The culture of scientific research 2014

Analysis of responses to an online survey

October 2014

Prepared for the Nuffield Council on Bioethics

NUFFIELD COUNCIL ON BIOETHICS

Prepared by

Research by Design Ltd
White House ♦ 111 New Street ♦ Birmingham ♦ B2 4EU
Tel: 0121 643 9090 ♦ Email: info@researchbydesign.co.uk
http://www.researchbydesign.co.uk

rbd Research by Design

Contents

Section 1: Executive summary

1.1 Demographic profile of respondents

- Over half of those taking part in the survey specialise in the biosciences (56%), whilst around a quarter specialise in medicine (27%).

- Eight in ten respondents work in a university setting, with a further fourteen percent working for a research institution.

- The vast majority of those responding to the survey have a researcher role (81%) with three in ten working as post-doctoral researchers and around one in ten working as researcher/ lecturers (14%), senior researcher/lecturers (14%) and professors (11%)

- Around two thirds of respondents are aged 26 to 45 (64%). Fifty six percent of the overall sample is made up of females. Over three quarters of respondents who stated their nationality are British (78%).

- Almost two thirds of respondents heard about the survey through email correspondence (62%), while a further fourteen percent became aware of it via Twitter.

1.2 Motivational aspects of being a scientist

- For over a third of respondents (35%) making scientific discoveries for the benefit of society is the main motivator for becoming a scientist. This is closely followed by those who state 'improving my knowledge and understanding' as their main motivation (29%).

- Gaining recognition from the public, working as a team, gaining recognition from peers, and training the next generation of scientists are seen as the least motivating factors.

1.3 Perceptions of 'high quality research'

- Rigorous is used by the vast majority of respondents (89%) to describe their understanding of high quality research. Accurate (71%), original (64%), honest (61%) and transparent (59%) make up the top five.

- Legal (9%), respectful (5%) and reproducible (1%) are the least used words to describe high quality science.

1.4 Effects of the UK research environment on scientists in terms of encouraging the production of high quality research

- There is a mixed response towards the Research Excellence Framework's (REF) effect on scientists in terms of encouraging the production of high quality science. Around a quarter of

respondents (26%) believe it is having a positive or very positive effect overall, whilst around four in ten (38%) disagree, and believe it is having a negative or very negative effect.

- Over a half of respondents believe the way funding for specific projects and programmes is awarded is having a negative or very negative effect. Conversely, one quarter feel it is having a positive or very positive effect.

- Over four in ten of those taking part in the survey (41%) feel the way multidisciplinary & collaborative research is supported is having a positive or very positive effect. However, around a quarter disagree and believe it is having a negative or very negative effect.

- Open access publishing is perceived by almost two thirds of respondents' as having a positive or very positive effect, while around a quarter feel it is having no effect (23%). Only a small minority (7%) of those taking part in the survey believe open access publishing is having a negative or very negative effect overall.

- There is a positive perception of the peer review process with the majority of respondents (71%) citing it as having a positive or very positive effect. Conversely, around one in ten feel it is having a negative or very negative effect.

- There is a mixed response to media coverage of science, with equal proportions of respondents (33%) believing it is having a positive or negative effect. Over a quarter (27%) feel it is having no effect.

- Over a half of respondents state the way scientists are assessed for promotions during their careers is having a negative or very negative effect, whilst only a fifth of respondents believe it is having a positive effect.

- Around a half of those taking part in the survey feel the provision of professional education, training and supervision is having a positive or very positive effect. Around a quarter (23%) state it is having no effect, whilst around a fifth (19%) believe it is having a negative or very negative effect.

- Around four in ten cite the commercialisation of research as having a negative or very negative effect. Only a fifth believe it is having a positive or very positive effect.

- Over a half of respondents (53%) feel the ethical review process is having a positive or very positive effect. Only one in ten (13%) believe it is having a negative or very negative effect.

- Around a third of respondents believe research governance and contractual processes are having a negative or very negative effect (31%), whilst a quarter (24%) cite a positive or very positive effect.

- Six in ten respondents cite initiatives that promote integrity in science as having a positive or very positive effect. A quarter feel they are having no effect and only three percent believe they are having a negative effect.

- Almost two thirds of those taking part in the survey state that data sharing policies are having a positive or very positive effect (63%), whilst only five percent feel it is having a negative or very negative effect.

1.5 Effects encouraging high quality science

- Respondents comment that increased collaboration, access to funding, open access publishing and the peer review process are having the most positive effect on scientists in terms of encouraging high quality science.

- Respondents suggest the positive effects are related to research transparency and data sharing, variety in research and the freedom to investigate interesting areas, as well as access to financial resources and increased support for interdisciplinary collaboration.

- In terms of negative effects on scientists, the pressure of the REF to be the first to publish, a lack of structured career progression, and the way scientists are assessed are mentioned by respondents.

- These negative issues result in a short termism culture, problems securing funding, losing talent to the commercial sector and increased pressures to meet publishing metrics.

1.6 Effect of competition

- Respondents' views on the effects competition is having on the production of high quality science is polarised, with similar proportions stating it is having a positive effect (37%) and negative effect overall (35%).

- Respondents comment that whilst competition can promote higher quality research, it can also result in the research being rushed and it being less collaborative.

- The majority of respondents consider applying for funding (94%) or jobs and promotions (77%) as the most competitive aspects of being a scientific researcher. Gaining public recognition is seen as the least competitive aspect.

1.7 Compromising on research integrity and standards

- Almost six in ten (58%) respondents are aware of scientists feeling under pressure to compromise on research integrity and standards, with poor methodology and data fraud frequently mentioned in the free text responses.

- Just over a quarter (26%) of those taking part in the survey have felt tempted to compromise on research integrity.

1.8 Changing the UK research environment to facilitate high quality research

- In order to encourage the production of high quality science in the UK respondents would like to change the way research is funded, with a desire for cross-disciplinary funding to be made available.

- Career structure and progression, as well as the metrics used to evaluate research findings are also cited as an area for change.

Section 2: Introduction

2.1. Survey background & objectives

Scientific research is increasingly professional, interdisciplinary, multi-institutional, globally competitive and technologically advanced. This presents exciting opportunities for further scientific understanding, but some elements of current research culture may be undermining efforts to maintain ethical conduct in science and produce high quality, valuable, accessible research.

