus 60% of men).

There are indications that increased understanding of science leads people to feel less like they have no choice in trusting those who govern science. Those who do not feel informed about science are more likely to agree (72% agree, compared with 59% of those who do feel informed) while those who have high science knowledge scores are more likely to *disagree* (31% disagree, compared with 20% overall).

7.2 How well does government involve the public?

Cynicism about public consultations

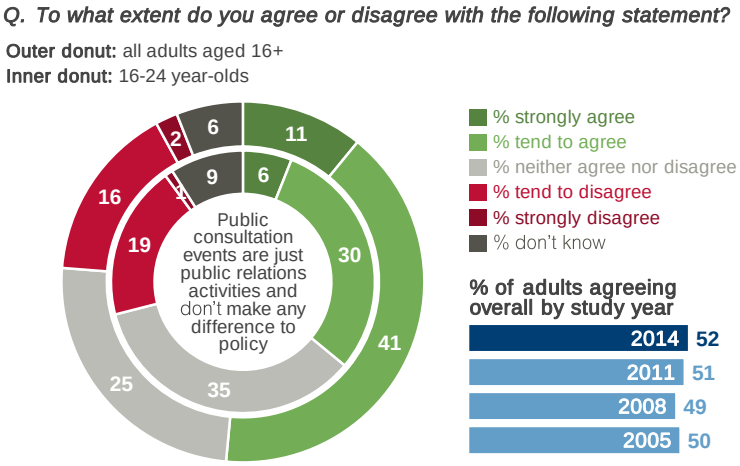
Figure 7.5 highlights that many of the public are cynical about public consultation events in general, with half (52%) thinking they do not make any difference to policy. This has been a consistent finding over the last decade, suggesting that this is a widespread view that is not easily changed. This in turn highlights how important it is to be clear with participants about how findings from public dialogues on science issues will be used, and to ensure that participants feel from the outset that their views are being taken on board, since many will initially be unsure of this.



think that public consultations do not make any difference to policy

This is another area where there is a strong divide by age group, as Figure 7.5 also indicates. Young adults aged 16-24 are less likely to be cynical about public consultation events (36% agree, compared with 52% overall), and more likely to be neutral (35% neither agree nor disagree, versus 25% overall).

Figure 7.5 – whether people think public consultation events make a difference to policy



Bases (for 2014): 1,749 UK adults aged 16+; 510 16-24 year-olds

People of Asian origin are typically less likely to agree and more likely to be neutral on this topic (39% neither agree nor disagree, versus 24% of white people). The more affluent and the more educated are more likely to disagree with the idea that consultations do not make a difference to policy, although these groups are still cynical on balance (26% of ABs and 24% of those educated to a higher level disagree, compared with 18% overall).

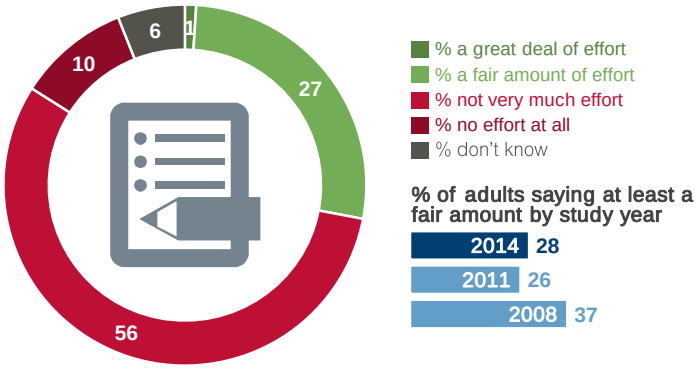
It is also worth noting that people who think public consultation events do not make a difference to policy are no more or less willing than others to get involved in decision-making about science. Therefore, cynicism does not necessarily equate with apathy or disengagement, and those that do want to be involved may still need reassurance about whether their views will be acted on.

How much effort is the Government making?

Given the context of widespread cynicism about public consultations generally, it is unsurprising that, on balance, people do not think the Government is making much effort to consult the public on science specifically. Two-thirds (66%) think the Government makes little or no effort, as Figure 7.6 shows. This has not changed since 2011, though perceptions are still less positive than in 2008.

Figure 7.6 – whether people think the Government is making an effort to consult the public on science

Q. How much effort do you think the Government is making to consult the public on science?



Base (for 2014): 1,749 UK adults aged 16+

While young adults seem to be less cynical about public consultations generally, they are no more or less positive than average about the efforts the Government is making to consult on science specifically.

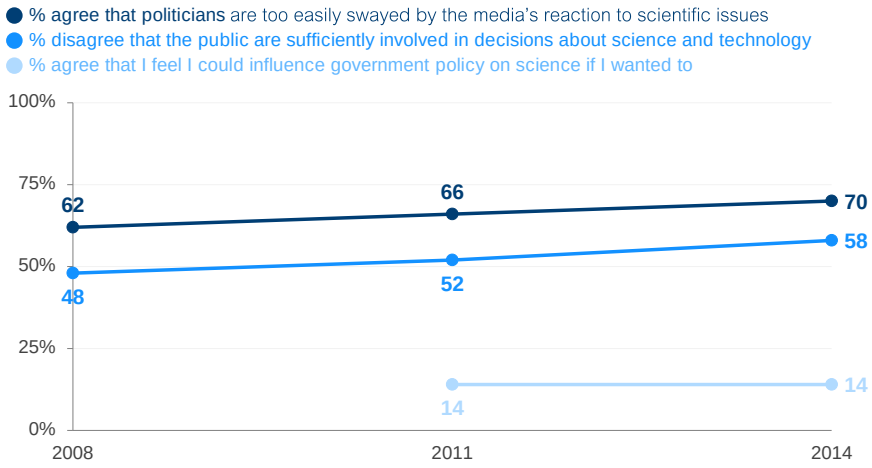
There are nonetheless other demographic differences. Men are more likely than women to say that the Government is making at least a fair amount of effort on this (31% versus 26%). Once again, people of Asian origin are more likely than white people to say this (42% versus 27%).

Do people feel involved?

Given perceptions of a lack of effort to involve the public, and the overwhelming desire for the public to *be* involved (as noted earlier in this chapter), it is perhaps as expected that most people do not feel that the public *are* sufficiently involved in decisions about science at the moment (16% think this), and do not typically feel they can personally influence these decisions (14% think this).

The balance of opinion has been consistent on these issues since 2011, but it is worth noting that the proportion *disagreeing* that the public are sufficiently involved has increased since 2011 (by six percentage points to 58%), as Figure 7.7 shows. The proportion saying that politicians are too easily swayed by the media's reaction to science-related issues has also increased gradually since 2008 (by eight percentage points to 70%), potentially highlighting growing concern about how policy decisions on these types of issues are made.

Figure 7.7 – perceptions of how well the public are involved over time



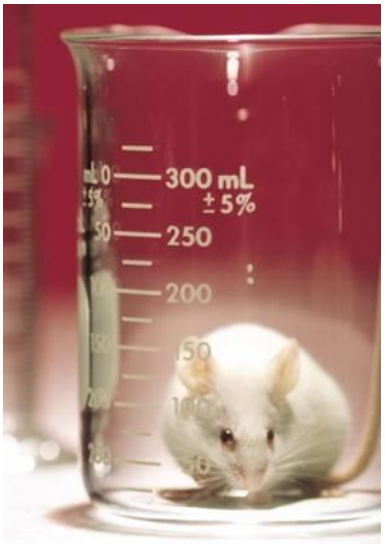
Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

People's confidence in getting involved may be linked to their level of education. Almost half (45%, versus 33% overall) of those with no qualifications *strongly* disagree that they could influence government policy on science if they wanted to.

7.3 How well do scientists communicate with the public?

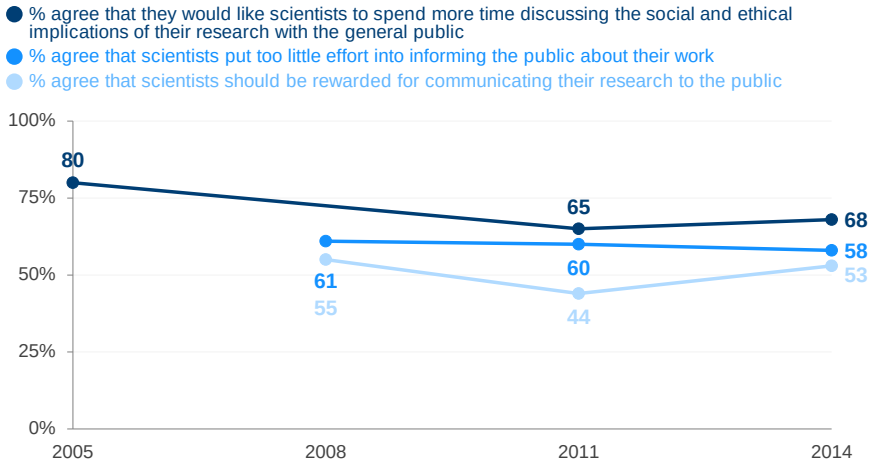
As discussed earlier in this chapter, there is considerable public appetite for scientists to listen more to the public. Figure 7.8 shows there is also a desire for scientists to talk more with the public about their work. Seven-in-ten (68%) would like scientists to talk more about the social and ethical implications of their research and six-in-ten (58%) think that scientists currently put too little effort into informing the public about their work. Both these scores have not changed since 2011, but there now seems to be a greater emphasis on scientists being rewarded for this kind of communication than in 2011 (up nine percentage points to 53%). Of course, the findings cannot indicate *how* people think scientists should be rewarded, i.e. whether they mean a financial reward or another type of reward.

The desire to hear more from scientists about their own work was also a theme from the Day of Discovery workshop, where participants had the chance to meet scientists and ask them questions. Many participants had long conversations with the scientists and used the opportunity to get what they considered as an authoritative view of the scientists' respective fields. Some participants also suggested that this kind of interaction could improve people's trust in scientists, help to break down the ongoing stereotype of older, male scientists, and provide good role models for aspiring scientists.



Seven-in-ten still want scientists to talk more about the social and ethical implications of their work

Figure 7.8 – perceptions of how well scientists communicate with the public over time



Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

It is worth noting that those who feel that scientists put too little effort into informing the public do not necessarily see rewarding them as the answer – the groups agreeing with each of these statements are somewhat different:

- Those who do not feel informed about science are more likely than those who do feel informed to say that scientists do not make enough effort to inform the public (63% agree, versus 53% of those who do not feel informed), and are less likely to think that scientists should be rewarded for this (49% versus 58%).

- Men are more likely than women to agree that science communication should be rewarded (57% versus 49%), and more likely to *disagree* that scientists put too little effort into this (19% versus 12%).

- Young adults are also more likely than others to disagree that scientists put too little effort into informing the public (20% disagree, versus 15% overall), and are no more or less likely than average to think that scientists should be rewarded for doing so.

This suggests that some people tend to hold scientists responsible for the perceived lack of communication, whereas others do not necessarily fault scientists themselves but may feel they are constrained in their efforts to communicate with the public. At the Day of Discovery workshop, many participants fell into the former camp, assuming that scientists did not make enough effort to engage the public. They were surprised to hear from scientists that, in their view, these public engagement opportunities were often limited and highly competitive.

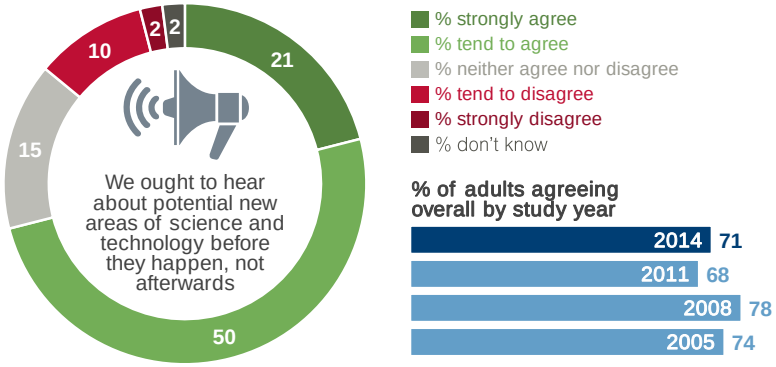
The survey also finds that people who have attended science-related leisure or cultural activities in the previous 12 months are also more likely than those who have not to think that scientists should be rewarded for better communicating their work (55% versus 49%).

7.4 The importance of early communication

Seven-in-ten (71%) feel that they should hear about potential new developments in science and technology before they happen, not afterwards. While this is of course not always possible in reality, the statement does highlight the importance of engaging the public in dialogue in the early stages of emerging technologies. This has been a majority opinion for the past decade, as Figure 7.9 indicates.

Figure 7.9 – whether people want to hear about potential new areas of science before they happen

Q. To what extent do you agree or disagree with the following statement?



Base (for 2014): 1,749 UK adults aged 16+

The online qualitative research also suggests that this attitude may be linked to ongoing concerns about the pace of change. The findings support the idea of scientists engaging in dialogue with the public at an early stage – without this, public consultation risks appearing as an afterthought.

"We should be able to slow things down so that there is thinking time, and our views should be taken into consideration. The public should be taken seriously."
Online community participant

> We should be able to slow things down so that there is thinking time. The public should be taken seriously.
>
> Online community participant

Science in people's lives

8 Science in people's lives

As Chapters 2 and 4 respectively report, people see science as playing a role in their day-to-day lives and most think it is important to know about science. This chapter continues to look at science in people's lives, and specifically the role it has in leisure, study and work.

Key findings

- In the past year, two-thirds have undertaken a science-related leisure or cultural activity, such as a visit to a science museum. This group are also more likely than others to have participated in non-science related cultural activities as well. This suggests that rather than there being two different sets of people interested either in science or in arts-related cultural activities, there is instead a single group of people who tend to go to both.
- Women appear to play a particularly important role in informal science learning. People are more likely to go with their mother than their father to these types of activities, and women themselves are more likely to take others with them rather than going alone.
- While a quarter think school put them off science, most still feel that the science they learnt at school has been useful in their everyday lives. People are even more positive about the maths they learnt at school, feeling it has been useful day-to-day and in the workplace.
- Both science and engineering are seen as vibrant and interesting areas to work in, and as offering well-paid jobs. These opinions have also become more positive over time. However, there are still challenges, as young people and those with children at home tend to be less positive than average about these careers.
- When it comes to studying and working in science and engineering, women tend to be less positive than men across many indicators. This difference in attitudes may develop before adulthood, with far fewer young women than young men participating in science or engineering clubs at school.

8.1 Science as a leisure or cultural activity

As the Wellcome Trust's recent review of informal science learning (see Falk et al., 2012) highlights, informal science activities such as visits to museums contribute highly to people's science knowledge. Moreover, it finds that these activities encourage a broader way of thinking about science, based on general principles rather than specific contexts. Indeed as earlier

chapters in this report mention, visits to science-related leisure or cultural activities are typically associated with more positive attitudes to science and scientists, and with feeling more informed about scientific research and development.

PAS 2014 demonstrates that these kinds of activities are popular – two-thirds (67%) have been to at least one of the science-related leisure or cultural activities asked about in the survey in the previous year (shown in Figure 8.1). In fact, two-fifths (38%) have done at least two such activities over this period. A comparable question asked of 14-18 year-olds in the 2013 *Wellcome Trust Monitor* (Wellcome Trust/Ipsos MORI) showed that just under three-fifths (57%) had engaged in one of these activities in previous year, indicating that these activities are perhaps more commonly undertaken by adults than by young people.

Two-thirds have been to a science-related leisure or cultural activity in the previous year

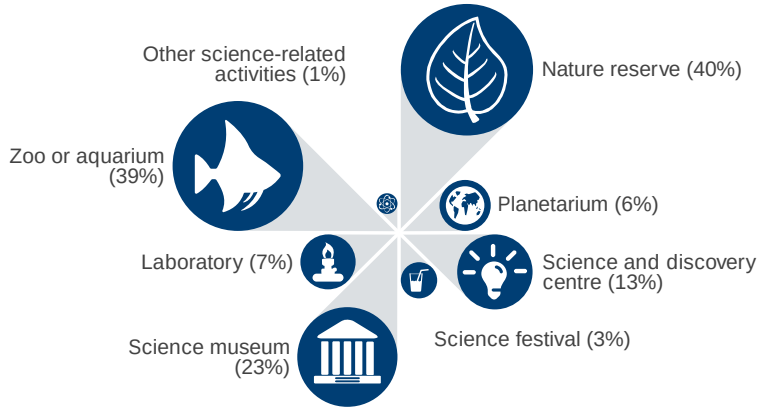
Figure 8.1 shows that four-in-ten adults visited nature reserves (40%), or zoos or aquariums (39%) in the past year. Over two-in-ten (23%) have been to a science museum while over one-in-ten (13%) say they have gone to a science and discovery centre. Just three per cent say they attended a science festival, suggesting these remain a relatively niche activity – this score is nonetheless on a par with the five per cent who say they attended a literature festival over this period (not shown in Figure 8.1), indicating that science festivals are no more or less popular than other types of cultural festival.

It is important to note that the 13% score for science and discovery centres may be an underestimate, as people do not always know what these are – Lloyd et al. (2012 report for the Wellcome Trust) found, for example, that young people were unfamiliar with the term in qualitative research – so might not acknowledge having visited one. Nevertheless, where comparisons are possible[39], the findings at this question are consistent with those from PAS 2011, suggesting that participation in these types of activities has remained broadly stable over last three years.

[39] While individual answer options used in both PAS 2014 and PAS 2011 at this question are broadly comparable, the PAS 2011 list of answer options did not include nature reserves, and included “zoo” on its own, rather than “zoo or aquarium”.

Figure 8.1 – science-related leisure or cultural activities people have undertaken

Q. Which, if any, of the these have you visited or attended in the last 12 months?



Base: 1,749 UK adults aged 16+

There are no substantive differences in participation in these activities either by gender or by age (within the adult population). However, there are other demographic differences that suggest a certain type of person is more likely to do these sorts of activities. This includes the more affluent (80% of ABs have undertaken a science-related activity in the past year, compared with 67% on average – among C2DEs, this drops to 55%). White people are also more likely than those from ethnic minorities to have done a science-related activity over this period (69% versus 51%).

Those with children at home are more likely to have undertaken a science-related activity in the previous year than those without children (78% versus 61%). This suggests these kinds of activities might be seen as family activities – something which is explored further later in this chapter.

Given that the availability of the types of activities in Figure 8.1 will differ depending on where people live, differences by region might also be expected. The regions with the highest recorded participation in these types of activities are the East of England (79%, versus 67% overall), the South East (78%) and the North West (77%). While these kinds of regional differences can have various explanations, it is notable that the East of England was also singled out in the PAS 2011 report as having the highest proportion of people attending science-related leisure or cultural activities.

By contrast, people in London are less likely than average to have visited these sorts of activities (53%, versus 67% overall). Specifically, they are no more likely than average to have visited a science museum, and less likely than average to say they have been to a science and discovery centre in the past year (6%, compared with 13% overall), despite the high concentration of these types of activities in London. Of course, this is very likely to be explained by London's more socially and ethnically diverse population – as aforementioned, ethnic minorities and the less affluent are less likely to visit these sorts of places.

Science versus arts activities

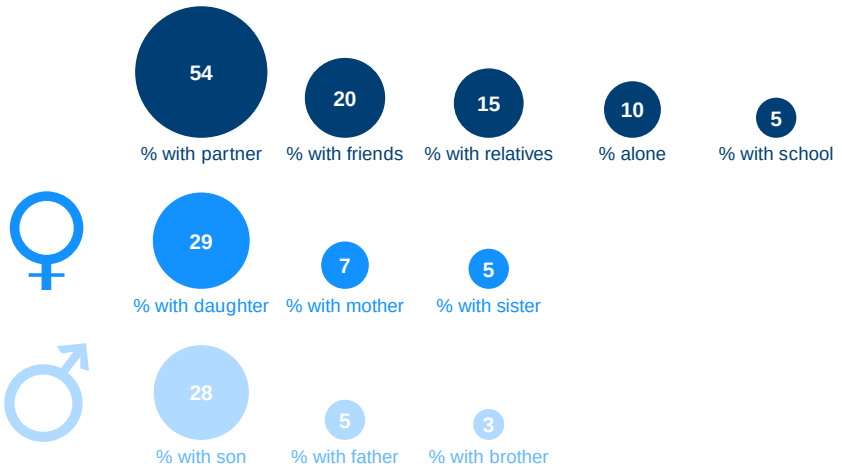
As in 2011, those who visit science-related leisure or cultural activities appear to participate more in non-science related cultural activities too. The two-thirds who have undertaken a science-related activity in the previous 12 months are also more likely to have visited an art gallery (40% have done so, versus 15% of those who have not done a science-related activity), visited another non-science related museum (39% versus 11%) and attended a literature festival (7% versus 2%). This contrasts with the "two cultures" hypothesis raised by Snow in 1959; PAS 2014 indicates that there is a single group of people who typically go to all sorts of cultural activities, whether science or arts-related, rather than two different sets of people who immerse themselves either in science or in arts-related cultural activities.

This is further illustrated by differences between the PAS segments. Of all six segments, those most likely to have been to a science-related leisure or cultural activity are Confident Engagers (88%, compared with 67% on average), Distrustful Engagers (76%) and Late Adopters (76%), which fits in with these segments' especially positive attitudes towards science generally. These are also the segments most likely to have gone to the non-science related activities asked about in the survey.

Who do people go with?

Science-related leisure or cultural activities are typically something people do with others rather than alone, as Figure 8.2 shows. People are especially likely to go to them with partners, with children or with friends. Figure 8.2 also appears to show relative gender equality in terms of whom people take to these types of activities, for example between sons and daughters.

Figure 8.2 – who people went with to science-related leisure or cultural activities

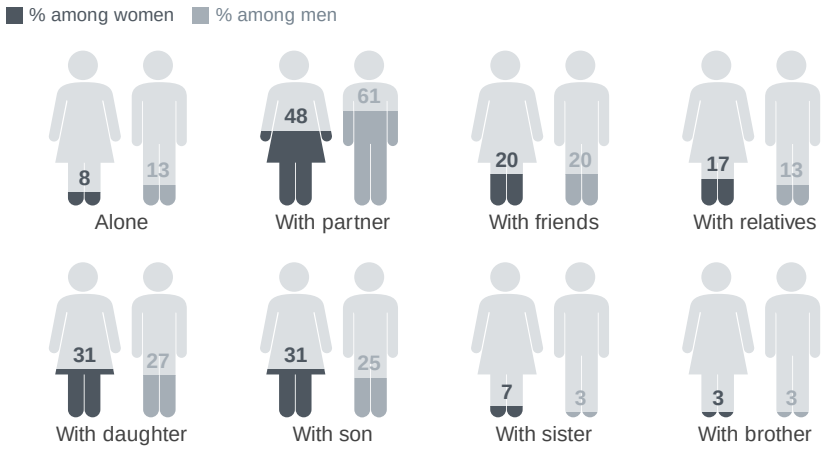


Base: 1,133 adults who have been to a science-related leisure or cultural activity in the last 12 months

Women appear to play a particularly important role in informal science learning. Young adults aged 16-24 are more likely to go with their mothers than with their fathers to things like science museums (20% with mothers, versus 12% with fathers), zoos or aquariums (33% versus 24%) and nature reserves (31% versus 26%).

In addition, and as can been seen in Figure 8.3, women are less likely than men to go alone or with their partners, and instead more likely to with children, sisters or relatives.

Figure 8.3 – who men and women went with to science-related leisure or cultural activities



Bases: 599 women who have been to a science-related leisure or cultural activity in the last 12 months; 534 men who have done this

8.2 Studying science

PAS 2014 also explores attitudes to formal science education. School science plays an especially important role in the UK relative to other countries – a 2011 online panel survey of 14-22 year-olds (Redshift Research/Lenovo) found that young people in the UK were more likely than those in other countries, including the US, Canada and Japan, to have already made the decision to pursue a science, technology, engineering or maths (STEM) career or not *before* finishing secondary school.

Does school put people off science?

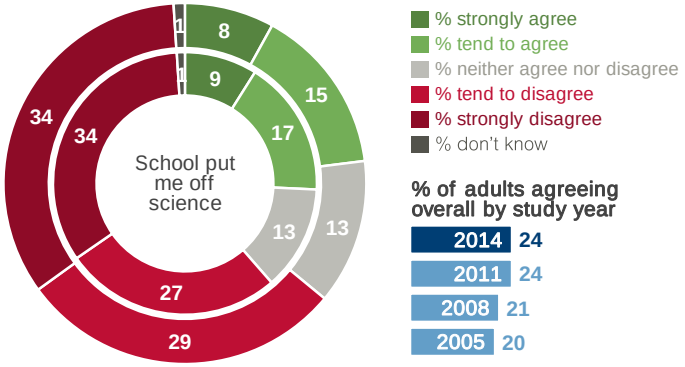
Recent research shows that people have mixed feelings about school science in the UK. The 2013 *Wellcome Trust Monitor* (Wellcome Trust/Ipsos MORI) found that two-thirds (64%) of adults considered their school science lessons to have been interesting, and this feeling was even more prevalent among young people aged 14-18 (82% of whom thought this). Nevertheless, evidence from the ASPIRES study (see Archer, Osborne and DeWitt, 2012) suggests that young people and parents still consider science to be a relatively hard school subject, only accessible to “brainy” people.

Given these mixed views, PAS 2014 aimed to uncover whether people think school had an overall positive or negative effect on their attitudes to science. As Figure 8.4 indicates, a quarter (24%) think school put them off science. This is generally no different across age groups, including 16-24 year-olds whose experience of science at school would be more recent, or ongoing.

Figure 8.4 – whether people think school put them off science

Q. To what extent do you agree or disagree with the following statement?

Outer donut: all adults aged 16+
Inner donut: 16-24 year-olds



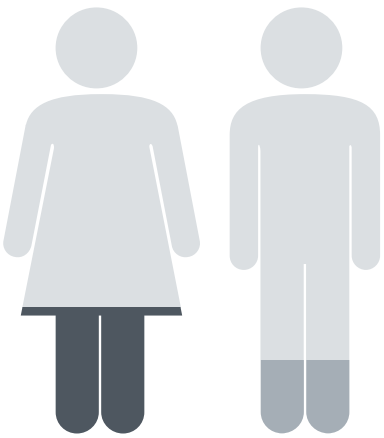
Bases (for 2014): 1,749 UK adults aged 16+; 510 16-24 year-olds

However, women are more likely than men to think school put them off (30% versus 17%). This was also the case in the 2011 survey, highlighting the ongoing gender imbalance when it comes to experiences of school science. This gender imbalance is well-documented, particularly in relation to studying physics, with the *Girls in the Physics Classroom* report (Murphy and Whitelegg, 2006) highlighting that school physics lessons often lacked personal relevance for girls.

Changes over time

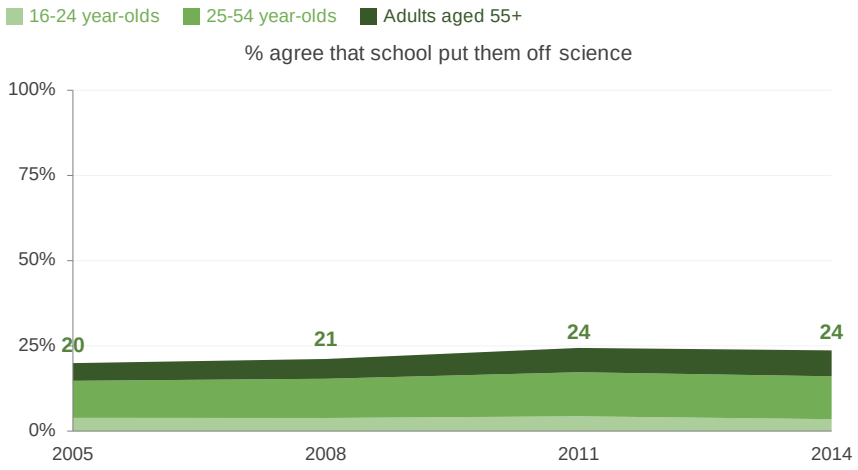
As Figure 8.4 showed, agreement that "school put me off science" is consistent with the 2011 score, but higher than in previous years. However, this does *not* necessarily mean that those who have left school since 2008 are having a worse experience than earlier generations. If this were case, the changes over time would be driven by 16-24 year-olds, who have most recently experienced science lessons at school.

Figure 8.5 illustrates the proportion of those agreeing each year, and how this breaks down by age group. This shows agreement has in fact remained stable among 16-24 year-olds. It is instead the middle and older age groups that have driven agreement up, suggesting they are reflecting more critically on their school science lessons than they used to.



As in 2011, women are more likely to say school put them off science than men

Figure 8.5 – agreement that "school put me off science" over time by age group



Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

How useful is school science?

The 2013 *Wellcome Trust Monitor* (Wellcome Trust/Ipsos MORI) showed that one of the things that most encouraged studying science was the chance to learn about things relevant to real life (40% of young people aged 14-18 said this). Qualitative research by the National Foundation for Educational Research (2011) has also shown that young people would be better engaged with science if it were more applicable and relevant to modern lives. In this context, PAS 2014 measures how useful both science and maths are seen to be in people's daily lives and jobs.

Figure 8.6 shows that half (51%) think the science they learnt at school has been useful in their everyday lives, while a third (33%) disagree. People are even more positive about the maths they learnt at school, with three-quarters (76%) saying it has been useful in their everyday lives and seven-in-ten (68%) saying it has been useful in their job. However, these scores are lower among 16-24 year-olds, who will have experienced school science and maths lessons more recently, but will have equally had less time to put what they have learnt to use in everyday life and in the workplace.

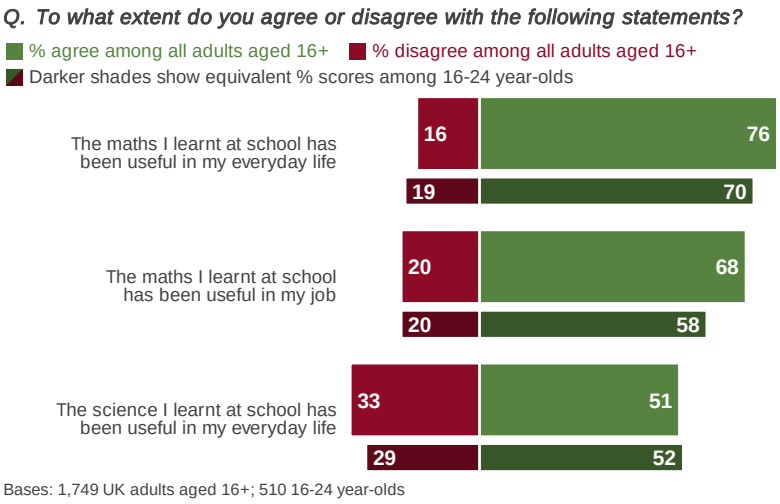
Among all adults, the proportion saying school science has been useful in their everyday lives has risen since 2011 (from 44% to 51%), as has the proportion saying this about the maths they learnt at school (from 67% to 76%).

These generally positive findings regarding maths learnt at school contrast with findings from Ipsos MORI/Royal Statistical Society (2013) research, which showed that people tended to place a relatively low value on maths skills. In that research, people were four times more likely to say they would be proud of their children if they excelled in reading and writing (55% said this) than if they were very good at numbers (13%). Overall, this suggests that while most people think the maths they learnt at school is useful day-to-day, they could be underappreciating this usefulness.

51%

think the science they learnt at school has been useful in their everyday lives

Figure 8.6 – whether people think the science and maths they learnt at school is useful



Bases: 1,749 UK adults aged 16+; 510 16-24 year-olds

Once again there is a gender gap, with women more likely than men to disagree with each of these three statements. The less affluent (DEs) are also less likely than average to agree that the science they learnt at school has been useful in their everyday lives (38%, versus 33% overall).

School science and engineering clubs

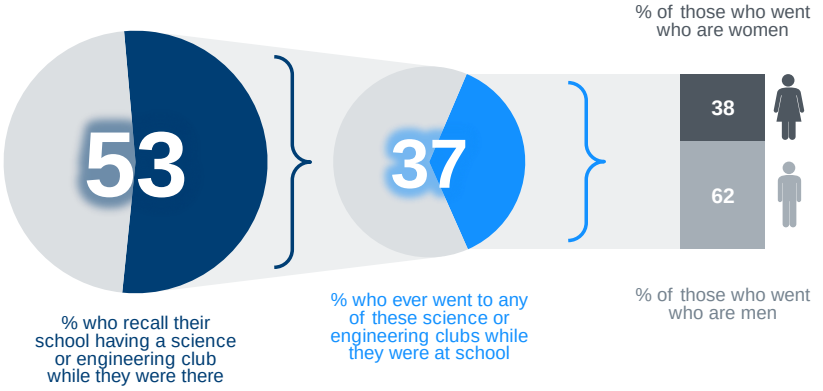
Lloyd et al. (2012 report for the Wellcome Trust) note that informal science learning, as well as taking place outside of school, can happen effectively inside school through things like after-school clubs, where young people have their existing friendship groups. The 2011-15 STEMNET evaluation (National Foundation for Educational Research, 2013a) has also found that science or engineering clubs have a positive impact, with participating pupils more likely than average to say that they enjoyed science, and that they wanted to work in a science-related job.

PAS 2014 finds that over five-in-ten (53%) of 16-24 year-olds recall having science or engineering clubs at their school, up from four-in-ten (38%) in 2011, suggesting either that the prevalence of these clubs has increased, or that young adults are now more aware of them.[40] Among this five-in-ten, as Figure 8.7 shows, over a third (37%) had attended these clubs, similar to the 2011 figure.

Figure 8.7 also illustrates the stark gender divide in science or engineering clubs, with three-fifths (62%) of those who attended these clubs being young men.

Figure 8.7 – recall and attendance of school science or engineering clubs

[40] STEMNET data show that there was actually a STEM club operating in around six-in-ten secondary schools at the time of PAS 2014 survey fieldwork. The delivery model for the STEM Clubs programme was refreshed in 2012, so this figure is not directly comparable with data from before this date (i.e. when the PAS 2011 survey took place).



Bases: 510 16-24 year-olds; 268 whose school had a science or engineering club; 108 who ever went to any of these

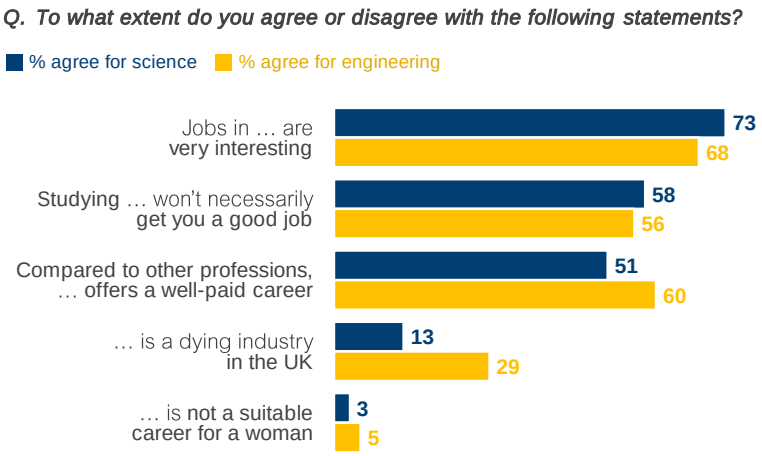
8.3 Careers in science and engineering

On the whole, both science and engineering are seen as vibrant and interesting areas to work in, and as offering well-paid jobs, as Figure 8.8 indicates. Moreover, opinions of these jobs have typically become more positive over time (where data are available for previous years). Compared to 2011, more now find jobs in science interesting (up five percentage points to 73%) and more say jobs in engineering are interesting (up seven percentage points to 68%). The proportion saying engineering offers a well-paid career has also increased gradually since 2008 (from 55% to 60%).

These perceptions appear to match the reality. For example, the latest EngineeringUK *State of Engineering* report (Kumar, Randerson and Kiwana, 2013) shows that the engineering industry has grown, accounting for 24.5% of UK turnover in 2013, up from 23.9% in 2011. The same report also shows that engineering or technology graduates are more likely than the average graduate to go into fulltime employment, and are the second highest paid group of graduates, after medicine and dentistry graduates.

There are further perceived differences between science and engineering, building on those discussed in Chapter 2, and again suggesting they are viewed as very different industries. While jobs in engineering are particularly likely to be seen as well-paid (60% agree, versus 51% saying this about careers in science), there is still a greater perception that it is a dying industry (29%, versus 13% saying this for science). Nevertheless, the proportion saying engineering is a dying industry has diminished since 2011 (by seven percentage points from 36%).

Figure 8.8 – perceptions of working in science and engineering



Bases: 858 UK adults aged 16+ asked about science; 891 asked about engineering

Views of younger adults – who are more likely to be entering work for the first time – are often different from the average, especially when comes to engineering. Typically, 16-24 year-olds have a less sceptical view of how the engineering sector is performing, and of job prospects in this sector – they are more likely to *disagree* that it is dying industry (57% disagree, compared with 49% on average), and more likely to agree that engineering offers a well-paid career (65%, versus 60% overall).

However, this does not necessarily mean that young adults are personally more interested in careers in engineering. Those aged 16-24 are less likely than average to think that jobs in engineering are interesting (59%, versus 68% overall). This not an unusual finding – the *Engineers and Engineering Brand Monitor* (see FreshMinds Research/EngineeringUK, 2012) has consistently found that adults aged 20 and over are more likely to describe engineering as interesting than those aged 17-19.