The Nuffield Council on Bioethics co-ordinated a project to gather evidence and facilitate debate of these issues throughout 2014. This project was led by a Steering Group that includes representatives of key organisations within the UK science community, including the Royal Society, Society of Biology, Institute of Physics, Royal Society of Chemistry and Academy of Medical Sciences.

The aims of the project were:

- To foster constructive debate among all those involved in scientific research about the culture of research in the UK and its effect on ethical conduct in science and the quality, value and accessibility of research.
- To advance current debate through wide dissemination of the outcomes of these discussions.

The project activities included an online survey, the results of which are presented in this report, a series of discussion events at research institutions around the UK, and evidence-gathering meetings with stakeholders such as publishers and funders of research. The findings of all the activities will be published towards the end of 2014.

The aim of the survey was:

- To gather views and evidence from scientists and others involved in scientific research on how the different features of the research environment are affecting, both positively and negatively, the work and behaviour of all kinds of UK scientists at different stages of their careers.

To find out more about the wider project visit: www.nuffieldbioethics.org/research-culture

2.2. Research methodology

2.2.1. Online survey

The Nuffield Council on Bioethics created and hosted an online survey on the culture of scientific research using the Survey Monkey tool. The online survey was launched on 27 March 2014 and ran until 31 July 2014.

The survey consisted of 26 questions, starting with multiple choice demographic questions, and moving on to rating and free text questions, which asked respondents to provide their views on various aspects of the research environment.

In total 970 people completed the survey. Details of the demographics of those completing the survey are provided in section 3.

2.2.2. Promotion of the survey

The survey was disseminated through a variety of the Council's networks, including emailing Council members and other contacts and incorporating information in fortnightly bulletins and bimonthly newsletters. The survey was also promoted through the Council's website and social media channels such as Twitter and Facebook and the Council's blog. The promotion activities were largely aimed at scientists working in the UK, although an article about the project and survey appeared in EuroScientist in May 2014.

The members of the project Steering Group also assisted with the promotion of the survey, using the networks and contacts of the Royal Society, Institute of Physics, Society of Biology, Royal Society of Chemistry and Academy of Medical Sciences.

A series of events at research institutions around the UK facilitated debate as part of the wider project and were also used to encourage people to complete the survey.

2.3. Analysis and reporting

2.3.1. Tables and charts

The output from the survey is in the form of conventional cross-tabulations. These provide results for the total sample and various sub-groups (e.g. subject specialty, organisation, job title, age, gender and nationality). Where statistically significant differences between sub-groups exist, details have been included within this report.

In the tables, figures shown in the green box indicate that the value is significantly higher than the figures in the red box within the same section and row. Using the table below as an example, significantly more female respondents (green shading) state the way multidisciplinary & collaborative research is supported is having a 'positive effect overall', versus male respondents (red shading). Also, the table shows significantly more respondents aged 35 to 45 (green shading) cite the way multidisciplinary & collaborative research is supported is having a 'positive effect overall' on research in the UK, in comparison with respondents aged over 45 (red shading).

How multidisciplinary & collaborative research is supported	**Total**	Male	Female	Under 35	35-45	Over 45
Very Positive effect overall	**4%**	3%	5%	6%	3%	3%
Positive effect overall	**37%**	29%	41%	38%	40%	29%
Base:	***772***	*272*	*362*	*259*	*198*	*182*

Within the main body of the report, figures of 3% or less are not shown in the charts and percentages that do not sum to 100% are due to rounding or more than one answer being given.

The 'base' figure referred to in each chart and table is the total number of people responding to the question.

Text in blue italics refer to *examples of comments from respondents*.

2.3.2. Sampling

By their very nature, surveys typically represent the views of a sample of a population. In this case, the sample is respondents to the questionnaire, and the population is all UK scientists. If we were able to survey all UK scientists, then responses to the questionnaire would give us 'true' population values. However, because these results are based on a sample of UK scientists, we need to know how well the estimates in the sample match those we would expect to find in the population.

2.3.3. Confidence intervals

In order to increase confidence in sample estimates, and their relationship to 'true' values in the population, we can calculate a confidence interval. A confidence interval provides us with a range of values within which the true population estimate is likely to lie. Commonly, market research studies use a 95% confidence level, which means that we can be 95% confident that the true value of the population, as estimated from the sample data, lies within the confidence interval. The 95% confidence that we have

in the accuracy of the interval is referred to as the confidence level i.e. we are 95% confident that the true population value is within the confidence interval.

For example, this survey shows that 89% of those completing the survey use 'rigorous' to describe their understanding of 'high quality research'. However, due to intrinsic characteristics of sampling, we convert this 89% estimate to a confidence interval. We calculate the 95% confidence interval as the sample estimate ± 2.2%. Hence, we are 95% certain that the 'true' population value lies between 86.8% and 91.2%.

2.3.4. Statistical significance

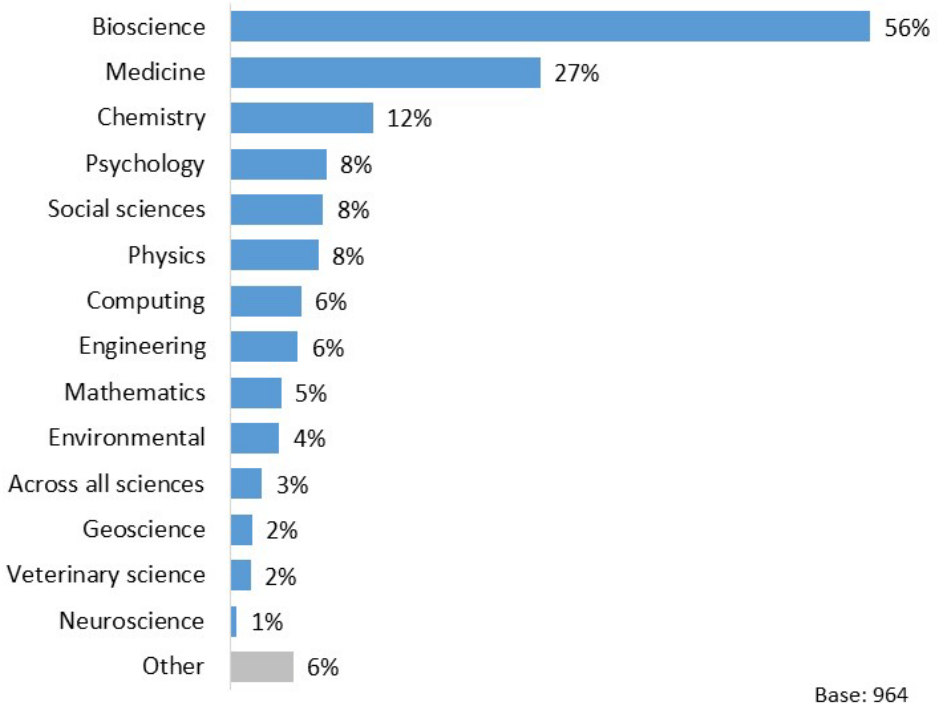
When comparing the results from different sub-groups within the sample, say those who are a PhD student and those who are a Professor, the results are tested for statistical significance. Statistical significance refers to whether a result that we obtain is a 'true' result, or whether it was caused by sampling error. Thus, we are interested in whether observed differences between sub-groups in our sample are true, i.e. we would expect to find the same differences present in the total population. In keeping with our 95% confidence from earlier, when we obtain a significant result we are 95% confident that the differences observed between sub-groups in the sample would also be present in the total population. Alternatively, there is only a 5% chance that any differences we observe between sub-groups in the sample are a result of sampling error.