There are again differences by gender. Women are less likely than men to agree jobs in engineering are well-paid (56% agree, versus 64% of men), or interesting (61% versus 73%). Similarly they are less likely to think science careers are well-paid (46% agree, versus 57% of men), or interesting (68% versus 78%). These differences typically hold for 16-24 year-old women and men as well, with one stark exception – women aged 16-24 are *more* likely than men aged 16-24 to say careers in science are interesting (79% versus 64%). This result contrasts with a lot of the gender differences seen in the rest of the survey.

There also appear to be cultural and class differences. Those from less affluent backgrounds are more likely to think that science is well-paid (57% of C2DEs agree, compared with 51% on average) and that engineering is well-paid (68% of C2DEs agree, compared with 60% overall). People of Asian origin are more likely to think science is well-paid (72% agree, versus 48% of white people). They are also somewhat more likely to say that science is not suitable career for women (12%, versus 3% of white people) and to say the same thing about engineering (26% versus 4%), although

Women are less likely than men to think jobs in science and engineering are interesting

importantly these are still the views of a small minority among this ethnic group.[41]

Finally, those with children at home also tend to have different views from those without children. They are less likely to *strongly* agree that jobs in engineering are interesting (16% strongly agree, versus 25% of those without children), and less likely to agree that jobs in science are interesting (65% versus 76%). They are also slightly less likely to *disagree* that science is not a suitable career for a woman (87% disagree, versus 93% of those without children) and that science is a dying industry in UK (55% disagree, versus 72% of those without children). These differences, while small, are particularly important given that parents are key influencers – the 2013 *Wellcome Trust Monitor* (Wellcome Trust/Ipsos MORI) found family members to be young people's most common source of information on careers, and the one they found most useful.

[41] While these differences between those of Asian origin and white people are statistically significant, it is important to note the small sample size for people of Asian origin at these questions (c.50 respondents), which makes the margins of error relatively large.

Science and the economy

9 Science and the economy

This chapter examines the perceived role of science within the UK economy, focusing on two topics. First, it looks at people's understanding and opinions of science funding. Second, it explores the perceived economic impact of science.

PAS 2014 takes place in a different economic climate from the 2011 study. Over the course of the 2011 fieldwork, Ipsos MORI's *Economic Optimism Index* showed that more people expected the state of the UK economy to get worse than to improve within 12 months. By contrast, during the 2014 fieldwork, economic optimism was much higher, with more people expecting the economy to improve than to get worse.[42] This shift appears to be reflected in the findings in this chapter.

Key findings

- People's knowledge of who funds science tends to be low. Seven-in-ten are aware of the Government's funding of science, but just over a third mention private companies.
- In spite of this low level of knowledge, many are concerned about funding – especially private funding – and the impact this has on the independence of scientists.
- At the same time, people are strongly supportive of government funding of science, and tend to consider it as a priority area that should not be cut. This is perhaps because people consider science to have an important role in the UK economy, driving growth, international competitiveness and future prosperity.
- The perceived importance of science to the UK economy appears to be received wisdom, rather than being based on people's knowledge of science or of economics.

[42] Trend data from the Ipsos MORI *Economic Optimism Index* are available on the Ipsos MORI website at: http://www.ipsos-mori.com/researchpublications/researcharchive/poll.aspx?oItemID=43.

9.1 Science funding

Who funds science?

As in 2011, people overwhelmingly associate the funding of scientific research with the Government – seven-in-ten (70%) mention this without prompting. Just over a third (36%) mention private companies.

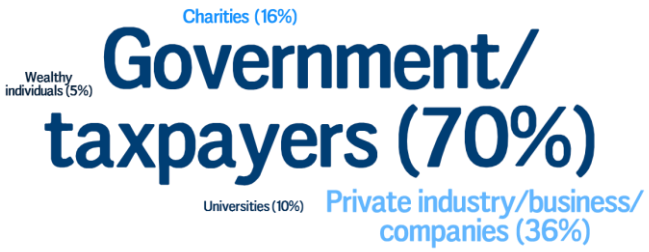
The public's perceptions in this area do not necessarily reflect the reality. A 2013 report by the National Audit Office looks at UK research and development funding sources between 1995 and 2011, and shows that the private sector is the largest funder of research and development, contributing over half the UK's total spending on research and development over this period.

The other most common unprompted responses at this question are shown in Figure 9.1. Beyond these, other responses are mentioned by less than one per cent of participants, and just under two-in-ten (17%) say they do not know. While the responses mentioned do broadly cover the main funding sources for science, around half (53%) of those who do give an answer at this question only give a *single* answer, which suggests that individuals often do not have a good idea of the different sources of funding there are for UK-based scientific research.

Changes since 2011 indicate that people may now be slightly less aware of how science is funded. Fewer now mention private companies (36%, versus 44% in 2011) and more say they do not know (17% versus 13%).

Figure 9.1 – perceptions of who funds scientific research in the UK

Q. As far as you know, who funds scientific research in the UK?



Base: 1,749 UK adults aged 16+
N.B. word clouds are illustrative of data, not statistically representative; only codes registering 2% or more are shown

Women are more likely than men to say they do not know who funds science (22% versus 11%). Young adults aged 16-24 are also more likely than average to say they do not know (29%, versus 17% overall).

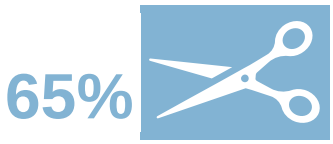
Should science be government-funded?

Within the context of reduced public sector spending generally, people still support government spending on science, as Figure 9.2 illustrates. Even in cases where this spending brings no immediate benefits, eight-in-ten (79%) support scientific research being government-funded. A third (35%) *strongly* agree with this, which is higher than in 2011 (when 25% strongly agreed).

The UK public are not alone in this view. A similar question, asking whether "even if it brings no immediate benefits, scientific research which adds to knowledge should be supported by government," was included in *Special Eurobarometer 340* (European Commission, 2010), and found that those in the UK were in line with the EU average in their strong support for government spending on science. Similarly high levels of support have also been recorded among US citizens – the 2012 US General Social Survey (reported in National Science Foundation, 2014), asking another variation on the same question, found 83% agreeing that "scientific research that advances the frontiers of knowledge is necessary and should be supported by federal government".

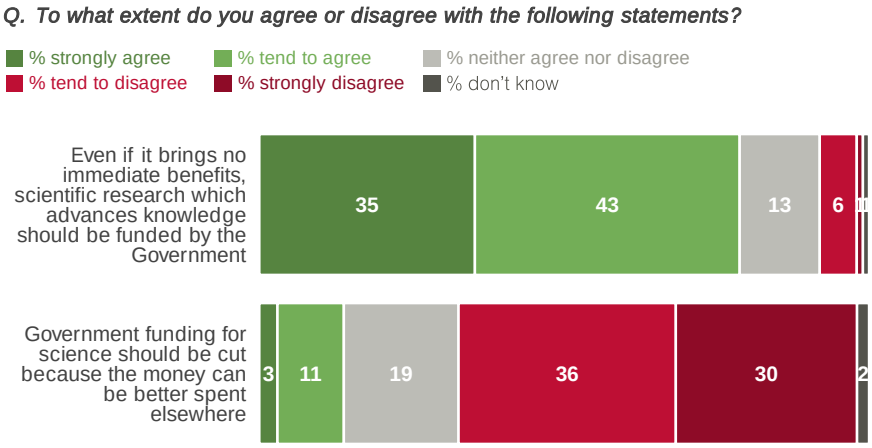
In the UK, two-thirds (65%) also see this kind of spending as a priority for the Government, disagreeing that it should be cut because the money can be better spent elsewhere (although it should be noted that this question was not asked in relation to increasing or cutting other specific areas of government spending, which might of course raise a different response). Again, strength of opinion on this has changed since 2011, with more now *strongly* disagreeing (30%, compared with 23% in 2011).

The qualitative research offers insights into why people think government funding of science is important. Participants at the Day of Discovery workshop and in the online qualitative research thought that governments were more likely to take a long-term approach to funding than profit-driven private companies, which would lead to greater benefits in the long run. They also thought that governments need to be more transparent about what they fund, whereas this would not be the case for private funders. More broadly, participants often considered government funding as a way of counterbalancing industry funding of science, which was often viewed negatively – this is discussed in more detail later in this section.



disagree that science funding should be cut because the money can be better spent elsewhere

Figure 9.2 – perceptions of government funding of science



Base: 1,749 UK adults aged 16+

Young adults do not feel as strongly about government spending on science. They are less likely than average to *strongly* agree that scientific research which advances knowledge should be funded by the Government (28%, versus 35% overall), and are less likely to *disagree* that government funding for science should be cut (60%, versus 65% overall). They instead tend to be more neutral on both these statements.

Women are also less likely than men to agree that scientific research which advances knowledge should be funded by the Government (75% versus 83%) and less likely than men to *disagree* that government funding for science should be cut (59% versus 72%).

Do people understand blue-skies research?

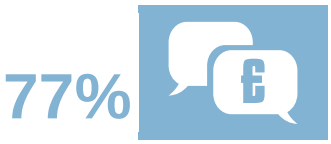
While the PAS 2014 survey finds support for scientific research even when it brings no immediate benefits, the qualitative research suggests that the concept of blue-skies research is still very difficult for many people to grasp. Day of Discovery participants who were presented with this finding from the survey thought that even if there were no immediate benefits, there must be some eventual benefit from the research further down the line, i.e. they found it difficult to understand that research that does not necessarily realise benefits on its own is an important part of the scientific process.

While some participants noted that scientific research was still contributing to a body of knowledge even if it did not find a positive result, others instead felt that the funding was wasteful if it did not lead to direct benefits. There was also an assumption that scientists and funders already know what works so should focus their research on those areas.

"We should fund things that we know definitely work – there are plenty of them."
Day of Discovery workshop participant

Concerns about science funding

The independence of scientists who receive funding from different sources has been a consistent concern for people over the last decade, as Figure 9.3 illustrates. Three-quarters (77%) think this independence is often put at risk by the interests of funders, while two-thirds (66%) are specifically concerned by scientists being too dependent on business and industry for funding. These scores are no different even among those who class themselves as scientists, or who say they work with scientists, highlighting how widespread this perception is. Agreement with the latter statement has increased steadily since 2008 by six percentage points (from 60%).



think that scientists' independence is often put at risk by their funders

Again, the qualitative research provides insights into why the public are wary of industry funding of science.

- Some Day of Discovery workshop participants thought that some areas of scientific research, such as medical research, were too important to leave solely to the private sector because the benefits would affect everyone. Some worried that private companies typically directed funding to more profitable areas which may not be those with the greatest societal benefit.

- Some had concerns about research reaching biased conclusions that favoured the funder, and thought this was particularly an issue with tobacco companies, pharmaceutical companies and fast food companies.

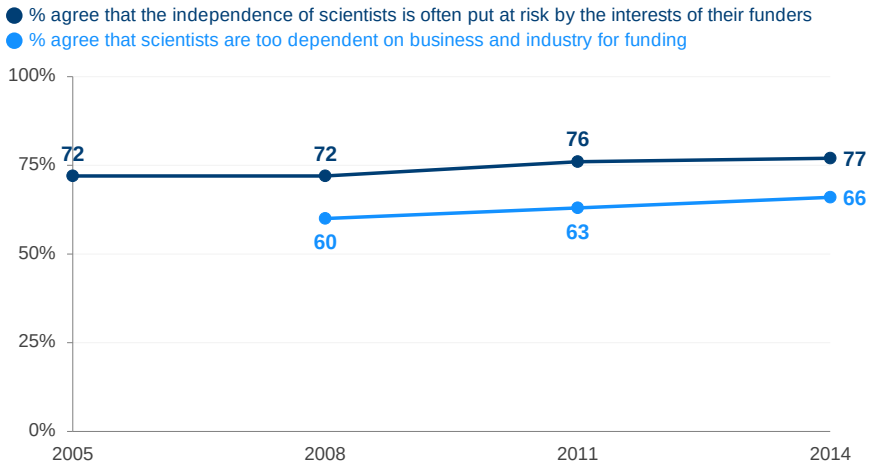
- Finally, some participants raised the issue of patents and protection by private companies leading to scientific knowledge not being shared for the common good.

"The main objectives for industry-funded research may be profit-focused rather than driven by human need."
Day of Discovery workshop participant

"I think funding should come from government and charitable donations, otherwise private companies will protect their discoveries just as the big drug firms do."
Online community participant

These concerns may tie in with the finding reported earlier in this chapter that people appear not to know much about the role of the private sector in science funding. They may also help to explain why trust in scientists working for private companies is typically lower than for those attached to other institutions.

Figure 9.3 – concerns about science funding over time



Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

There are no consistent subgroup differences across these two questions. However, it appears that the issue of scientists depending too much on business and industry for funding is less of a concern for young adults aged 16-24, with just half (53%, compared with 66% overall) agreeing with this. This is in spite of this age group being less trusting of scientists working for private companies (as explored in Chapter 6) – this dichotomy demonstrates that there may be many reasons to explain why people are concerned about how scientists are funded, and it is not just a trust issue.

9.2 The economic benefits of science

Does science benefit the economy?

As Figure 9.4 shows, people are overwhelmingly positive about the contribution science makes to the UK economy, in terms of growth, international competitiveness and future prosperity. Very few (under five per cent) disagree that science contributes to these things.

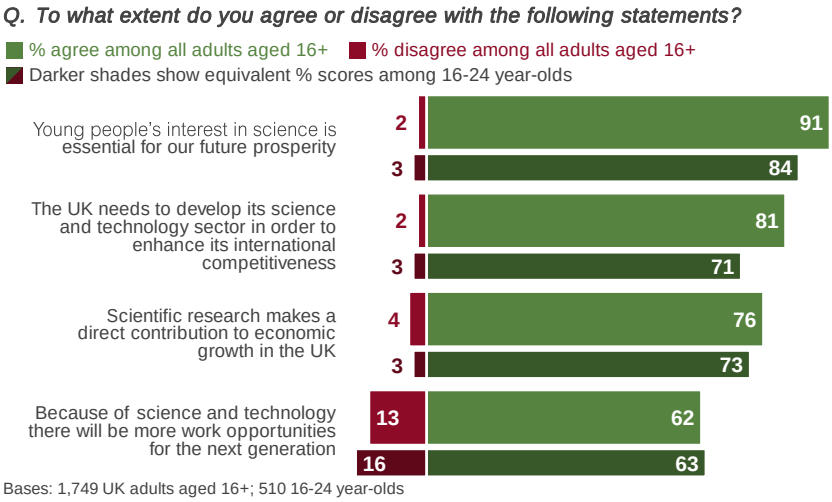
People are on balance positive about science's impact on employment too, although this garners relatively less agreement, with two-in-ten (20%) neutral about this. This reflects qualitative findings from the Day of Discovery workshop, where few participants spontaneously mentioned an increase in jobs as an economic benefit of investing in science. Indeed, some felt that science and technology could threaten jobs by increasing the automation of manual processes. When considering the economic benefits of science, participants instead focused more on the outputs of scientific research, and how these would make existing jobs easier or create new products to sell.

As can be seen in Figure 9.4, young adults are marginally less positive about the impact of science on the economy. They are less likely to agree that the UK needs to develop its science and technology sector to enhance international competitiveness (71%, versus 81% overall), and that young people's interest in science is essential for our future prosperity (84%, versus 91% overall).

91%

think young people's interest in science is essential for our future prosperity

Figure 9.4 – perceived impact of science on the economy



Bases: 1,749 UK adults aged 16+; 510 16-24 year-olds

Men are more likely than women to *strongly* agree on each of these statements. The most affluent (ABs) are also more likely to strongly agree with each statement than average.

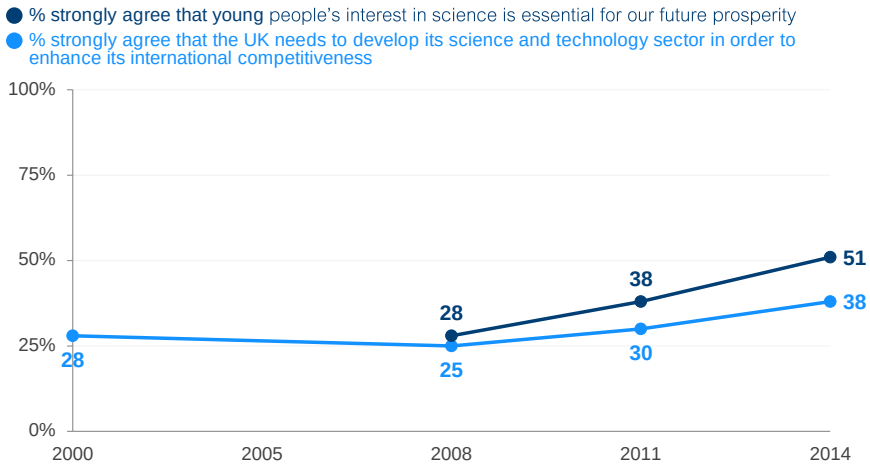
Those with children at home, who tend to have slightly less positive attitudes towards careers in science (as detailed in the previous chapter), are in this case no more or less likely than average to agree that young people's interest in science is essential for future prosperity.

Changes over time

While overall agreement (combining people who strongly agree or tend to agree) with these statements has not changed since 2011, strength of agreement has increased over time. The proportions specifically *strongly* agreeing that scientific research directly contributes to UK economic growth and that because of science and technology there will be more work opportunities for the next generation have both risen by five percentage points since 2011 (from 23% and 16% respectively). Figure 9.5, which shows attitudes over time on the other two statements, suggests this is reflective of a gradual shift in attitudes over a longer period, at least since 2008.

This shift in attitudes may again be linked to the different economic climate in which PAS 2014 takes place relative to previous years. It also fits with the increase in support for government funding of science since 2011 (as discussed earlier in this chapter).

Figure 9.5 – perceived impact of science on the economy over time

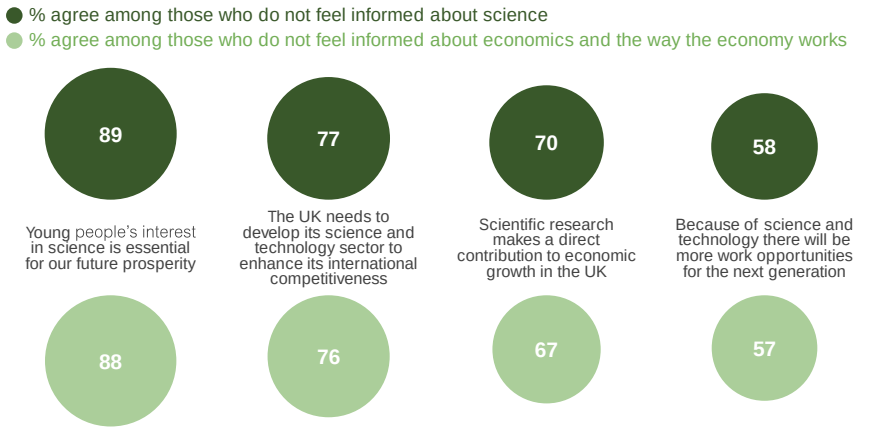


Bases: c.1,800+ adults per wave (see Chapter 1 for more details)

Is the economic contribution of science received wisdom?