Formally, statistical significance involves testing a null and an alternative hypothesis. When comparing results between sub-groups, the null hypothesis would state that there is no difference between the estimates provided by the sub-groups. The alternative hypothesis would state that there is a difference between the estimates provided by different sub-groups. A significant result means that we can reject the null hypothesis and accept the alternative hypothesis i.e. there is a difference between the estimates provided by different sub-groups. A non-significant result means that we cannot reject the null hypothesis i.e. there is no difference in the estimates provided by the different sub-groups.

Section 3: Demographics

Q1. What area(s) of science do you work in, if relevant? You can tick more than one answer *(Sample base: 964)*

Over half of those taking part in the survey work in bioscience (56%) and around one quarter medicine (27%). Around 1 in 10 work in chemistry (12%), psychology (8%), social sciences (8%) and physics (8%).

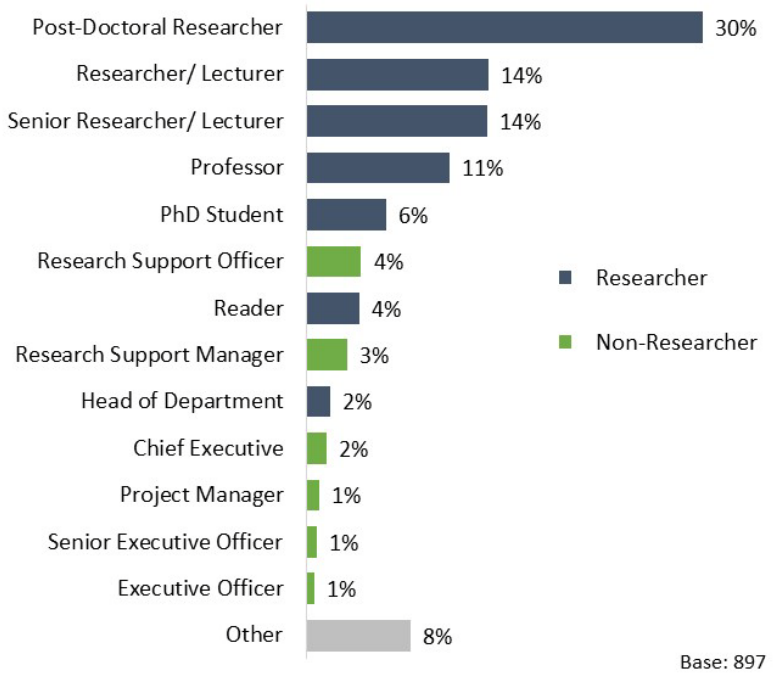


Q2. What type of organisation do you work for, if relevant? You can tick more than one answer *(Sample base: 947)*

The vast majority of respondents work for a University (80%), whilst just over 1 in 10 work in a research institution (14%). Those working in all other types of organisations make up a small proportion of the total.

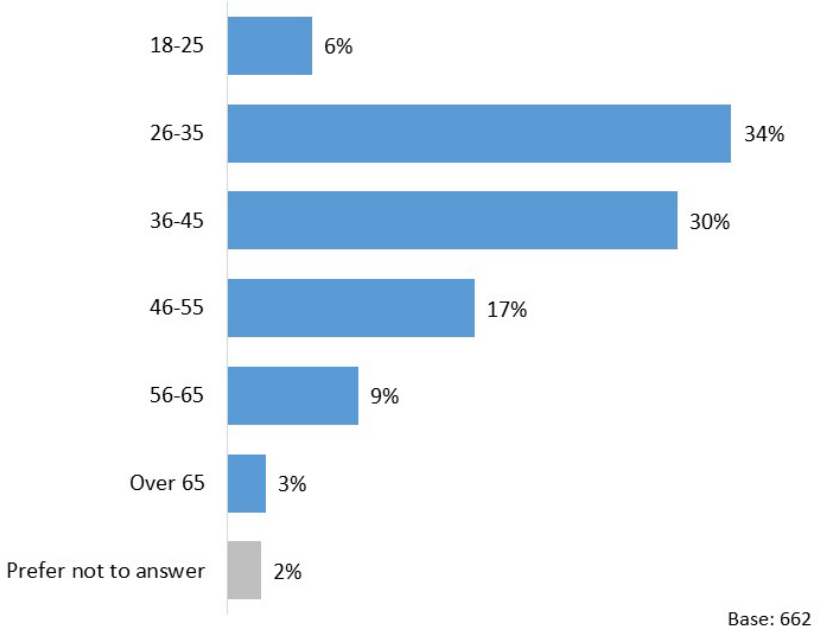
Q3. Which of the following most closely matches your job title? *(Sample base: 897)*

The vast majority of those taking part in the study have a researcher role, with 3 in 10 working as post-doctoral researchers. Around 1 in 10 work as a researcher/ lecturer (14%), senior researcher/ lecturer (14%) or professor (11%). Those without a research background make up a small minority of the total sample, with research support officers, research support managers, chief executives, project managers, senior executive officers and executive officers collectively accounting for only 12 per cent.