As might be expected, those who feel informed about science and those who feel informed about economics and the way the economy works are more likely to agree with all four statements about the economic contribution of science than those who do not feel informed about these things. Nonetheless, it is worth noting that even among those who do *not* feel informed about either science or economics, a clear majority still agree with all the statements – especially agreeing that young people's interest in science is essential for future prosperity, as Figure 9.6 shows. Therefore, the belief that science makes an important contribution to the economy does not necessarily rely on people's knowledge of science or of the economy, and may instead be a received wisdom.

Figure 9.6 – perceived economic impact of science based on how informed people feel



Bases: 987 adults who do not feel informed about science; 742 who do not feel informed about economics and the way the economy works

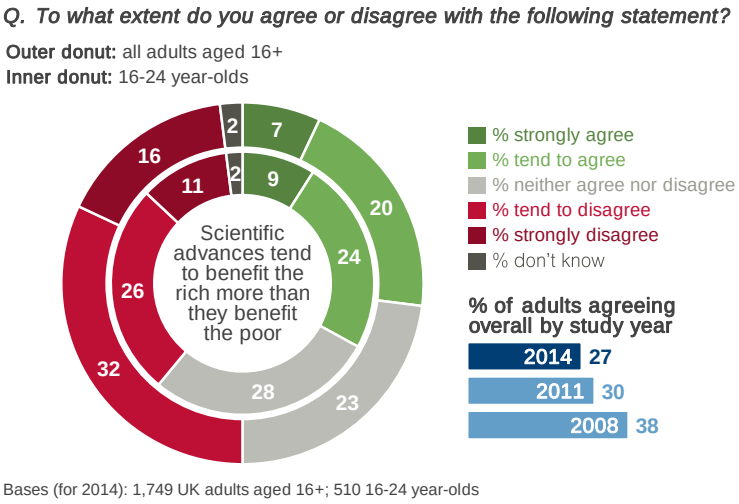
Who benefits?

While people are generally positive about the overall impact of science on the UK economy, a sizable minority still have concerns about who benefits, with a quarter (27%) saying “scientific advances tend to benefit the rich more than they benefit the poor”, as can be seen in Figure 9.7. Around half (48%) disagree, so this is far less of an issue than it was in 2008, when more agreed than disagreed (38% versus 31%).

This question has also been asked recently of the Australian public (Ipsos Australia, 2013), who were more likely to agree than disagree (34% versus 28%), indicating that the UK public are generally less concerned about this issue.

In the UK, young adults aged 16-24 appear to be more neutral on this issue (28% neither agree nor disagree, compared with 23% overall), as Figure 9.7 shows. Nevertheless, when focusing only on 16-17 year-olds, agreement is much higher (42% of this age group agree), suggesting the youngest adults are generally more sceptical about who benefits from scientific advances.

Figure 9.7 – whether people think the rich benefit more than the poor from science



Bases (for 2014): 1,749 UK adults aged 16+; 510 16-24 year-olds

Ethnic minorities (35% agree), those not in work (32% agree) and the least affluent (41% of DEs agree) are all more likely than average (27%) to think the rich benefit more than the poor from scientific advances, though only the latter subgroup is more likely to agree than disagree (41% versus 33%).

Again, those who feel informed about science and those who feel informed about economics and the way the economy works are both more likely to disagree that the rich benefit more than the poor from science. However, it is once more worth noting that even those who do not feel informed about either of these things still *disagree* on balance, suggesting that this is another received wisdom, not necessarily reliant on knowledge of science or of the economy.

The challenge of discussing economic benefits

It is important to note that “the economy” does not always have positive connotations in public discourse. Participants at the Day of Discovery workshop often made a clear distinction between how science benefits *people* and how science benefits *the economy*, not really considering that people were part of the economy. Participants frequently mentioned new technologies and improvements in healthcare as ways in which science made a positive economic impact on people. However, when asked how science benefits “the economy”, many thought instead of the profits made by the companies that scientists work for. While some participants suggested that this would eventually trickle down and benefit society as a whole, many felt that society as a whole would never benefit in this way.

Therefore, while the PAS 2014 survey findings show that people widely recognise the economic contribution of science to society, it is still important for policymakers and science communicators to be clear about what they mean when discussing the economic benefits of science with the public.

The Public Attitudes to Science segments

10 The Public Attitudes to Science segments

This chapter focuses on the six attitudinal segments first observed in PAS 2011, and how these have evolved over time. A summary description of each segment, and how their attitudes to science differ, is included in the introduction to this report, while a full description of each segment is available in the PAS 2011 Main Report. Building on the 2011 study, this chapter also considers how these segment descriptions can be further enhanced using the new questions included in the 2014 survey.

Key findings

- The number of Confident Engagers has fallen, while the number of Disengaged Sceptics has increased since 2011. However, over the same period, the number of Late Adopters has increased and the number of Indifferent has fallen, so it cannot definitively be said that the population has become more or less engaged with science overall.
- The segments who are most engaged with science not only tend to have a greater factual knowledge of science, but also appear to have greater non-science related cultural knowledge. This again suggests that there are perhaps not two cultures of science versus arts, but instead a group of people who are more engaged with both these areas.
- As was suggested in 2011, the 2014 survey confirms that those from the Concerned segment tend to have stronger spiritual or religious beliefs than the other segments.
- The most engaged segments – Confident Engagers, Distrustful Engagers and Late Adopters – are among the most likely to use new communications technologies such as smartphones and tablets, and to use social media. Late Adopters in particular are more likely to have recently used a variety of social media platforms.

10.1 How have the segments evolved over time?

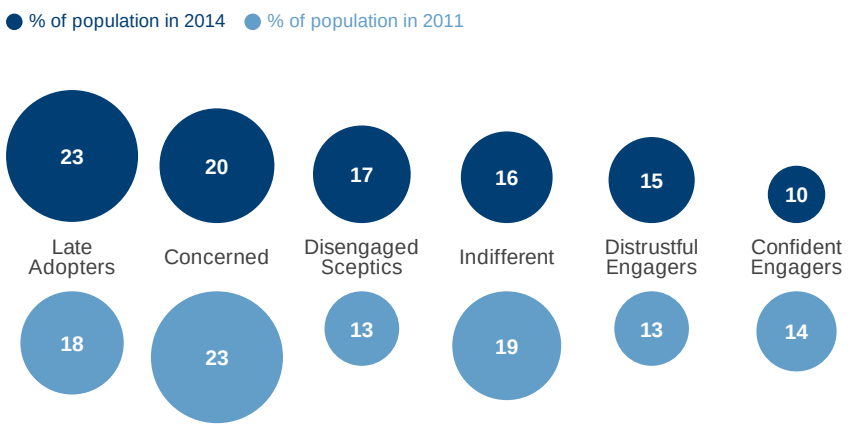
How have the segments changed in size?

As Figure 10.1 illustrates, the number of Late Adopters and Disengaged Sceptics in the population has increased, while the number of people from the Indifferent and Confident Engager segments has fallen since 2011.

The fall in the proportion of Confident Engagers suggests there are now fewer people with unequivocally positive attitudes towards science. However, this fall broadly matches the increase in the number of Late Adopters, who are also highly engaged with science. Similarly the increase in the number of Disengaged Sceptics matches the fall in the Indifferent segment, with both of these segments tending to be less engaged with science. Overall, this suggests that the population as a whole has not become especially more or less engaged – although attitudes have shifted, people have moved to similarly engaged segments. This is supported by the findings in Chapter 2, which show that overall interest in science is in fact *stronger* than in 2011.

While Confident Engagers and Late Adopters are similar in many ways, there are differences between the two that are important to bear in mind for science communicators. PAS 2011 suggested that whereas Confident Engagers are generally interested in all aspects of science, Late Adopters tend to be more interested in specific science-related issues – often those related to their ethical and environmental interests. The 2011 study also noted that Late Adopters tend to have a broader view of what constitutes science, potentially thinking of TV shows like CSI as science-based shows.

Figure 10.1 – segment size as a proportion of the population over time



Base (for 2014): 1,749 UK adults aged 16+

How have the demographics of the segments changed?

There have also been changes in the demographic make-up of some segments:[43]

- **Late Adopters** are now more balanced in terms of gender (52% are women and 48% are men), having been more predominantly female in 2011. This perhaps reflects that people who were Confident Engagers in 2011 now identify more with the traits of the Late Adopters segment.

- The **Concerned** are now older than previously (19% are aged 65 and over, compared with 13% in 2011).

- **Disengaged Sceptics** are now younger (19% are aged 65 and over, versus 26% in 2011) and more ethnically diverse (12% are from ethnic minorities, versus 5% in 2011). These changes suggest that the increase in the size of this segment is not just due to people moving from the relatively older Indifferent segment, but possibly also includes those who were once part of the Concerned segment, who are also more likely to be younger and from ethnic minorities.

- **Distrustful Engagers** are still more likely to be men than average, though the proportion of women in this segment has risen since 2011 (from 29% to 40%).

10.2 What have we learnt about the segments?

Levels of science knowledge and cultural knowledge

Two groups of questions new to the PAS studies, looking respectively at people's factual science knowledge and cultural knowledge, were included in the 2014 survey:

- The science knowledge quiz has been used in various other surveys in the UK and elsewhere, including the *Wellcome Trust Monitor*, as a basic measure of science literacy. It consists of nine true-or-false questions, giving everyone a science knowledge score between 0 and 9.

- The cultural knowledge quiz has been adapted from a similar set of cultural knowledge questions asked by Sullivan (2008). The quiz comprises a list of famous people from art, music and science (four names from each) and people are asked to assign each person to the field for which they are known. The correct answers for the art and

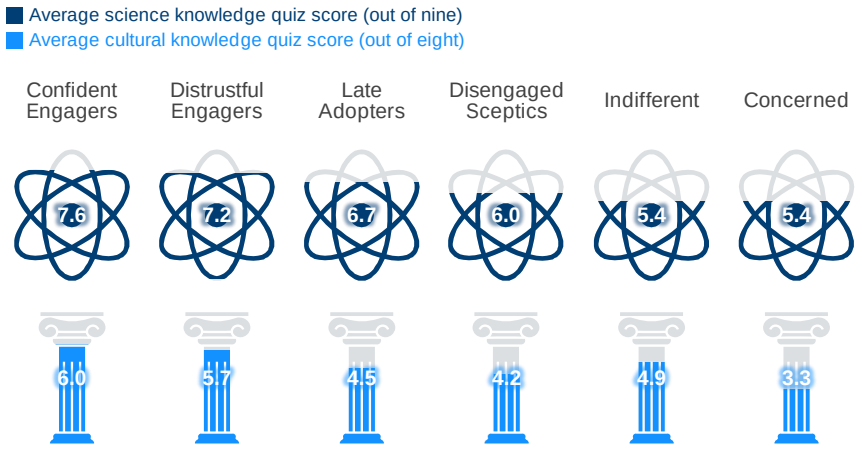
[43] While there are some observed changes in the social grade profile of segments between PAS 2014 and PAS 2011, these potentially reflect that the weighted sample profile for the 2014 survey includes more ABC1s as a whole than in 2011. Therefore they may not indicate a real change in affluence over time and have not been reported on here.

music questions have been combined to give each person a non-science related cultural knowledge score between 0 and 8.[44]

Figure 10.2 shows the average scores within each segment on both these indicators, giving an insight into how the segments differ based on their science knowledge and cultural knowledge. Confident Engagers, who are among the most engaged with science generally, tend to score highest on both counts. Those from the Concerned and Disengaged Sceptics segments, who tend to be less engaged with science, tend to score lowest.

As Figure 10.2 demonstrates, engagement with science, science knowledge and non-science related cultural knowledge all appear to be broadly associated with one another. In other words, the people who are most interested in science and most knowledgeable about it are also among the most likely to have interests in other areas such as the arts. This again suggests that there are perhaps not two cultures of science versus arts as described by Snow in 1959, but instead a group of people who are more engaged with both these areas (as aforementioned in Chapter 8). It also suggests that science-related cultural activities potentially compete with arts-related cultural activities, as they both tend to attract a similar audience.

Figure 10.2 – average science knowledge and cultural knowledge scores by segment



Bases: 341 Concerned; 159 Confident Engagers; 319 Disengaged Sceptics; 266 Distrustful Engagers; 294 Indifferent; 370 Late Adopters

Religious belief

The PAS 2014 survey is also the first in the series to explore people's religious beliefs. In the 2011 study, it was suggested that the Concerned tended to have stronger spiritual or religious beliefs than the other segments, and this is confirmed in the 2014 data. The Concerned are more likely to attend a religious service once a week or more (21%, versus 13% on average) and are more likely to think that "humans and other living things

[44] This score is intended to be a basic proxy for cultural knowledge among the segments, rather than an in-depth look at the cultural capital of each segment. The list of famous names included in the quiz are typically from the western classical canon so, as might be expected, scores are generally lower among younger adults and ethnic minorities.

were created by god and have always existed in their current form" (39%, versus 19% overall). Disengaged Sceptics are also more likely than average to agree with this statement (24% agree).

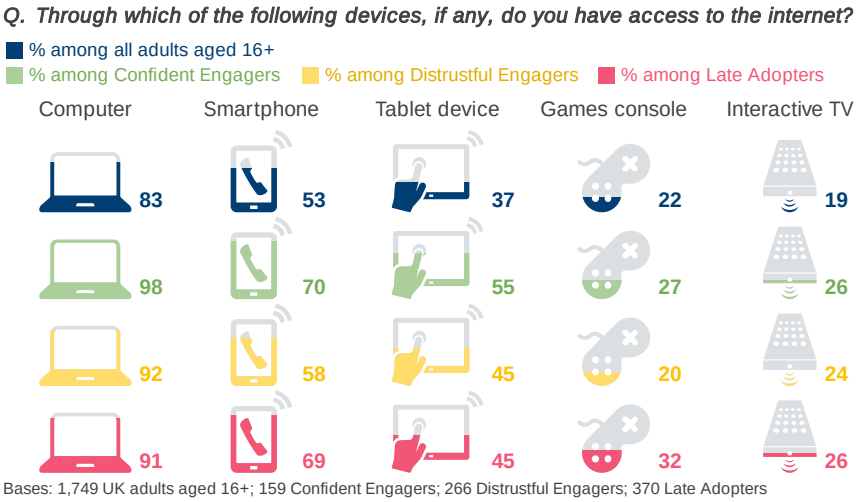
Muslims are most likely to be in the Concerned segment (33% of Muslims belong to this segment), though it should be noted that Muslims still only account for one-in-ten (10%) of the Concerned segment overall, with the rest of this segment identifying with other religions, or with no religion.

How the segments use technology and social media

Since PAS 2011, not only has the number of general internet users in the UK expanded, but the prevalence of new technologies such as smartphones and tablets has also increased. The Ipsos MORI *Tech Tracker* survey measured an increase of 15 percentage points in smartphone ownership and an increase of 14 percentage points in tablet ownership from late 2011 to mid-2013.[45] As Figure 10.3 indicates, the three segments most engaged with science are most likely to be using these new technologies.

Both Late Adopters and Confident Engagers are more likely than average to have access to the internet through computers, smartphones, tablets and interactive TVs. Distrustful Engagers are also more likely than average to have access via computers, tablets and interactive TVs. Finally, Late Adopters are more likely to have access via a games console as well.

Figure 10.3 – use of new communications technologies by segment



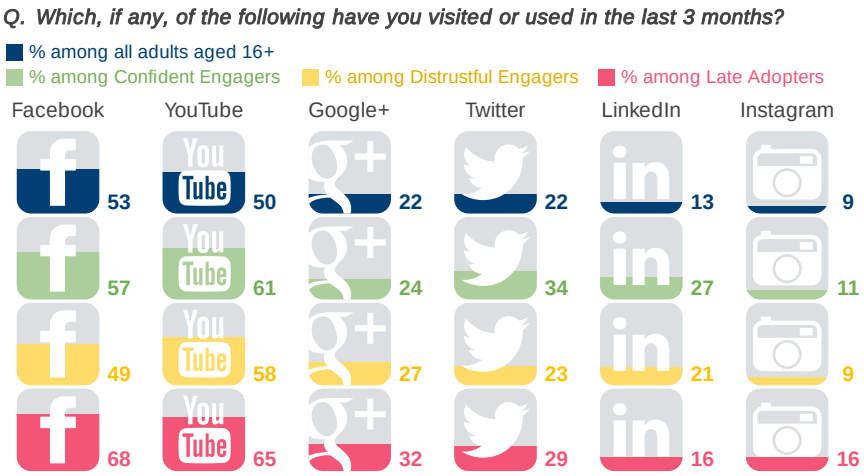
Bases: 1,749 UK adults aged 16+; 159 Confident Engagers; 266 Distrustful Engagers; 370 Late Adopters

These three segments are also among the most likely to be social media users, which Figure 10.4 illustrates. In particular, Late Adopters are more likely than others to have recently used a wide range of social media, including Facebook, YouTube, Google+, Twitter and Instagram. Confident Engagers and Distrustful Engagers are more likely than average to have recently been on YouTube and on LinkedIn, with the latter perhaps reflecting

[45] The 2013 Q2 *Tech Tracker* is available on the Ipsos MORI website, at: http://www.ipsos-mori.com/researchspecialisms/ipsosmediact/customresearch/technology/techtracker.aspx.

that they tend to be older than the Late Adopters segment. Confident Engagers are also more likely than average to be Twitter users.

Figure 10.4 – use of social media by segment



Bases: 1,749 UK adults aged 16+; 159 Confident Engagers; 266 Distrustful Engagers; 370 Late Adopters

Attitudes to big data

11 Attitudes to big data

This chapter looks at attitudes towards the first specific science topic chosen for further exploration in PAS 2014, big data and, by association, energy efficient computing. The survey questions covered in this chapter were asked of around a quarter of the main sample (446 adults), who were randomly selected. Therefore, while the findings are still representative of the UK public, it should be remembered that margins of error are higher.

There is no single definition of big data, though the term is commonly applied to datasets that are so large or complex that they require large amounts of computing power or new data processing software. As the concept is difficult to grasp, the PAS 2014 survey did not ask directly about "big data", but explored attitudes towards current uses of people's data and towards potential future uses of big data.

In recent years there has been a considerable amount of public opinion research on privacy and use of people's data. As mentioned in Chapter 1, to add value to the PAS survey findings in this area, Ipsos MORI carried out a separate public dialogue on behalf of the Economic and Social Research Council (ESRC) and the Office for National Statistics (ONS) in late 2013. The dialogue specifically explored attitudes to the linking of government administrative data for research purposes. Some of the key findings from this dialogue, among other research, are used throughout this chapter to contextualise the PAS survey findings.

As a further context for the findings presented here, it should be noted that two major news stories may recently have played a part in influencing attitudes to data usage. First, the US National Security Agency's collecting of personal data emerged in June 2013, a few months before survey fieldwork. Second, the phone hacking trial in the UK began in October 2013, during fieldwork.

It is also important to note that the PAS 2014 fieldwork took place *before* the rollout of the NHS Care.data database, and its subsequent delay, were announced (in January and February 2014 respectively). Given the large amount of media coverage this proposed database has received, it is possible that national attitudes to big data have developed even further since PAS 2014.

Key findings

- While people do appear to have concerns about how their data are currently being used by different service providers, most do not act on these concerns and tend to stick with the services they are already signed up to.
- Six-in-ten say they do not mind how their personal data are used as long as they are anonymised. However, among those who say this, some still oppose anonymised personal datasets being used in specific contexts, possibly overlooking that the data are anonymised, or not trusting the anonymisation process.
- People on balance oppose personal data being used for commercial gain. At the other end they largely support the use of personal data in contexts where there is a tangible public benefit, such as in medicine, transport and policing.
- Most are not aware of the energy implications of the increasing use of big data. This is even the case with those most engaged with science generally, who are among the least concerned about this issue.

11.1 Concerns about current use of data

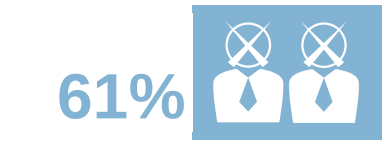
In the ESRC/ONS dialogue, participants noted that keeping their personal data secure was very important to them, and many had concerns about their data being leaked, lost, shared or sold by the organisations that currently hold it. At the same time, many felt that they had little control over the data that was held about them, and saw providing their data to organisations as an unavoidable aspect of modern life, if they wanted to use public services or have access to free or low-cost commercial services.

"You just have to give your information to use these services, if you want to be treated by a doctor, if you want a job."
ESRC/ONS public dialogue workshop participant

The PAS survey finds that while people may have concerns about how their data are used, most do not act on these concerns, especially if they are already signed up to a particular service. Over two-fifths (46%) say they have decided not to take up one of the services shown in Figure 11.1 because of concerns about how their data might be used. Under a fifth (16%) say they have stopped using any of these services because of this.

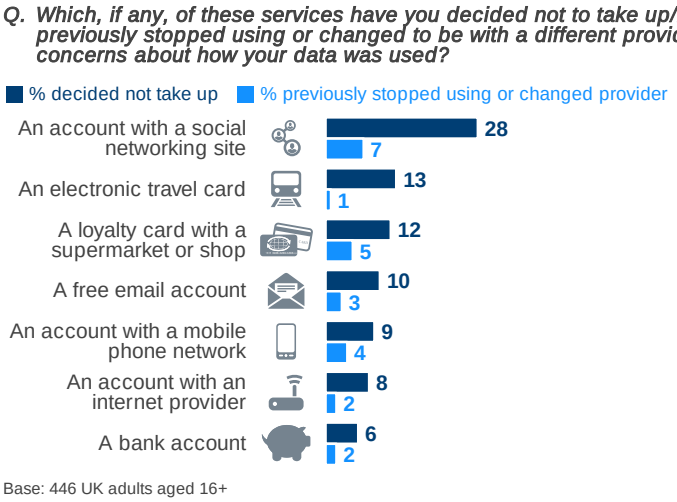
Figure 11.1 breaks down these findings by type of service. The findings suggest there are relatively strong concerns about the use of data by social networking sites, with three-in-ten (28%) saying they have not taken out a social networking account because of these concerns.

Among those who have decided not to take up a service or previously stopped using a service because of data concerns, most people mention just one of the services in Figure 11.1. This chimes with other survey research by Demos (Bartlett, 2012) which found that just three-in-ten of the public are resolute non-sharers, while the rest of the population are generally willing to share their data under varying circumstances, even though they may not do so in particular situations.



say they do not mind how their personal data are used if they are anonymised

Figure 11.1 – whether people have changed their behaviour because of concerns about data usage



Base: 446 UK adults aged 16+

Young adults aged 16-24 appear to have fewer concerns than others about how their data are currently used. For example, just seven per cent of 16-24 year-olds (versus 28% overall) say they have not started a social network account because of data concerns.

While this difference may partly reflect that younger adults are more interested in joining social networks in the first place, the idea that young adults are more open with their data does reflect findings from the ESRC/ONS dialogue. Younger participants (from 16 years old) tended to be more aware of how their data are collected, for example through Facebook posts. Some described taking a quid pro quo approach to data, whereby they were happier to pass on their data to get something in return, such as discounts or loyalty rewards. This generational difference in attitudes has also been observed in qualitative research by the Wellcome Trust (2013), which found that younger people were generally more accepting of data on them being collected and used by others.

11.2 How important is anonymity?

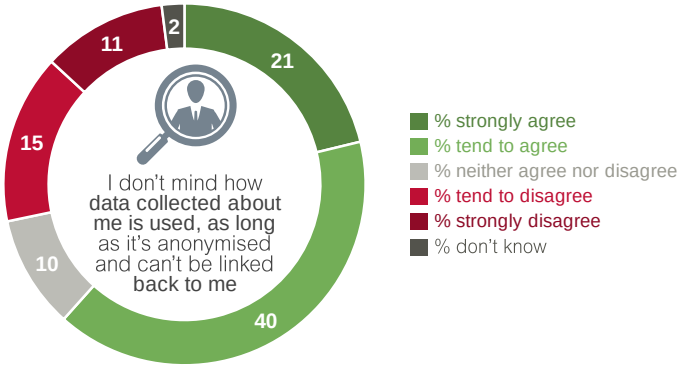
The reassurance of anonymity in big datasets is important. Six-in-ten people (61%) agree that they do not mind how their personal information is used, provided that it is anonymised and cannot be linked back to them, as Figure 11.2 shows. Nonetheless, a quarter (27%) disagree, so there is still a challenge in bringing people on board even after anonymity is explained.

The power of anonymity as a concept is also clear from the ESRC/ONS dialogue. Once participants had been taken through the step-by-step process of removing personal identifiers from a dataset, they often felt that the data that were left did not necessarily belong to them anymore, since what was left *could* have come from anyone. In particular, in a scenario where people's names and addresses, and any familiar numbers such as a National Insurance number are removed, many participants no longer saw themselves as being part of such a dataset. Of course, explaining this process in an understandable way to the wider public still represents a considerable challenge.

In addition, it should be noted that what people consider "personal" information, and therefore what they consider to be anonymised data, will still differ from person to person. Some participants in the ESRC/ONS dialogue still thought that anonymised personal data (referred to as "de-identified" data in the workshops) remained *their data* after going through this process, simply by virtue of being *about* the individual. This was also a finding in the Demos research (Bartlett, 2012), and of *Special Eurobarometer 359* (European Commission, 2011a), which highlighted that people in the UK were more stringent than the average EU citizen about what they considered to be personal information, especially when it came to financial and medical information. This was compared to much more relaxed attitudes towards personal information in Scandinavian countries – Denmark, Finland and Sweden – in particular.

Figure 11.2 – whether people mind how their data are used if anonymised

Q. To what extent do you agree or disagree with the following statement?



Base: 446 UK adults aged 16+

On this issue, agreement is particularly strong among Disengaged Sceptics (31% agree, versus 21% on average), while people from the Concerned segment are among the least likely to agree (49% agree, versus 61% overall).

11.3 Opinions on potential uses of big data

The survey asked whether people supported or opposed various potential future uses of big datasets. When answering, people were told that in each

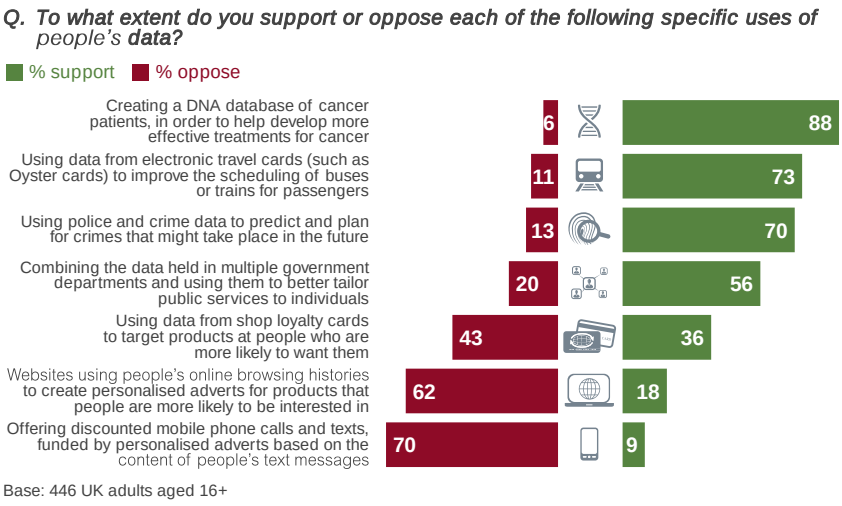
of these examples, the data are anonymised so that individuals cannot be identified.

As Figure 11.3 illustrates, people are most supportive of individuals' data being used when there are tangible public service benefits. Nine-in-ten (88%) support the use of people's data to help develop treatment for cancer, three-quarters (73%) support data being used to improve the scheduling of transport services and seven-in-ten (70%) support data use to prevent crimes. This was also the case in the ESRC/ONS dialogue, with participants highlighting medicine, education and social care as good areas in which to put personal data to use, because the implications were most clear.

The linking of government administrative data to better tailor public services garners relatively less support (56%). This might be because the benefits of this type of data linking are difficult to conceptualise, and indeed in the ESRC/ONS dialogue, participants often did not initially understand the value of much of the blue-skies research that would be made possible through government administrative data linking.

The commercial use of data tends to be opposed on balance, even though in practice most people have not opted out of things like mobile phone contracts or loyalty card schemes (as discussed earlier in this chapter). This is not a new finding – concerns about data being used for profit were present both in the ESRC/ONS dialogue and in qualitative research for the Wellcome Trust (2013), with participants in the Wellcome Trust research being worried that health companies would use the data to target their products at more vulnerable groups, such as older people.

Figure 11.3 – whether people support or oppose potential future uses of big data



Reflecting the earlier age differences noted in this chapter, young adults appear to be more relaxed about the commercial use of people's data. For instance, only around half (53%) of 16-24 year-olds (compared with 70% overall) oppose companies showing personalised adverts based on the content of people's text messages if they then offer discounted mobile phone calls and texts, and a quarter (25%, versus 9% overall) support this.

The commercial use of personal data is opposed on balance

Once more, those in the Concerned segment also stand out. They are more likely than average to be opposed to the two most favoured potential uses of big data asked about in the survey. Two-in-ten (22%, versus 11% overall) oppose the use of people's data to improve the scheduling of transport services, and one-in-ten (12%, versus 6% overall) oppose the idea of creating a DNA database to improve cancer treatment.

Why do people oppose some potential uses of big data?

The majority opposition to some of the more commercial uses of people's data conflicts somewhat with the idea that six-in-ten do not mind how their data are used *as long as they are anonymised*. When asked unprompted why they have opposed the various potential uses of data asked about, the answers people give suggest that many overlook the idea of data being anonymised, or are sceptical about this and think the data can still be used to target individuals. As Figure 11.4 shows, four-in-ten (40%), cite the potential for abuse of their personal information or identity theft as a reason, while two-in-ten (18%) think people will incur junk mail or spam. This was also a recurring issue throughout the ESRC/ONS dialogue workshops, with participants frequently forgetting that they were discussing anonymised data and needing to be constantly reminded of this by the workshop facilitators and social scientists present.

Data security is another point of concern highlighted in the survey, implicit in worries about identity theft, and also with over one-in-ten (14%) concerned about hackers getting hold of their data.

Others appear to object in principle to the various potential uses of people's data, with a third (32%) saying that people have a right to privacy and just under two-in-ten (17%) saying that consent has not been given.

Figure 11.4 – reasons people oppose potential future uses of big data

Q. *What makes you oppose people's data being used in some of these ways?*

Base: 382 adults who oppose one of the potential uses of people's data asked about
N.B. word clouds are illustrative of data, not statistically representative; only codes registering 2% or more are shown

Men are more likely than women to say they do not trust either companies, government or the police (27% versus 15%) when asked why they oppose these potential uses of people's data.

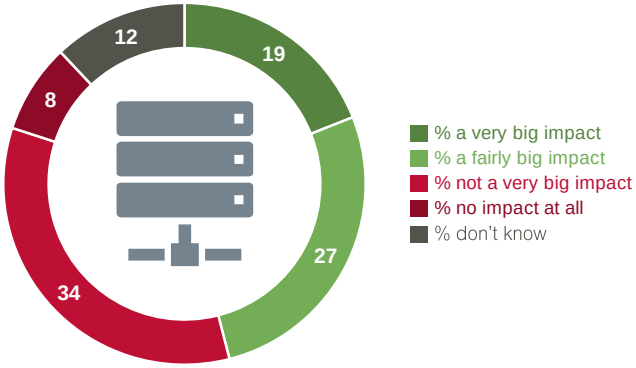
11.4 The energy impact of big data

The energy requirements of big data analysis are one of the largest elements of its cost. In 2013, Intellect (the trade association for UK IT companies) estimated the energy consumption of UK-based data storage centres to be between 2 and 3 Terawatt hours – roughly the same amount of power required to run the London Underground network for 20 months.

PAS 2014 suggests this is an issue many of the public are not aware of right now. As Figure 11.5 shows, just under five-in-ten (46%) think that the supercomputers employed in big data analysis will have a big impact on the UK's energy consumption in the future, while four-in-ten (42%) think that there will not be a very big impact, if any, and one-in-ten (12%) say they do not know.

Figure 11.5 – what impact people think supercomputers will have on future energy consumption

***Q. The analysis of large datasets often requires the use of supercomputers that use electrical power. How much of an impact, if at all, do you think these supercomputers** will have on the UK's energy consumption in the future?*



Base: 446 UK adults aged 16+

It is worth noting here that those most engaged with science are among the least concerned about this issue. Those who feel informed about science (51%), Confident Engagers (76%) and Distrustful Engagers (68%) are more likely than average (42%) to say that these supercomputers will have little or no impact at all on the UK's future energy consumption. This highlights that the need for energy-efficient computing in an age of big data is not really an issue that even the most engaged members of the public have considered much to date.

Attitudes to agri-science and food security

12 Attitudes to agri-science and food security

This chapter covers attitudes towards the second specific science topic chosen for further exploration in PAS 2014, agri-science and food security. In particular, it looks at attitudes to genetically modified (GM) crop technology as part of the wider food security debate. This builds on previous survey research, which has tended to look at the issue in isolation. Again, the survey questions covered in this chapter were asked of around a quarter of the main sample (455 adults), who were randomly selected.

Key findings

- Seven-in-ten feel that ensuring the world has enough food to go around is a very big issue today. It is considered less of a current concern for the UK specifically, though six-in-ten still see this as at least a fairly big issue for the UK today and two-thirds agree that it will become a big issue in the UK in the future.
- People do not necessarily see food security as a scientific issue, particularly when it comes to global food security. When looking at why people say it is a big issue, many people's answers seem to reflect what they have seen and heard about in other countries, and the economics behind this, although population growth and climate change are also commonly mentioned.
- Just as very few see no risks in GM crops, few think there are no benefits. The most commonly perceived benefit, mentioned by half the public, is increased food production. Relative to the benefits, people do not strongly perceive any *single* factor to be a risk, though their potential negative impact on health is mentioned by one-quarter.
- Eight-in-ten feel that no food producing techniques and technologies that might raise world food production should be rejected out of hand. When pressed on GM crops specifically, people's enthusiasm wanes, although a majority still agree they are needed. This suggests that GM crops may be clouding the wider food security debate due to their contentious nature.

12.1 Is food security an issue?

As the Global Food Security programme highlights, the world's population is expected to reach nine billion by 2050, substantially increasing the demand for food. This is considered a UK issue as much as a global one – the UK

currently imports around two-fifths of its food, and this proportion is set to increase.[46]

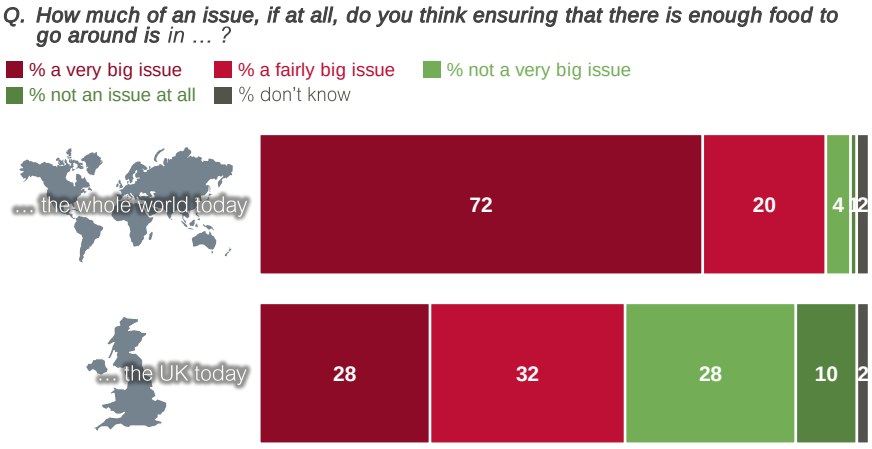
PAS 2014 shows that a large number in the UK recognise food security as an issue, especially at the global level. As Figure 12.1 indicates, seven-in-ten (72%) feel that ensuring the world has enough food to go around is a very big issue today. It is considered less of a concern for the UK specifically, though six-in-ten (60%) still see this as at least a *fairly* big issue for the UK today, and only one-in-ten (10%) do not see it as a problem at all. While not directly comparable due to different question wording, these scores are broadly consistent with those recorded in a 2012 TNS-BMRB survey on behalf of the Global Food Security programme, which also found that a majority of the UK public considered this as an issue both globally and at home.

Nevertheless, the UK public are not necessarily as concerned about this problem as their European neighbours. *Special Eurobarometer 389* (European Commission, 2012a) found that while concern about global food production was high in the UK (74% concerned), it was lower than in Germany (85%) or France (80%). In addition, that survey found that people in the UK were not as strongly concerned about *domestic* food security (13% concerned) as those in France (19%).