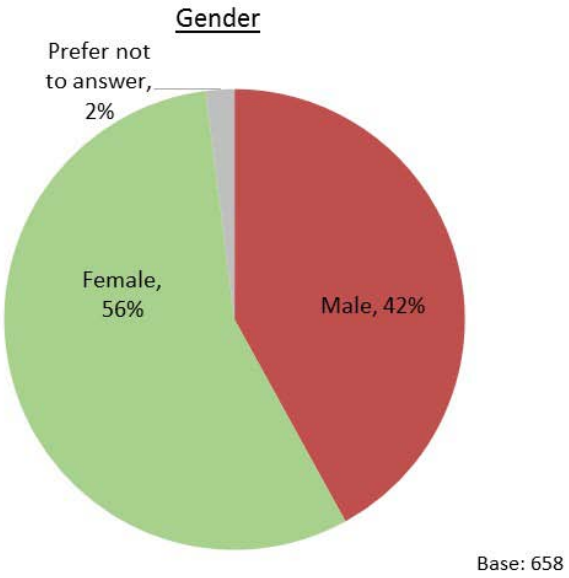


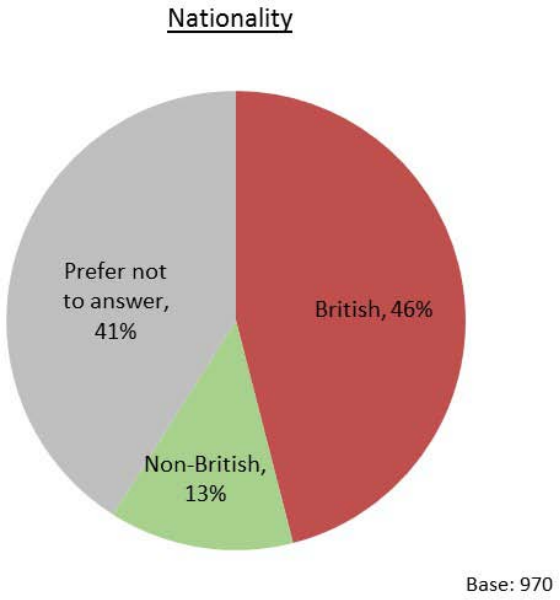
Q20. How old are you? *(Sample base: 662)*
Q19. What is your gender? *(Sample base: 658)*
Q21. What is your nationality? *(Sample base 970)*

Of those taking part in the survey, the majority are aged 26 to 45 (64%), around three in ten are aged 45 or over (29%).



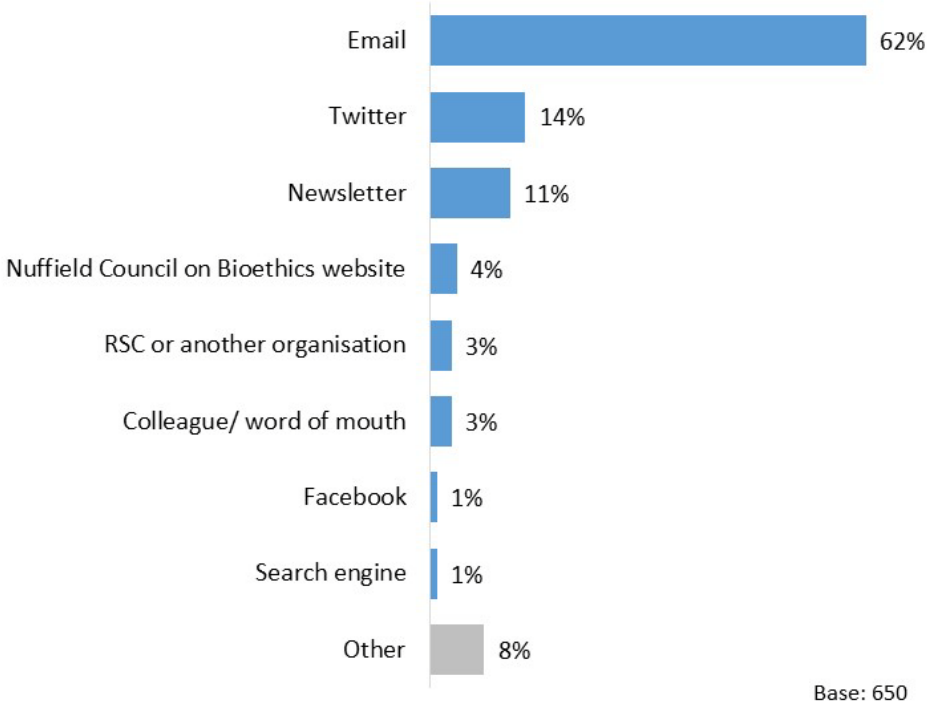
Slightly more females took part in the study than males (56% vs. 42%). The majority of those who stated their nationality were British (78%).





Q25. How did you hear about the survey? *(Sample base: 650)*

The majority of respondents became aware of the survey through email correspondence, with six in ten hearing about the survey through this method. Twitter and newsletters also proved to be useful for gaining the attention of respondents, with over 1 in 10 hearing about the survey through these methods. However, Facebook and generic search engine results did not prove to be as fruitful with only two per cent of respondents hearing about the survey through these channels.



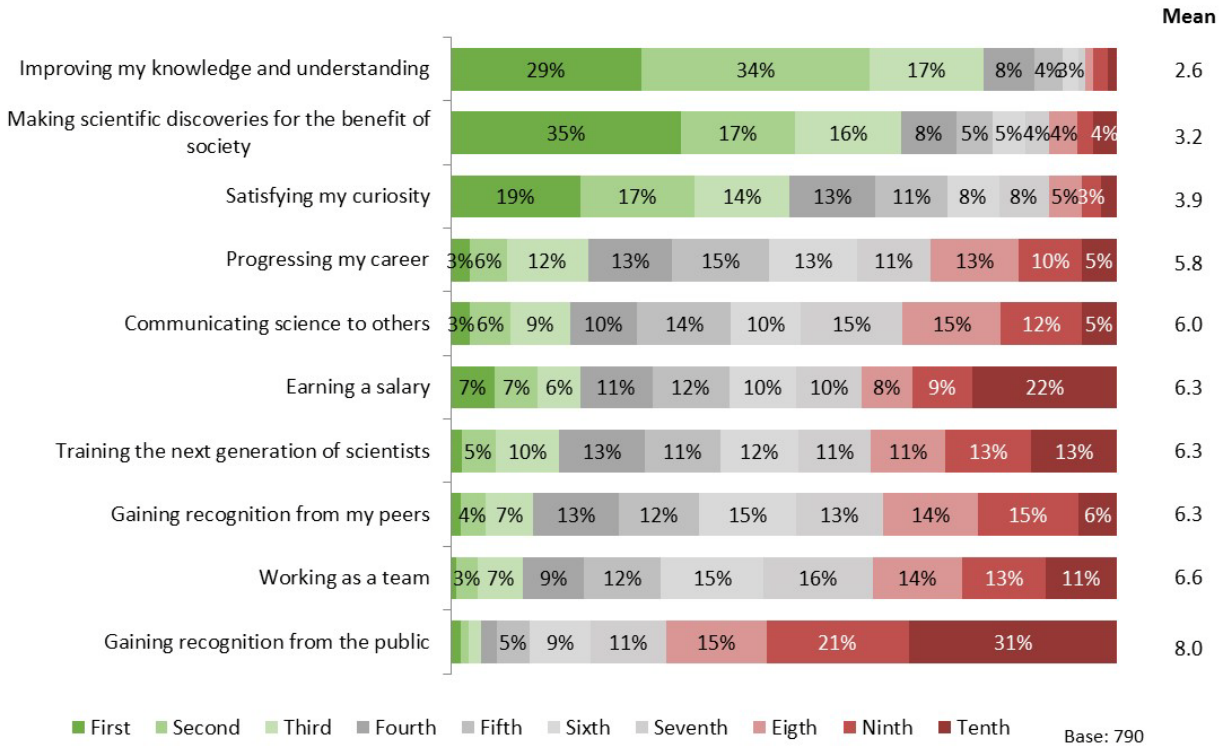
Section 4: Research findings

4.1. Motivational aspects of being a scientist

Q4. What motivates you in your work as a scientist? *(Sample base: 790)*

'Improving knowledge and understanding', and 'making scientific discoveries for the benefit of society' are the main motivations for respondents. Gaining recognition from peers and the public as well as working as a team are seen to be the least motivational aspects for respondents.

Over a third of respondents (35%) answering this question cite 'making scientific discoveries for the benefit of society' as their main motivation, whilst 29% of respondents state 'improving knowledge and understanding' as their main motivator. When considering the mean ranking, 'improving knowledge and understanding' comes out first with a greater mean ranking of 2.6, followed by 'making scientific discoveries for the benefit of society' (3.2). The mean score for 'improving my knowledge and understanding' is greater due to the combined response ranking it first, second and third.



Amongst different subject specialties; almost half (47%) of those working within the field of medicine cite 'making scientific discoveries for the benefit of society' as their main motivation. This is significantly higher than those who work within the bioscience (34%), computing (27%), engineering (23%), chemistry (22%) and physics (16%) areas. 'Satisfying my curiosity' is significantly higher amongst respondents working within the computing (31%), physics (30%) and biosciences (24%) areas than those within medicine (15%).

Proportionately, more professors (39%) select 'improving my knowledge and understanding' as their main motivation, compared with senior researchers/lecturers (21%). Conversely, significantly more senior researchers/lecturers (9%) than professors (1%) cite 'earning a salary' as their main motivation first.

When comparing all research staff to all non-research staff, a higher proportion of those working in research state 'satisfying my curiosity' as their main motivation (21% vs 11% non-researchers). Whilst significantly more non-researchers say 'earning a salary' (14% vs. 5% researchers) and 'communicating science to others' (7% vs. 2%) are their main motivators.

When considering the age of respondents, broadly there is very little difference in their motivations. However, significantly more of those over 45 state 'earning a salary' (9% vs. 4%) and 'training the next generation of scientists' as their main motivator (4% vs. 0%), in comparison to those under 35.

Female respondents are more likely to quote 'making scientific discoveries for the benefit of society' as their main motivation (40% female vs. 31% male), whilst male respondents are more likely to refer to 'satisfying my curiosity' as their main motivation (27% male vs. 15% female).

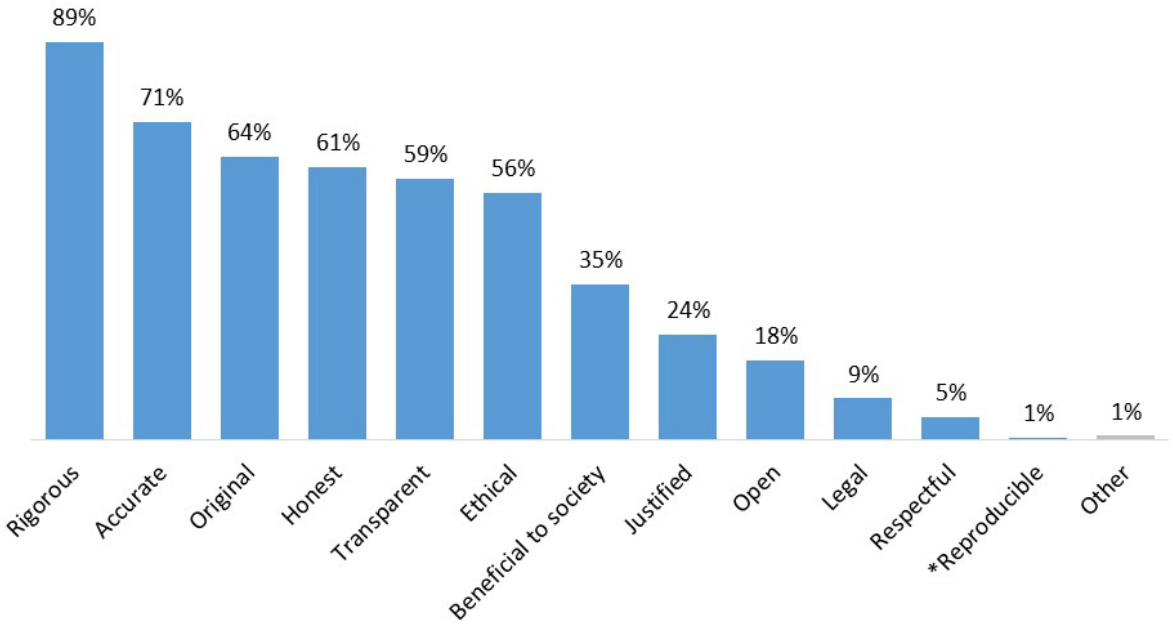
Proportionately more non-British respondents (34%) are likely to cite 'improving my knowledge and understanding' as their main motivation for their work versus British respondents (24%).

No significant differences are evident between respondents working for different kinds of organisations.