60%

think ensuring there is enough food to go around is at least a fairly big issue in the UK today

Figure 12.1 – whether people see food security as a current issue globally and in the UK



Base: 455 UK adults aged 16+

The more affluent are among the more strongly concerned about food security as a global issue (86% see it as a very big issue, versus 72% overall).

Young adults appear to be less concerned about domestic food security. Among 16-24 year-olds, just two-in-ten (18%, versus 28% overall) think ensuring the UK has enough food to go around as is very big issue today.

[46] More information can be found on the Global Food Security programme website, at: http://www.foodsecurity.ac.uk/.

What makes food security a big issue?

While most people in the UK think food security is an important issue, both at home and across the world, they do not necessarily see it as a scientific issue.

When those who think it is a big issue are asked unprompted why they think this, many people's answers seem to reflect what they have seen and heard about in other countries, and the economics behind this. As can be seen in Figure 12.2, four-in-ten (40%) cite starvation or famine in poor countries. Other answers which are similarly about other countries and economics include inequality between countries (16%), the global economy (13%), rising prices (12%) and unfair trade agreements (12%).

However, several people do consider food security to be intertwined with other issues that might be considered science-related issues. Three-in-ten (30%) mention population growth and two-in-ten (19%) mention climate change. Scarce resources such as land and water (16%) and changing diets (6%) are also mentioned.

Figure 12.2 – reasons people think food security is a big issue

Q. What do you think makes ensuring that there is enough food to go around a big issue today?

Base: 426 adults who think ensuring that there is enough food to go around is a big issue today
N.B. word clouds are illustrative of data, not statistically representative; only codes registering 2% or more are shown

Of the large number who think food security is a big issue globally, a little over a third (36%) do *not* currently see it as a big issue for the UK, or say they do not know if it is a big issue for the UK. Taking this subgroup, i.e. excluding the people who think it is a domestic issue, and looking at the reasons they give for their answers suggests people frame discussions on global food security slightly differently to domestic food security.

- Famine in poor countries (40%) and increasing population growth (25%) remain the most commonly cited reasons.

- Scarce resources (24%) and inequality between countries (23%) become the third and fourth most commonly mentioned reasons among this subgroup, more so than climate change (18%). This is different from Figure 12.2 (which includes those who think food

security is a big issue in the UK), where climate change is the third most commonly mentioned reason.

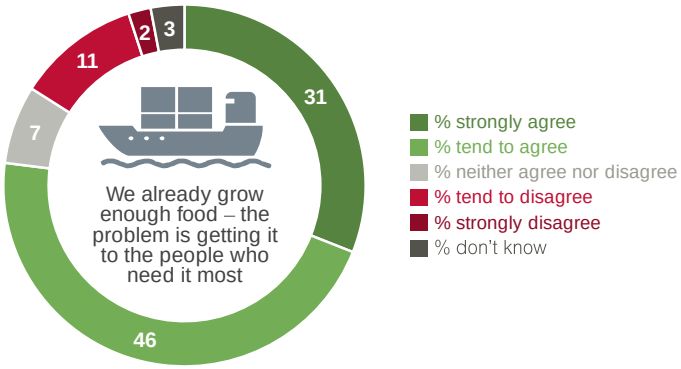
These differences suggest that the global food security debate is perhaps considered more of a political or economic issue, whereas the scientific angle (for example in terms of climate change) features more strongly when discussing UK food security specifically.

Do we grow enough food already?

Concern with global food security is not just about the overall level of food production. It is also linked to perceptions of food being wasted or directed to the wrong places. As Figure 12.3 indicates, three-quarters (77%) agree that enough food is grown around the world already, but that there are problems with getting it to the right people. This question also featured in the 2012 TNS-BMRB survey, which found a similar result. This is perhaps another indicator that many people consider this an economic problem as much as a scientific one.

Figure 12.3 – whether people think enough food is already grown in the world

Q. To what extent do you agree or disagree with the following statement?



Base: 455 UK adults aged 16+

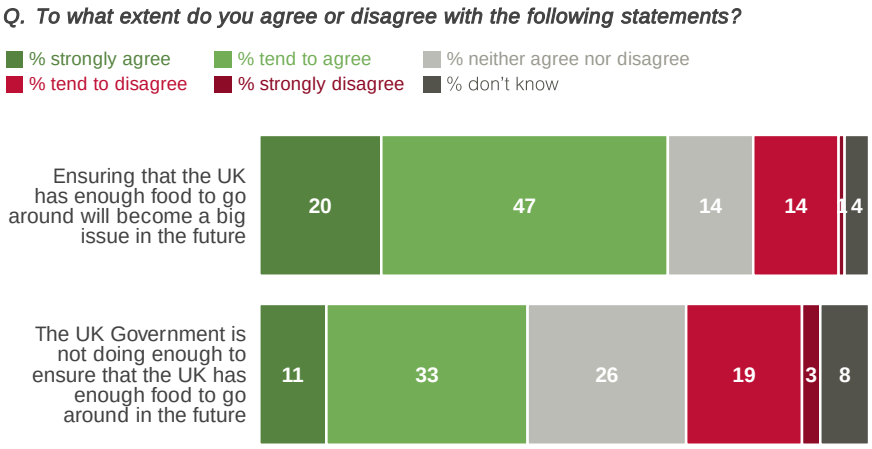
Disengaged Sceptics, who tend to be from less affluent backgrounds, are more likely to *strongly* agree with this statement than others (45%, versus 31% overall).

Will domestic food security be an issue in the future?

There is greater public concern over the UK's food security in the longer term, as Figure 12.4 highlights. Two-thirds (67%) agree that ensuring there is enough food to go around in the UK will become a big issue in the future – more than the proportion who feel that it is a big issue at present (60%). Even among those who do not think domestic food security is a big issue today, or say they do not know if it is, over two-fifths (45%) do agree it will become a big issue in the future.

The level of trust in the UK Government to address this future shortfall is low. Just over two-fifths (44%) think that the UK Government is *not* doing enough to ensure food security in the future. Only one-fifth (22%) think that the UK Government is doing enough. Nevertheless, possibly reflecting a lack of overall knowledge around this issue, a third (33%) are neutral or say they do not know.

Figure 12.4 – perceptions of domestic food security as an upcoming issue



Base: 455 UK adults aged 16+

12.2 GM crops in the context of food security

What do people see as the good and bad aspects of GM crops?

As noted in Chapter 2, GM crops are still one of the more contentious science-related issues explored in PAS, with just over a third (36%) of those who have heard of GM crops before saying the benefits of GM crops are greater than the risks, and three-in-ten (28%) saying that the risks are greater than the benefits. To look at this in more detail, those who have heard of GM crops before were asked unprompted what they consider the risks and benefits to be. GM crops were defined in the survey as "plants in which the genetic make-up has been altered in a way that does not happen naturally".

Figure 12.5 shows people's responses in the form of a word cloud, where benefits are in green and risks are in red. It should of course be remembered that these are people's *perceptions* of risks and benefits, and do not necessarily reflect the actual risks and benefits of GM crops. Moreover, some of the answers people give suggest that they are not only focusing on the scientific risks and benefits of GM crops, but more broadly on what they consider to be the good and bad things about the technology – this might be the case with those mentioning GM not being properly tested (8%) or not being natural (8%).

As Figure 12.5 highlights, half the public (50%) perceive increased food production to be one of the main benefits of GM crops, and this is by far the most commonly perceived benefit. Other benefits commonly mentioned, by around two-in-ten, are increased disease resistance (22%) and greater

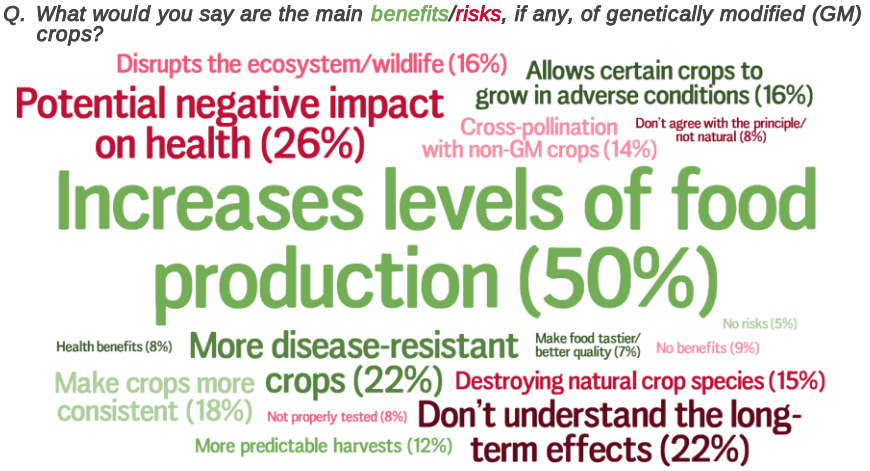
consistency of crops in terms of taste, size or quality (18%). Just one-in-ten (9%) think that there are no benefits to the technology at all, although it should be noted that a further 15 per cent (not shown in Figure 12.5) do not know what the benefits might be.

Relative to the perceived benefits, the public do not strongly perceive any *single* factor to be a risk when it comes to GM crops, though again very few (5%) think there are no risks at all. The most commonly perceived risk, by a quarter (26%), is their potential negative effect on health. Two-in-ten (22%) also say that not understanding the long-term effects is one of the main risks. This response, alongside the perception that the technology is not properly tested (mentioned by 8%), suggest that some still feel that there has not been enough research into GM crops to be confident about the technology.

80%

think that no agri-technologies should be ruled out to help increase world food production

Figure 12.5 – perceived risks and benefits of GM crops



Base: 429 adults who have heard of genetically modified crops
N.B. word clouds are illustrative of data, not statistically representative

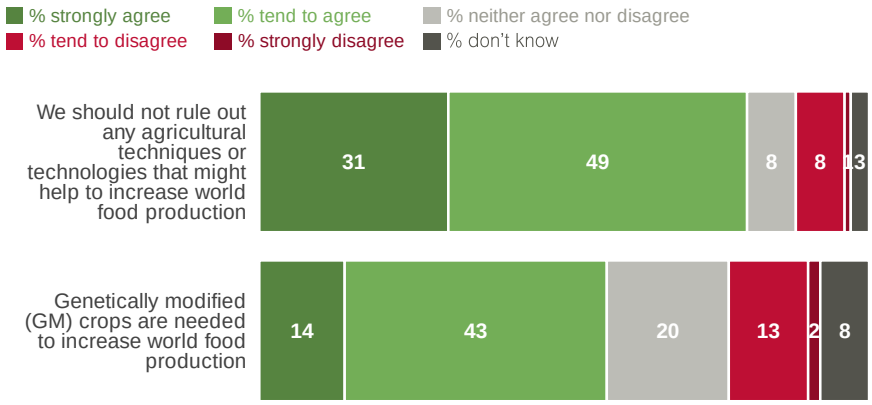
Are GM crops considered part of the food security debate?

As Figure 12.6 indicates, eight-in-ten (80%) feel that no agricultural technologies should be ruled out to help increase world food production, and only one-in-ten (9%) reject this notion. This shows that the public supports the viewpoint put forward in the 2009 Royal Society report, *Reaping the benefits*.

However, when pressed on GM crops specifically, people's enthusiasm wanes. Nearly six-in-ten (58%) agree that GM crops are necessary to increase world food production, but one-in-five (20%) are neutral and just under two-in-ten (15%) disagree. This suggests that while many do see GM crops specifically as contributing towards global food security, this particular technology may be clouding the wider food security debate due to their contentious nature – it is possible that people would engage more with agri-science if GM crops were seen as one of the many technologies being put forward to help improve global food security.

Figure 12.6 – perceptions of agri-science being used to increase global food production

Q. To what extent do you agree or disagree with the following statements?



Base: 455 UK adults aged 16+

Attitudes to robots

13 Attitudes to robots

This chapter looks at attitudes towards the third specific science topic chosen for further exploration in PAS 2014, robotics and autonomous systems (referred to hereon simply as robots). These attitudes were explored in the survey, as well as in the online qualitative research, where participants were asked to have a conversation about robots with their friends and family. In the survey, robots were defined explicitly as machines that can make their own decisions – machines that do *not* make their own decisions, such as those performing the same set of actions repetitively, were not considered as robots. Again, the survey questions covered in this chapter were asked of around a quarter of the main sample (428 adults), who were randomly selected.

Key findings

- Awareness of different uses of robots tends to reflect the balance of media coverage. Their use in manufacturing, space exploration and for military or security purposes is relatively well known. At the other end, few have heard anything about robots being used in the care or education sectors.
- There is relatively widespread support for using robots in roles that are potentially dangerous or difficult for humans to do, such as space exploration, manufacturing and military or security purposes. There is considerably less support for robots being used in caring roles, either with older people, or with children.
- Nonetheless, *general* opposition to use of robots in specific sectors does not necessarily stop people from supporting certain *specific* applications of robots in these sectors. Three-in-ten support robots being used as companions for older people and people with dementia, which is double the proportion who support the use of robots in the care of older people generally.

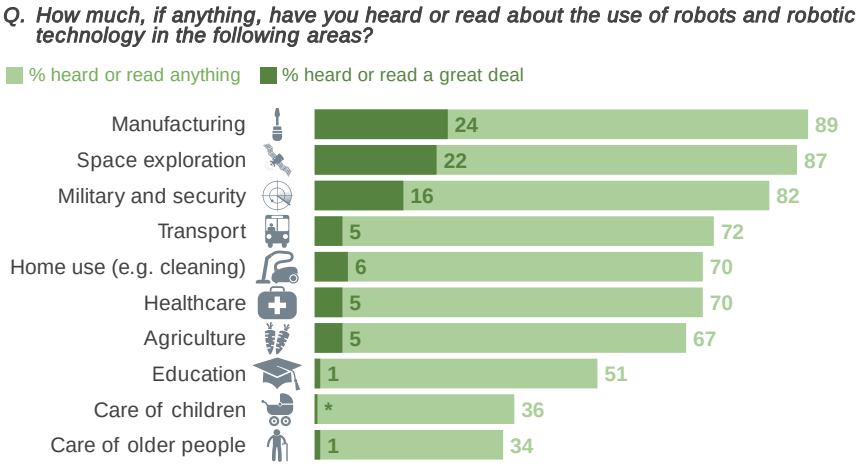
13.1 Awareness of different uses of robots

As the *Eight Great Technologies* (Willetts, 2013) report highlights, robots have current and potential applications in a wide range of areas, from space exploration to social care. The use of robots for space exploration and defence purposes has received considerable media coverage since the previous PAS study, tying in with the landing of the Mars Curiosity Rover in August 2012 and various news reports about the military use of aerial

drones. While there have been some news stories focusing on other applications[47] since 2011, these stories have generally been more sporadic.

As Figure 13.1 illustrates, awareness tends to reflect the balance of media coverage. The use of robots in manufacturing and in space exploration is particularly well known, with two-in-ten or more saying they have heard or read a great deal about this (24% and 22% respectively). The use of robots for military or security purposes is also well established relative to their other uses, with over one-in-ten (16%) saying they have heard or read a great deal about this. By contrast, the majority of the public say they have not heard anything about the use of robots in the care or education sectors.

Figure 13.1 – whether people have heard or read about robots being used in different areas



Base: 428 UK adults aged 16+

There are differences in awareness by gender, again reflecting the wider gender imbalance in science seen elsewhere in this study. Men are more likely than women to say they have heard or read something about robots used in various areas, including space exploration, military and security applications, healthcare and transport. These gender differences are also broadly present among younger adults.

There are few consistent differences by segment. However, Confident Engagers are more likely to have heard or read a great deal about robots being used in the home (21%, versus 6% overall) and in transport (14% versus 5%). Distrustful Engagers are more likely to have heard or read about the military uses (25%, versus 16% overall) and healthcare uses (12% versus 5%) of robots.

[47] See, for example, the following news story on the BBC News website from 8 November 2012 about the use of robots to help autistic children learn: http://www.bbc.co.uk/news/education-20252593.

13.2 Opinions on different uses of robots

Support for using robots in different areas generally

68%

oppose the use of robots in childcare

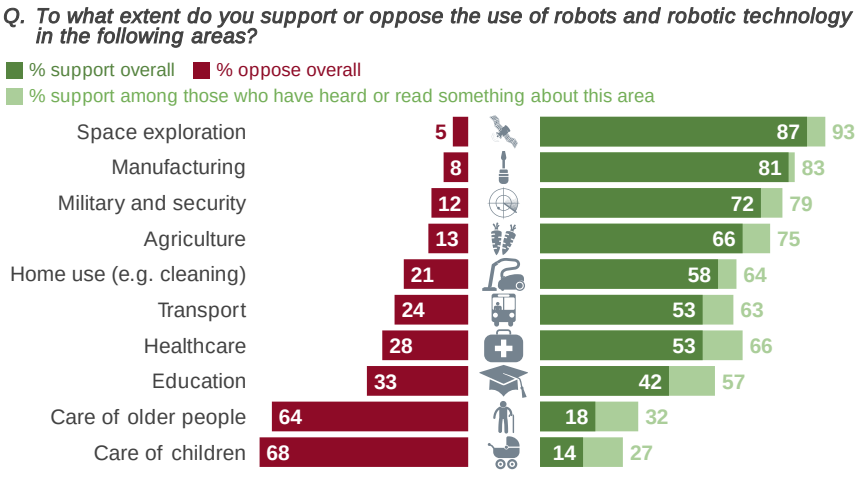
As Figure 13.2 shows, there is widespread support for using robots in roles that are potentially dangerous or difficult for humans to do, such as space exploration (87%), manufacturing (81%) and military or security purposes (72%). However, just six per cent support the use of robots in all the areas mentioned in the survey, and there is considerably less support for robots being used in caring roles, either with older people (18%) or with children (14%).

In this way, the UK public's views are in line with other EU countries. *Special Eurobarometer 382* (European Commission, 2012b) found that EU adults' top priority areas for robots were in space exploration, manufacturing and military uses, and that social care was the area where they were most likely to want robots banned.

Figure 13.2 also highlights that those who have heard or read something about each of the different areas in which robots can be used are more likely to support the application of robots in that area. Nonetheless, even among people who are aware of the potential applications of robots in caring roles, support for these uses is still relatively low, suggesting it is not simply fear of the unknown, but instead something else that people object to.

A Sciencewise (2013) report collating previous research on public attitudes to robots suggests that, in their opposition to robot carers, people specifically fear the loss of human-to-human contact, leading to a lower quality of care. This finding also emerges from the online qualitative research, where some participants were not convinced that robots would be capable of replacing humans in roles that require such complex interactions.

Figure 13.2 – whether people support or oppose the use of robots in different areas generally



Bases: 428 UK adults aged 16+ overall; 144+ who have heard or read something about each respective area

Once more, there are broad differences by gender. Men are more likely to strongly support the use of robots in each of these areas than women, with

the exception of home use (which men and women are equally likely to support). However, among 16-24 year-olds, these gender differences are less apparent.