4.2. Perceptions of 'high quality research'

Q5. Please select five words from the list below that best describe your understanding of 'high quality research' *(Sample base: 777)*

Almost 9 in 10 respondents use 'rigorous' as a word to describe their understanding of high quality research. Other words making up the top five are; accurate (71%), original (64%), honest (61%) and transparent (59%). Legal, respectful and reproducible are the least frequently selected words by respondents.



*Words not included in pre-coded list, mentioned spontaneously by respondents Base: 777

The table below outlines the top five most frequently selected words amongst the different specialist areas. Those within the bioscience, physics and chemistry areas use the same words, in the same order of popularity. Respondents within the medical, engineering, psychology and computing fields are more likely to include ethical in their top five. For those working in the social sciences, 'beneficial to society' is also used to describe high quality research.

Overall	Bioscience	Physics	Chemistry
Rigorous	Rigorous	Rigorous	Rigorous
Accurate	Accurate	Accurate	Accurate
Original	Original	Original	Original
Honest	Honest	Honest	Honest
Transparent	Transparent	Transparent	Transparent
(777)	*(424)*	*(62)*	*(94)*

Overall	Psychology	Engineering	Medicine	Computing	Social Sciences
Rigorous	Rigorous	Rigorous	Rigorous	Rigorous	Rigorous
Accurate	Accurate	Original	Ethical	Accurate	Ethical
Original	Original	Accurate	Accurate	Original	Beneficial to society
Honest	Ethical	Honest	Original	Honest	Original
Transparent	Transparent	Ethical	Honest/ Transparent	Ethical	Transparent
(777)	*(65)*	*(53)*	*(214)*	*(48*)*	*(64)*

*Caution, base below 50

Male respondents use the same top 5 words, in the same order as the total sample, while female respondents are less likely to use honest, and more likely to cite ethical.

The table below shows the top five words used by respondents in different roles to describe their understanding of high quality research. Post-doctoral researchers, senior researcher/lecturers and PhD students cite the same words as the overall top five but in slightly differing orders, whilst researcher/ lecturers and professors select ethical in their top five instead of transparent.

Overall	Post-Doctoral Researcher	Senior Researcher/ Lecturer	PhD Student	Researcher/ Lecturer	Professor
Rigorous	Rigorous	Rigorous	Rigorous	Rigorous	Rigorous
Accurate	Accurate	Accurate	Accurate	Accurate	Original
Original	Original	Original	Transparent	Original	Honest
Honest	Transparent	Honest	Original	Honest	Accurate
Transparent	Honest	Transparent	Ethical	Ethical	Ethical
(777)	*(228)*	*(116)*	*(46*)*	*(109)*	*(88)*

*Caution, base below 50

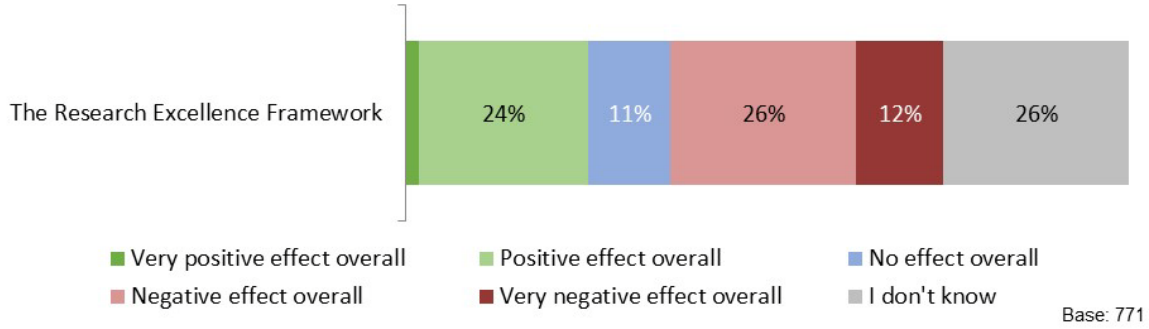
Researchers who responded prefer to use original as one of their top five descriptors whilst the non-researchers who responded would rather include ethical. This is alongside the other four descriptors cited among all respondents.

4.3. Effects on production of high quality research

4.3.1. The Research Excellence Framework

Q6a. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? The Research Excellence Framework *(Sample base: 771)*

One quarter of respondents believe the Research Excellence Framework (REF) is having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality science (25%), however almost 4 in 10 (38%) disagree and believe the REF is having a negative or very negative impact. Around a quarter did not know what effect REF was having on the UK research environment (26%), this tended to be PhD students (49%) and post-doctoral researchers (33%), rather than researcher/ lecturers (20%), senior researcher/ lecturers (11%) and professors (10%). A significantly higher proportion of female respondents are not sure compared with male respondents (29% vs. 18%).



A significantly greater proportion of respondents within the medicine field (28%) believe the REF is having a positive effect overall than those within bioscience (21%). Also, significantly more respondents within psychology (49%) and physics (48%) believe the REF is having a negative or very negative effect overall compared with those within the chemistry specialty area (29%).

When considering the organisation within which respondents carry out their research, a higher proportion of those in a university (42%) believe the REF is having a negative or very negative effect overall, versus those based in a research institution (25%).

With regards to gender, a significantly higher proportion of male respondents feel the REF is having a positive or very positive effect overall (28% male vs. 21% female).

More professors and researcher/lecturers (both 30%) believe the REF is having a positive effect overall, compared with post-doctoral researchers (19%) and senior researchers/ lecturers (17%). When comparing all research staff with all non-research staff, proportionately more researchers feel the REF is having a negative or very negative effect overall (41% vs. 24% non-research staff).

More of the older respondents feel the REF is having a negative or very negative effect on the UK science environment (36 to 45, 44% and over 45, 46%, compared with under 35's, 34%).

More British respondents feel the REF is having a negative or very negative effect compared with non-British respondents (45% vs. 33% non-British).

Of the 771 respondents answering this question, 56 provide additional comments relating to the REF. Of those, 48 comment that the REF has a negative impact on the production of high quality science. Amongst those, it is said to create a "publish or perish" culture, and results in scientists being assessed on the basis of metrics that, in the view of some respondents, do not always correlate with high quality science. There is a perception that the REF is singled out for rewarding scientists who publish in more prestigious journals (Nature and Cell are mentioned most often), with widespread recognition that the option of publishing in one of these journals is not available to every research project.

Those leaving positive comments point to the necessity of research assessment exercises and the effect of the REF on focusing the minds of researchers on the impact of their research.