When it comes to the use of robots in the home, people from ethnic minority backgrounds tend to be much less supportive than white people (43% versus 61%), which may reflect cultural differences.

Those with children at home might be expected to have particular views when it comes to the use of robots in childcare and in education, given the personal relevance of these areas. Similarly, older people might be expected to have different views on using robots to care for people their age. Nevertheless, the survey finds that these subgroups are no more likely than average to support or oppose the use of robots in these respective areas. This is likely to again reflect that the use of robots in these areas is an alien concept to most people, whether they have children living with them, or are older people, or neither.

Among the segments, Confident Engagers are more supportive than average of using robots in space exploration (all those interviewed support this, compared with 87% on average), agriculture (87% support this, versus 66% overall) and transport (70% versus 53%). Disengaged Sceptics are especially opposed to using robots in the care of older people (77% oppose this, versus 64% overall) and in healthcare (42% versus 28%).

Support for specific applications of robots

In its review of existing evidence on this topic, the Sciencewise (2013) report suggests that more specialised survey questions are needed to explore what people are thinking of exactly when they give their support for the use of robots in a particular sector. The PAS 2014 survey addresses this by asking about *specific* applications of robots within some of these sectors.

As can be seen in Figure 13.3, people are *less* supportive of using robots to fly unmanned planes in military operations than they are of using robots for military or security purposes generally (53% versus 72%). Similarly, people are less supportive of the specific examples of robots being used in education, healthcare and transport settings than they are of robots being used in these sectors more generally.

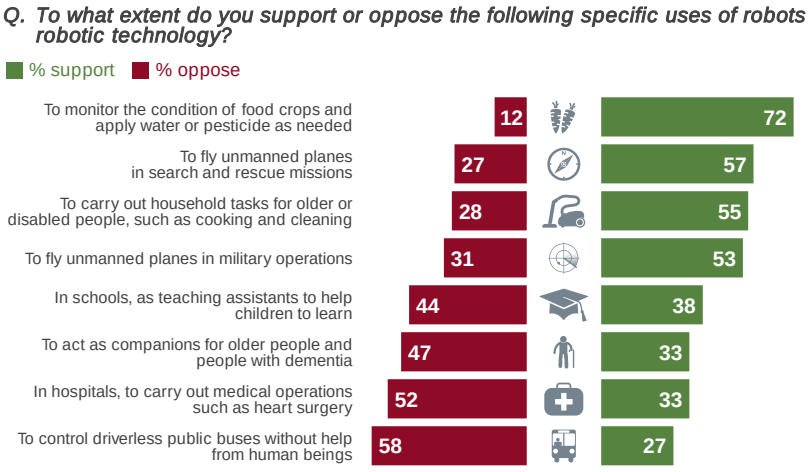
Once more, people are on balanced opposed to robots used in a direct caring role, acting as companions for older people and people with dementia – just a third (33%) support this. Nonetheless, this proportion is *higher* than the 18% who support the use of robots in the care of older people generally. Moreover, when given a different example of how robots might assist older people, through carrying out household tasks for them, more than half (55%) are supportive. These examples suggest that people might be more willing to accept robots being used to help an ageing population if they better understood the specific contexts.

Altogether, these differences show that general opposition to use of robots in specific sectors does not necessarily stop people from supporting certain

specific applications of robots in these sectors. This is perhaps because people find it difficult to envisage the potential uses of robots in a particular sector until they are given specific examples – in the online qualitative research, participants tended to think of robots as performing tasks that humans already do, and did not spontaneously consider robots as being able to conduct new tasks (for example, new "smart" temperature controls in people's homes).

The less clear-cut support for the specific military application of robots presented here is broadly in line with other research by YouGov (Rogers, 2013), which has shown the UK public to have mixed opinions on the use of unmanned planes, or drones, in military attacks. Of course, it is important to note that the example presented in the PAS 2014 survey was for the use of robots in "military operations", which are not necessarily lethal operations, so the 53% figure presented here does *not* necessarily indicate support for the use of lethal drones.

Figure 13.3 – whether people support or oppose specific applications of robots



Once again, men are more likely to support each of these specific applications of robots than women, with one exception – both men and women tend to be equally likely to support robots acting as companions for older people or those with dementia. Also once more, those from ethnic minorities tend to be less supportive of having robots carry out household tasks for older or disabled people (40% support this, versus 58% of white people), again potentially reflecting cultural differences.

There are no discernible differences by age. Even when it comes to using robots to care for older people, either to help with household tasks or as companions, the views of older people themselves do not tend to differ from the average.

Confident Engagers are more supportive than average of a variety of specific uses of robots, including in military operations (81% support this, versus 53% overall), search and rescue missions (74% versus 57%), medical operations (56% versus 33%) and as teaching assistants (55%

versus 38%). However, they are also among the most opposed to robots acting as companions for older people or those with dementia (63% oppose this, compared with 47% overall), suggesting this particular use is concerning even to those who are highly engaged with technological developments.

Attitudes to emerging energy technologies

14 Attitudes to emerging energy technologies

The fourth specific science topic explored in PAS 2014 is emerging energy technologies. The Department for Energy and Climate Change's (DECC) *Annual Energy Statement 2013* notes that the UK energy system is increasingly facing new challenges.[48] It needs to make the transition to low carbon and to replace the existing energy infrastructure, with around a fifth of 2011 capacity expected to close over the next decade.

This chapter looks at whether people think the Government is making an effort to meet these future energy needs, as well as looking at awareness and opinions of some of the technologies that may be required for this, specifically offshore wind, carbon capture and storage (CCS), and fracking to extract shale gas.[49]

Key findings

- There is little consensus of opinion on whether the Government is working hard to ensure that the UK has enough fuel in the future. Disagreement is higher than in 2011, potentially reflecting media coverage of rising energy bills around the time of the PAS 2014.
- Awareness of offshore wind farms is high, with over nine-in-ten having heard of them. People are largely supportive of offshore wind farms, even when they have not heard or read much about them. A majority think that they would have a positive impact on climate change and the UK economy.
- Awareness of CCS is much lower, with just over half having heard or read about it. Perhaps reflecting this, support for CCS is muted, with two-fifths either neutral or undecided on whether they support it or not. While people think on balance it would have a positive impact on climate change and the economy, large numbers still appear unclear about its benefits.
- Three-quarters have heard or read something about fracking to extract shale gas. This technology is more contentious, with similar proportions supporting and opposing its development. On balance, people expect fracking to benefit the economy and lower energy bills, but they are less sure of its net impact on climate change and concerned about its overall environmental impact.

[48] The DECC *Annual Energy Statement 2013* can be found on the gov.uk website, at: https://www.gov.uk/government/publications/annual-energy-statement-2013.
[49] In the survey, people were given brief descriptions of each of these technologies before being asked questions about them, so that they would answer with the correct technology in mind.

14.1 Confidence in government action

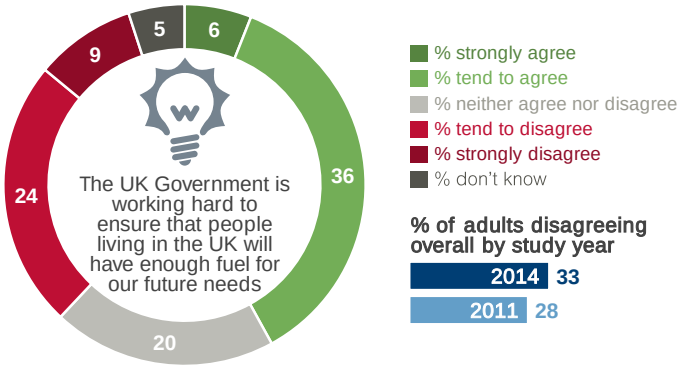
A 2012 Ipsos MORI survey (see Demski, Spence and Pidgeon, 2013 report for UK Energy Research Centre) has shown that just over half (54%) of the public think it is mainly the responsibility of national governments to ensure that appropriate changes are made to the UK energy system over the next 40 years. PAS 2014 shows that there is little consensus of opinion among the public on UK Government efforts on this.

As Figure 14.1 shows, two-fifths (42%) agree that the Government is working hard to ensure that people living in the UK will have enough fuel for our future needs, while a third (33%) disagree. People do not generally have strong views either way, with small proportions strongly agreeing (6%) or strongly disagreeing (9%).

Disagreement is somewhat higher than in 2011 (33% versus 28%), suggesting confidence in government action has fallen. This may partly be due to the greater politicisation of fuel policy around the time of the PAS 2014 survey fieldwork – there were several media stories in September 2013 about rising energy bills and the reactions of the main political parties to these rises.[50]

Figure 14.1 – whether people think the Government is making an effort on UK energy needs

Q. To what extent do you agree or disagree with the following statement?



Base: 1,749 UK adults aged 16+

Men are more likely than women to have an opinion on this issue, being more likely to disagree that the Government is working hard on plans for future fuel needs (37% disagree, compared with 29% of women). Women are more likely to be neutral (23%, versus 17% of men), or say they do not know (7% versus 3%). These gender differences are not however present among young adults aged 16-24.

[50] See, for example, the following news story on the BBC News website from 24 September 2014 about Ed Miliband's pledge to freeze energy prices: http://www.bbc.co.uk/news/uk-politics-24213366.

White people tend to have less faith in the Government on this issue than those from ethnic minorities (34% disagree, versus 24% of people from ethnic minorities).

People in Northern Ireland express greater confidence in UK Government action than those in the rest of the UK (62% agree, compared with 42% overall), while those in London are also more likely to agree than in the rest of the country (53% agree).

14.2 Awareness of emerging energy technologies

Public awareness of the three emerging energy technologies asked about in PAS 2014 varies greatly, as Figure 14.2 shows. The public are most familiar with offshore wind farms, with over nine-in-ten (95%) having at least heard of them and three-in-ten (29%) saying that they heard or read a great deal about them. This potentially reflects the fact that this is the most well-established of the three technologies, with the UK having been the world's largest producer of offshore wind energy since 2008.

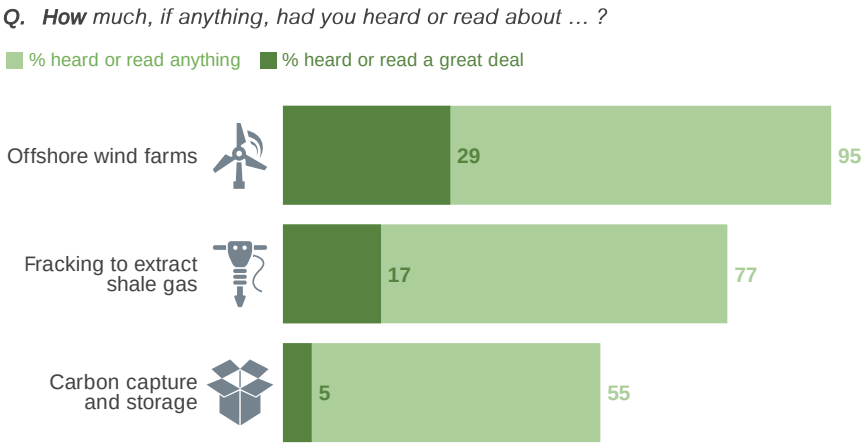
Awareness of fracking is lower. Around three-quarters (77%) have heard or read something about it, while under a fifth (17%) say they have heard or read a great deal. Nevertheless, in the context of other research, awareness has risen sharply within the last few years. While not directly comparable to the PAS 2014 findings (due to differences in question wording), the regular DECC *Public Attitudes Tracker* found in December 2013 that seven-in-ten (70%) had heard of fracking, compared with four-in-ten (42%) in July 2012.[51] Similarly, the regular University of Nottingham surveys on fracking (see O'Hara et al., 2014) have found that the number of people correctly linking fracking to shale gas has risen from four-in-ten (38%) in March 2012 to two-thirds (66%) in January 2014.

The rising awareness of fracking may reflect the increased media coverage of the topic in 2013. For example, there was a BBC Horizon programme on fracking in July 2013, and there has been significant media coverage of events such as the Balcombe anti-fracking protests (from July to August 2013).

Of the three technologies asked about, public awareness is lowest in relation to CCS, arguably the least developed of these emerging technologies. Just over half of the public (55%) have heard of CCS, while only five per cent say they know a great deal about it. Nonetheless, this does again suggest that awareness has increased over the last few years – while not directly comparable to PAS 2014 in question wording, *Special Eurobarometer 364* (European Commission, 2011b) found that just three-in-ten people in the UK (28%) had heard of CCS in 2011. It should be noted that this was generally in line with other EU countries, but well below knowledge in the Netherlands, where eight-in-ten (82%) had heard of CCS.

[51] Headline findings from the latest wave (Wave 8) of the DECC *Public Attitudes Tracker* are available on the gov.uk website, at: https://www.gov.uk/government/publications/public-attitudes-tracking-survey-wave-8.

Figure 14.2 – how much people have heard or read about emerging energy technologies



Base: 420 UK adults aged 16+

Awareness of all of these emerging energy technologies is higher among men than women. For example, four-in-ten men (40%) say that they have heard or read a great deal about offshore wind farms, compared with under two-in-ten women (16%).

Young adults aged 16-24 appear to have heard less about emerging energy technologies, particularly fracking (65% have heard of it, versus 77% overall).

There are some regional differences in awareness when it comes to fracking. Those from Yorkshire and Humberside (59%) and from Scotland (62%) are less likely than average (77%) to have heard or read about fracking before.

Finally, awareness of each of the three emerging energy technologies is also higher among broadsheet readers than among tabloid readers.

14.3 Opinions of emerging energy technologies

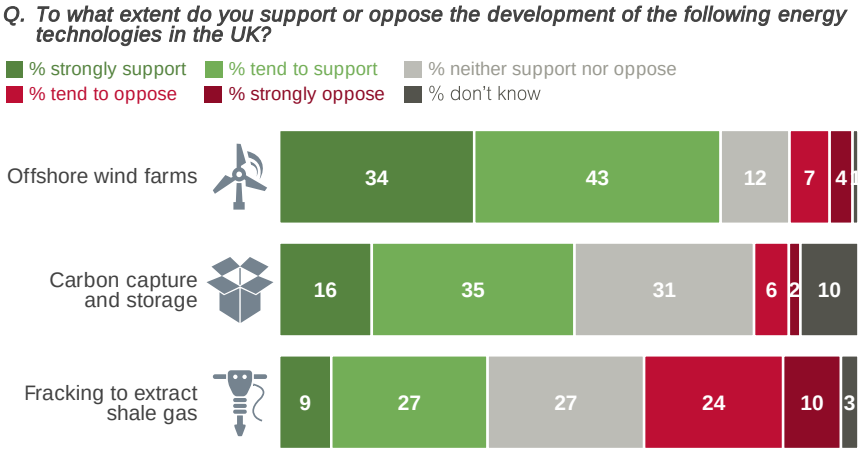
This section examines attitudes towards the three emerging energy technologies covered in the survey. These questions were asked of people who had heard or read at least something about the respective technologies.

Support for emerging energy technologies

As Figure 14.3 indicates, among those who have heard of each of the respective technologies, people are largely supportive of offshore wind farms (76% support their development), but less so when it comes to CCS (51%) or fracking (36%). Again, this may partly reflect that offshore wind is the more established of these technologies. For CCS, while support is lower, there is also little outright opposition – instead, two-fifths are either neutral (31%) or undecided (10%) on whether they support it or not.

A relatively large proportion (27%) are also neutral about fracking. However, in contrast to the other two technologies, this already seems to be more contentious – around one-in-three (36%) support its development, but a similar proportion (34%) oppose it.

Figure 14.3 – whether people support or oppose the development of emerging energy technologies



Bases: c.300+ adults who have heard of each topic area

Roughly equal proportions support and oppose the development of fracking to extract shale gas

Men are more supportive than women of fracking (42% versus 27%) and of CCS (57% versus 42%). However, they are somewhat more *opposed* to the development of offshore wind farms than women (14% versus 7%).

Once again, as was discussed in relation to other science topics in Chapter 2, there is *not necessarily* a simple relationship between being more informed about each of these technologies and being more supportive of them:

- Those who have heard or read a great deal about offshore wind are no more or less likely than others (who have heard about it, but not a great deal) to support its development. This perhaps reflects that it is widely seen as a "good" technology, even among those who do not know much about it.

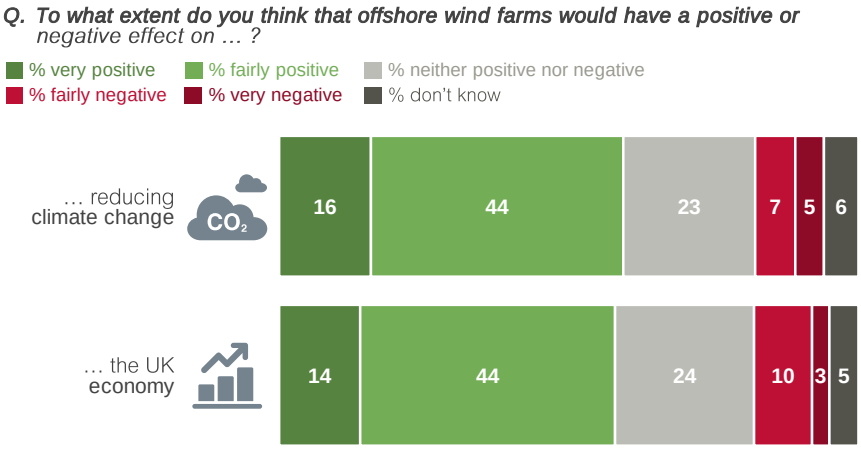
- While it is the case that people who have heard or read a great deal about fracking are more likely than others to support its development (53%, versus 36% overall), they are also no less likely to *oppose* it than others. This suggests that, as with many of the other science topics discussed in Chapter 2, more information does not necessarily change the views of those who are already opposed to it.

- Among those who have heard or read a great deal or a fair amount about CCS, two-thirds (66%, versus 51% overall) support its development, suggesting that in this case those who are more informed are typically more positive towards the technology.

The perceived impact of offshore wind farms

As can be seen in Figure 14.4, a majority think that the effects of offshore wind farms would be positive, in relation to both climate change (60%) and the UK economy (58%).