Of the respondents who left comments, those aged 36 to 45 (20 comments) are more likely to feel negatively about the REF, compared to those under 35 and over 45 (11 comments each). Those within the 36 to 45 age group describe the REF as "a hoop-jumping exercise", "a waste of time" and a means of "forcing tactical decisions that do not benefit science". Broadly in keeping with the profile of those taking part in the survey; more females comment on the negative effects of the REF than males (23 compared to 17 males), and the two largest job types commenting on this are post-doctoral researchers and senior researcher/ lecturers (12 comments each);

> *"[The] REF is a joke, a Lancet paper with zero citations is 4*, a paper in a top speciality journal with 100 is 1*."* [Senior researcher/ lecturer, male, 36 to 45 (Respondent 125)].

> *"[The] REF and RCUK funding are hoop-jumping exercises that favour specific fields, specific institutions and this odd notion of "sexy" science, good, solid science is being lost in the UK."* [Senior researcher/ lecturer, male, 36 to 45 (Respondent 500)].

> *"REF is a farce and not related to the good of research. Funding for specific projects and programmes is mainly about giving money to the big research institutions whether they follow the application regulations or not. Funding is now so full of bureaucracy that many of the younger clinicians can see no benefit in trying to research the issues they are interested in."* [Senior researcher/ lecturer, female, over 45 (Respondent 785)].

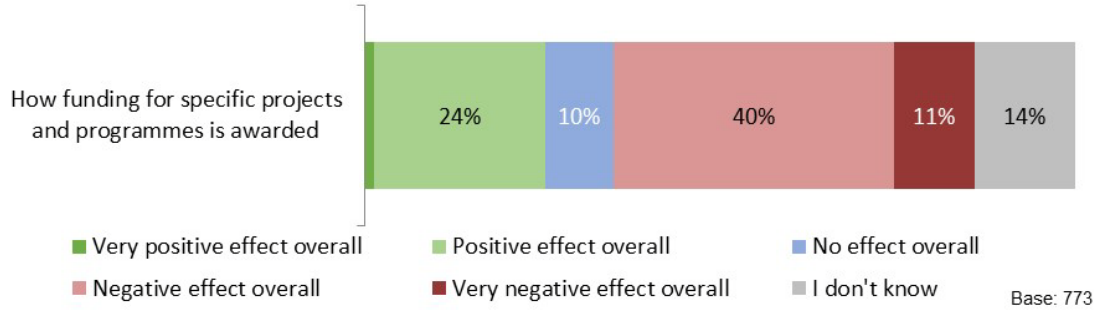
> *"We moan constantly about REF, but the fact is, it's public money and there has to be a way of distributing it. Any system designed is unlikely to satisfy everyone and the REF at least provides a regular framework for benchmarking and focusing the mind."* [Post-doctoral researcher, female, 36-45 (Respondent 193)].

4.3.2. How funding for specific projects and programmes is awarded

Q6b. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? How funding for specific projects and programmes is awarded *(Sample base: 773)*

Over half of respondents (51%) feel the way in which funding is awarded for specific projects and programmes in the UK is having a negative or very negative effect overall on scientists in terms of encouraging the production of high quality science. This is particularly prominent within those specialising in bioscience (55%) and medicine (53%) compared with those in social sciences (38%).

One quarter of respondents feel the current method of awarding funding has a positive or very positive effect, with those working in a university setting (27%) being significantly more positive than those in research institutions (17%).



When comparing all researchers with all non-researchers who responded, more researchers believe the way funding for specific projects and programmes is awarded is having a negative or very negative effect overall on scientists in terms of encouraging the production of high quality science (54% researchers vs. 37% non-researchers). When looking at the different job types; a greater proportion of professors who responded (37%) believe the way funding for specific projects and programmes is awarded is having a positive or very positive effect overall in comparison with post-doctoral researchers (20%). Conversely, significantly more senior researchers or lecturers who responded believe current funding methods are having a negative or very negative effect overall compared with PhD students (58% vs. 38% PhD). Post-doctoral researchers and researcher/ lecturers who responded are more likely to believe it is having a negative effect overall versus PhD students (44% vs 22%).

A significantly higher proportion of British nationals (13%) who responded believe the way funding for specific projects and programmes is awarded is having a very negative effect overall, than those of non-British nationality (5%).

No significant differences are apparent between the age and gender demographics.

68 of the 773 respondents provide additional comments relating to how funding for specific projects and programmes is awarded. Respondents indicate that too much of their time is wasted applying for a shrinking pot of money, that funding is often targeted at those who have already successfully won funding or are working in over-hyped research areas, and that the process of funding allocation is making it difficult for science to progress.

Demographically, those citing how funding for specific projects and programmes is awarded is broadly in line with the overall profile of those completing the survey; females are again the most represented in the comments, with 37 compared to 20 males. At job level, the greatest response is from the senior researcher/ lecturers (19 comments) and post-doctoral researchers (17 comments). The most represented ages are those under 45, with under 35 (21 comments) and 36 to 45s (23 comments).

> *"Funding is moving towards already successful PLS [Principal Investigators] with less funding being spread equitably." [Senior researcher/ lecturer, female, over 45 (Respondent 112)].*

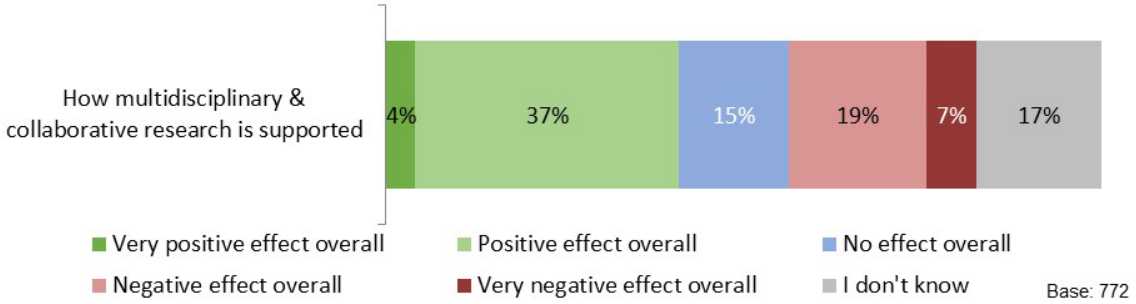
> *"I think the lack of funding for small groups and projects means that the focus has moved to larger groups, with reduces thinking 'outside the box.'" [Senior researcher/ lecturer, female, over 45 (Respondent 250)].*

> *"Funding is directed towards projects that are known to work and with the weight of publication demands. Wonderful work is being side stepped for projects that please funding bodies." [Other, female, 26 to 35 (Respondent 948)].*

> *"Current funding program concentrates on funding research where the research results are within reach, i.e. where the results can be pretty much guaranteed. This type of 'safe' funding also means it's very hard to find funding for unconventional / risky / not-trendy approaches. However, these are the ones most able to bring in the big advances in science."* [Senior researcher/ lecturer, male, 36 to 45 (Respondent 189)].