Figure 14.4 – perceived impact of offshore wind farms

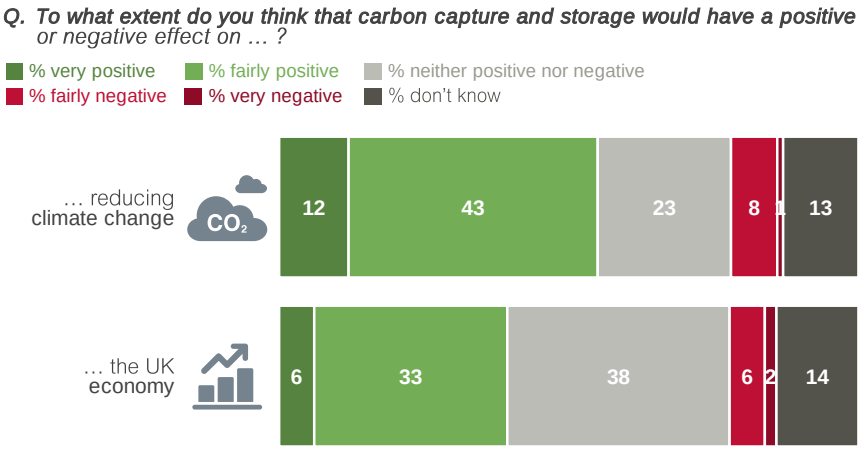


Base: 388 adults who have heard of offshore wind farms

The perceived impact of carbon capture and storage

On balance, people think the effects of CCS will be positive rather than negative, both with regards to climate change (55% positive, versus 9% negative) and the economy (39% versus 8%), as Figure 14.5 shows. A large proportion are either neutral (38%) or undecided (14%) in their opinion of its economic impact, again reflecting the relatively low awareness of this emerging technology. This was also an EU-wide finding of *Special Eurobarometer 364* (European Commission, 2011b), which noted that most EU citizens were unclear about the benefits of CCS.

Figure 14.5 – perceived impact of carbon capture and storage

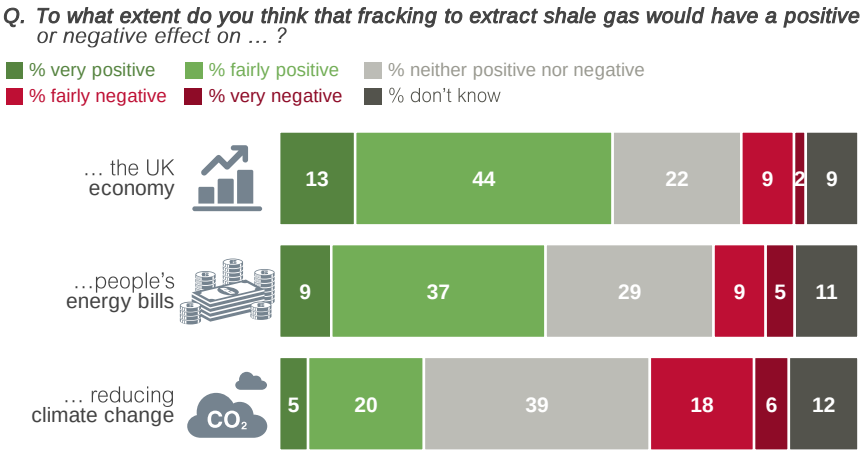


Base: 225 adults who have heard of carbon capture and storage

The perceived impact of fracking to extract shale gas

As can be seen in Figure 14.6, on balance the public expects fracking to have a positive effect on the UK economy (57% positive, versus 11% negative) and on energy bills (46% versus 14%). However, there is not a consensus view on these impacts, with relatively high proportions again neutral or unsure. There is even less of a consensus around the effects of fracking on climate change – people are just as likely to say that the effects would be positive (25%) as negative (24%), with around half either neutral (39%) or unable to give an answer (12%).

Figure 14.6 – perceived impact of fracking to extract shale gas



Base: 315 adults who have heard of fracking to extract shale gas

What do people see as the good and bad aspects of fracking to extract shale gas?

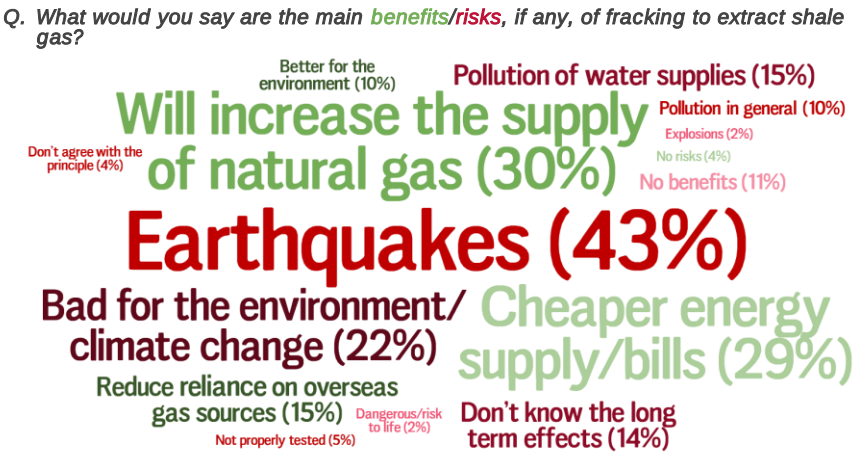
Those who have heard or read about fracking to extract shale gas before were asked unprompted what they consider the risks and benefits of this to be. Figure 14.7 shows people's responses in the form of a word cloud, where benefits are in green and risks are in red. As with similar questions elsewhere in the PAS 2014 survey, it should be remembered that these are people's *perceptions* of risks and benefits, and do not necessarily reflect the actual risks and benefits of fracking.

Overall, earthquakes stand out as the greatest perceived risk of fracking (mentioned by 43%). The next most commonly mentioned risk is the impact on climate change (22%), although as noted earlier in this section, much of the public are unsure about the effect fracking will have on the climate. Pollution is also a common theme. The regular University of Nottingham surveys (reported in O'Hara et al., 2014) suggest these have been ongoing concerns among the public since early 2012, though in those surveys slightly fewer now associate fracking with earthquakes than in March 2012.

In terms of benefits, people tend to focus on energy security and economic impacts. The most commonly mentioned benefits are an increased gas supply (30%) and cheaper energy supply or bills (29%). Another similar perceived benefit is a reduced reliance on overseas gas sources (15%). People are less likely to see environmental benefits to fracking, with only one-in-ten (10%) saying that it would be better for the environment. It is also

worth noting that around one-in-ten (11%) thinks there are no benefits to fracking whatsoever.

Figure 14.7 – perceived risks and benefits of fracking to extract shale gas



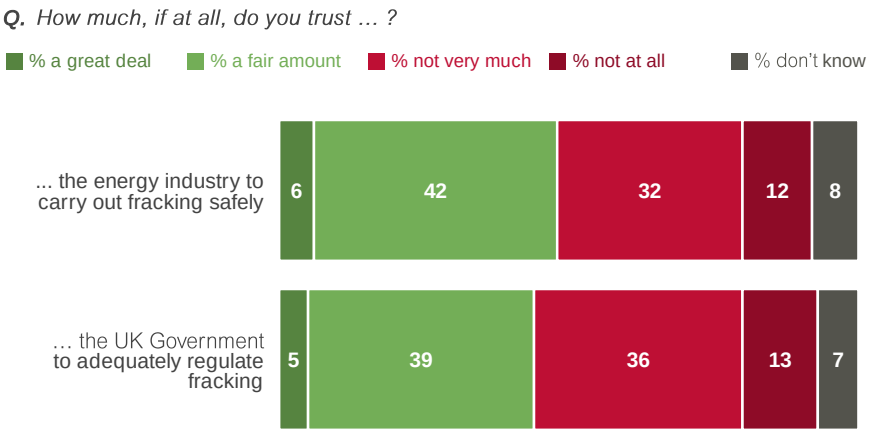
Base: 315 adults who have heard of fracking to extract shale gas
N.B. word clouds are illustrative of data, not statistically representative; only codes registering 2% or more are shown

People who have heard or read a great deal about fracking are more likely than others to mention the risks of pollution, both of water supplies specifically (31%, versus 15% overall) and in general (19%, versus 10% overall). This again highlights that, especially for a contentious issue like fracking, more information does not necessarily lead to more support, and may reinforce people's awareness or perceptions of potential risks.

Trust in the regulation of fracking

There is some uncertainty about the regulation of fracking. Those who have heard of it are divided on whether they can trust the UK Government to adequately regulate it (44% trust them a great deal or fair amount, versus 49% not trusting them very much or at all), and whether they can trust the energy industry to carry out fracking safely (48% versus 44%), as Figure 14.8 shows.

Figure 14.8 – confidence in fracking being well-regulated and done safely



Base: 315 adults who have heard of fracking to extract shale gas

Conclusions

Conclusions

What have we learnt about public attitudes?

PAS 2014 shows that the UK public are as enthusiastic about science as they ever have been, with attitudes to science having come a long way over the past 25 years. People today are generally more interested in science, more likely to think the benefits of science outweigh any harms, less likely to see a conflict between science and faith and more comfortable with the pace of change than they were in 1988.

Many of the findings reinforce those of the 2011 study and of other existing research:

- People see science as contributing to society not only through its economic impact, which they widely acknowledge, but also as part of UK culture, with many immersing themselves in science-related cultural activities just as they would with arts-related activities.

- The public continue to hold scientists in high regard, although there is still a sense that they can be secretive, and ultimately people still hold many misconceptions about how they go about their work.

- There are ongoing concerns about the speed of development, and whether government and regulators can ever truly keep scientists and the institutions they work for in check, but these are not increasing concerns (and over the long term, people have become *more* comfortable with the pace of change).

- Women and the less affluent continue to feel less engaged with science than others, and also feel less capable of engaging with it.

In addition, PAS 2014 provides a variety of new insights beyond what was observed in 2011:

- The long-term shift in public attitudes is not just due to individuals changing their views as they have got older. More often, it can be attributed to the emergence of a new younger generation, who in particular tend to be more at ease with the pace of change.

- This new generation tend to be more neutral in their attitudes to science. They are less likely to think that the benefits of science outweigh any harms, and are somewhat less positive about the economic contribution or government funding of science. At the same time, they are less critical of science reporting and seem less concerned about what scientists might do behind closed doors, or how they are funded.

- There is a low level of trust in mainstream science reporting, even though most people continue to get most of their information about

science through mainstream media. Nevertheless, it should be noted that some of the ideas the public has to improve science reporting, such as science blogs for laypeople, already exist and may benefit from being pushed to a wider audience.

While the survey findings are not directly comparable to other international research, the broad international comparisons that can be made suggest that the UK public tend to have the same hopes and concerns about science as people in other scientifically-developed countries, such as the US, Australia and countries in the EU. Religion also seems to play less of a role in UK attitudes than it does among the US public and other EU citizens. They also tend to be more engaged with science generally and feel better informed about it than other EU citizens.

Immediate lessons for policymakers and science communicators

Some of the insights from PAS 2014 are immediately relevant to those trying to engage the public with science or involve the public in decision-making today:

- Most people still find out about science most regularly from traditional media such as TV and print newspapers. This is the case both among younger and older adults, and while online sources are more prevalent among the younger generation, the importance of science communication on TV should not be underestimated. Even among those who do use online sources, people often turn to established organisations like BBC News.

- At the same time, *in the right contexts*, social media can be a very effective way of communicating important science messages. Messages that come from trusted and well-known voices, as well as stories with a humorous slant, visual appeal, or a public health element appear most likely to reach a wider social media audience. However, this will not always work – spreading science through social media seems to be much less effective when the topics being debated are already highly polarising or contentious.

- Women appear to play a particularly important role in informal science learning. People are more likely to go with their mother rather than their father to science-related leisure or cultural activities, and women themselves are more likely to take others with them rather than going alone. Tapping into this, for example via son and daughter trips to science-related activities, may be a particularly effective way of engaging women in science.

- While people place a great deal of trust in scientists generally, there is still scepticism about the independence of scientists. People tend to make assumptions about the intentions of scientists based on the institutions they work for. In turn, people often base their trust on the perceived intentions of scientists. Therefore, framing is important – a

"climate scientist" will be treated differently from a "university lecturer" or a "government expert". In addition, people want scientists to explain their intentions more, and want to know that scientists consider the social and ethical implications of their work.

- People are keen to hear more directly from scientists, but often want to focus on the results of scientists' work, rather than how they go about their work. At the same time, there are ongoing misconceptions about the peer review process and how scientists consider the risks of their work, which might be lessened if people knew more about how scientists work. Therefore, a challenge for science communicators lies in getting this information across while keeping their audience engaged.

- Those seeking to involve the public in decision-making face another challenge in that the groups that most want the public to be listened to are among the least likely to want to be involved themselves. This includes women and the less affluent, who tend to feel less capable of understanding science and technology. Public consultations and public dialogues therefore need to ensure that the views of those who feel less confident are not overlooked.

What could be explored further?

The findings also highlight further questions and challenges that, while outside of the scope of this research, might be explored in future research:

- While generic trust in scientists and engineers appears to have increased, regardless of the institutions they work for, the proportion who feel they have no option but to trust those governing science has also increased, which suggests this increasing trust may also be an *increasingly resigned* trust. Further research might look at why some people feel they have no option but to trust, and whether this attitude makes them less engaged with science.

- The findings suggest there are various received wisdoms about science that are not necessarily based on people's knowledge and understanding. Examples include the idea that scientists follow rules and regulations, that they consider the risks of their work and that science contributes to the economy. Future research might explore whether there are more received wisdoms and whether this has any negative implications.

- While social listening is able to track those who actively use social media, it cannot account for passive users, e.g. people who have Twitter accounts but only follow others rather than tweet or retweet. Further research could explore the passive use of social media and how this brings people into contact with science.

- In the qualitative research, many participants raised the idea of trusted scientific organisations, or organisations that represented scientists.

New research might examine what kinds of organisations people are thinking of here, and whether the public thinks there are any other authoritative voices or personalities in science.

What can we learn from the study methodology?

Those who are interested in researching public attitudes can also draw lessons from how PAS 2014 was conducted. In many ways, the 2014 study represents a departure from previous studies in the series, with a revised sampling approach and questionnaire design for the main survey, and new and innovative methodologies used in the qualitative research strands.

- The move from quota sampling to a probability sampling approach for the main survey makes this one of the most robust studies of UK attitudes to science ever conducted, and gives further credibility to the findings. As noted in Chapter 1, the lack of change on most indicators since 2011 gives some reassurance that comparisons to earlier studies are valid and also helps to reinforce the validity of the earlier studies themselves.

- The 2014 questionnaire included a core section plus four split-sample modules asking questions about the four specific science topics chosen for further exploration. The modular design did not necessarily allow for an in-depth look at each topic, and indeed was not intended for this. However, it does provide a way of collecting initial data on emerging science-related issues, to pave the way for future research into these areas. Having these modules within the PAS survey, rather than as ad hoc surveys, has also meant they can be analysed using the PAS segmentation.

- The Day of Discovery workshop worked well both as research and as a way of engaging the public with science in itself, proving that science communicators can use the findings from PAS 2014 to help engage their audiences, and find out what they think and want to know. Following the publication of this report, Ipsos MORI will be releasing a toolkit to help science communicators hold their own Day of Discovery events.

Appendices

Appendix A: list of steering group members

The following table lists members of the PAS 2014 steering group (in alphabetical order) and their respective institutions. The steering group was chaired by Karen Folkes from the Department for Business, Innovation and Skills (BIS).

Member	Institution
Professor Nick Allum	Essex University
Professor Martin Bauer	London School of Economics (LSE)
Dr Jenni Chambers	Research Councils UK (RCUK)
Ben Dipper	Office of Chief Scientific Adviser, Scottish Government
Dr Rosa Fernandez	BIS
Karen Folkes	BIS
Sir Roland Jackson	Sciencewise Expert Resource Centre
Melanie Knetsch	Economic and Social Research Council (ESRC)
Dr Hilary Leevers	Wellcome Trust
Ursa Mali	Centre for Science and Policy, University of Cambridge
Lesley Miles	The Royal Society
Nicola Partridge	Association of the British Pharmaceutical Industry (ABPI)
Dr Lesley Paterson	Royal Academy of Engineering (RAEng)
Neil Randerson	EngineeringUK
Kerry Seelhoff	BIS
Fran Spawls	Office for Life Sciences
Dr Edward Sykes	Science Media Centre
Gareth Thistleton	Shell
Joanne Ward	Office of Chief Scientific Adviser, Scottish Government
Ruth Williams	Research Councils UK (RCUK)

Appendix B: guide to statistical reliability

This appendix is intended only to provide a brief guide on the margins of error that apply to the PAS 2014 survey findings included in this report. For full technical details of the survey, readers should refer to the separate Technical Report.[52]

The final data are based on a sample of UK adults, rather than the entire population, so the percentage results are subject to sampling tolerances. As the following table shows, the tolerances that apply for PAS 2014 vary with the size of the sample and the percentage figure concerned. For example, for a question where 50% of all the adults sampled in the main survey give a particular answer, the chances are 95 in 100 that this result would not vary more or less than 2.6 percentage points from the true figure – the figure that would have been obtained had the entire population responded to the survey.[53]

Base	Effective sample size	Sampling tolerances applicable to percentages at or near these levels		
		10% or 90%	30% or 70%	50%
All adults	1,379	±1.6	±2.4	±2.6
All 16-24 year-olds	385	±3.0	±4.6	±5.0

Source: Ipsos MORI

[52] This available on the Ipsos MORI website, at: http://www.ipsos-mori.com/pas2014.
[53] These sampling tolerances take into account the design effects of clustering and weighting of the samples, hence the effective sample sizes are lower than the actual sample sizes.

Sampling tolerances must also be considered when comparing results between different subgroups, or between PAS 2014 and other comparable surveys. A difference must be of at least a certain size to be statistically significant. The following table is a guide to the sampling tolerances applicable to comparisons between subgroups and between PAS studies.

Bases	Effective sample sizes	Differences required for significance on percentages at or near these levels		
		10% or 90%	30% or 70%	50%
2014 versus 2011 all adults	1,379 versus 1,894	±2.1	±3.2	±3.5
All adults versus 16-24 year olds	1,379 versus 385	±3.1	±5.0	±5.7
Women versus men	724 versus 656	±3.0	±4.8	±5.3
White people versus ethnic minorities	1,235 versus 146	±4.2	±7.3	±8.5

Source: Ipsos MORI

It is important to note that, strictly speaking, these confidence interval calculations relate only to samples that have been selected using probability sampling methods. While this applies to the PAS 2014 main sample, it does not apply to the 2014 booster survey of 16-24 year-olds or to the 2011 survey, which both used quota sampling approaches. However, in practice it is reasonable to assume that these calculations provide a good indication of the confidence intervals relating to high-quality quota samples as well.

Appendix C: definitions of social grades

People in the PAS 2014 surveys have been assigned social grades based on the occupation of the chief income earner in their household. This was used instead of the National Statistics Socio-economic Classification as a proxy for affluence. The follow table lists the social grade definitions.

Social grade	Definition
A	Higher managerial, administrative or professional
B	Intermediate managerial, administrative or professional
C1	Supervisory or clerical and junior managerial, administrative or professional
C2	Skilled manual workers
D	Semi and unskilled manual workers
E	Casual or lowest grade workers, pensioners, and others who depend on the welfare state for their income, which includes students

Source: National Readership Survey

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