4.3.3. How multidisciplinary & collaborative research is supported

Q6c. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? How multidisciplinary & collaborative research is supported *(Sample base: 772)*



Of the 772 respondents 41% believe that how multidisciplinary and collaborative research is supported in the UK is having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality science, whilst around a quarter feel it is having a negative or very negative effect overall (26%).

Within the different scientific areas, significantly more of those within biosciences who responded believe that multidisciplinary and collaborative research is having a positive or very positive effect overall than those specialising in physics and computing (45% compared with 30% and 27%, respectively).

The table below summarises the responses by gender and age.

How multidisciplinary & collaborative research is supported	Total	Male	Female	Under 35	35-45	Over 45
Very Positive effect overall	**4%**	3%	5%	6%	3%	3%
Positive effect overall	**37%**	29%	41%	38%	40%	29%
No effect overall	**15%**	21%	12%	14%	18%	18%
Negative effect overall	**19%**	22%	18%	16%	19%	25%
Very negative effect overall	**7%**	9%	6%	5%	7%	11%
I don't know	**17%**	15%	17%	21%	13%	14%
Total positive effect	**41%**	32%	46%	44%	43%	32%
Total negative effect	**26%**	31%	24%	22%	26%	36%
Base:	***772***	*272*	*362*	*259*	*198*	*182*

*Significant differences between genders and age groups have been highlighted. The green coloured figures are significantly higher than those coloured in red.

It can be seen that a significantly higher proportion of female respondents believe both are having a positive or very positive effect overall (46% vs. 32% male).

More of those aged over 45 who responded believe multidisciplinary and collaborative research is having a negative or very negative effect overall (36% compared with under 45: 23%).

When considering all researchers and all non-researchers who responded, more research staff believe the way multidisciplinary and collaborative research is supported in the UK is having a negative or very negative effect overall on scientists in terms of encouraging the production of high quality science (28% vs. 16%). Of the different job types, significantly more PhD students who responded (16%) believe multidisciplinary research is having a very positive effect overall, versus post-doctoral researchers (5%), researcher/ lecturers (3%) and senior researcher/ lecturers (1%). While a higher proportion of senior researcher/ lecturers (15%) and professors (10%), believe this is having a very negative effect overall compared with post-doctoral researchers (4%).

Also, more of those in a university setting than in a research institution setting feel it is having a negative effect overall (21% vs. 10% research institution). Conversely, a significantly higher proportion of those operating from within a research institution (10%) believe the way multidisciplinary and collaborative research is supported in the UK is having a very positive effect overall, in comparison with those in a university setting (5%).

Upon analysis of the nationalities of those taking part in the survey, a higher proportion of British nationals (9%) believe that it is having a very negative effect overall, in comparison with non-British nationals (2%).

Of the 772 respondents answering this question, 27 provide additional comments relating to multidisciplinary and collaborative research. 21 respondents indicate the way multidisciplinary and collaborative research is supported is having a negative effect on UK research with the majority feeling it is not supported well enough. This may be because the structure of individual research councils/ bodies do not promote multidisciplinary and collaborative research. It is perceived by some that these have been developed to ensure high levels of research in their specific areas, as a result multidisciplinary efforts are side-lined and de-prioritised.

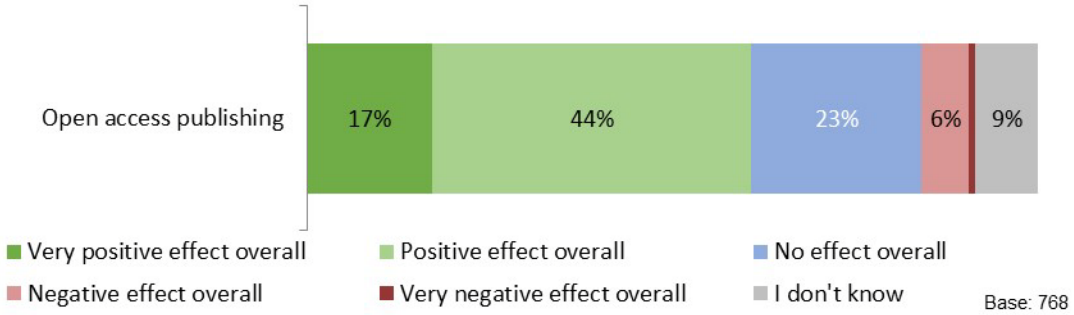
> *"Multidisciplinary research is not the priority of any one funding council, and is therefore side-lined by all of them!" [Post-doctoral researcher, female, under 35 (Respondent 44)].*
>
> *"Multidisciplinary research is poorly supported." [Post-doctoral researcher, female, under 35 (Respondent 715].*
>
> *"My feeling is that the research councils are having a negative effect on multidisciplinary research, but this is balanced by the active interest by charities and non-governmental bodies such as the Royal Society and Wellcome Trust."* [Researcher/ lecturer, male, under 35 (Respondent 424)].

4.3.4. Open access publishing

Q7a. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? Open access publishing *(Sample base: 768)*

Of those who responded to this question, 61 per cent feel open access publishing is having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality research. This increases to 81 per cent amongst those specialising in computing, which is significantly higher than those specialising in bioscience (63%), medicine (58%), psychology (55%), chemistry (54%), engineering (54%) social sciences (53%) and physics (52%).

Conversely, significantly more respondents specialising in chemistry (15%) perceive open access publishing to have a negative effect overall, compared with biosciences and medicine (both 7%).



A greater proportion of those working in a university setting (25%) compared with a research institution (13%) believe open access publishing is having no effect overall on scientists in terms of encouraging the production of high quality research. More male respondents than females believe open access publishing is having no effect (30% vs. 19% female).

Significantly more British nationals believe open access publishing is having a negative effect overall (8% vs. 2% non-British).

Amongst the different job types, significantly more PhD students who responded (29%) believe open access publishing is having a very positive effect overall versus professors (11%) and senior researcher/ lecturers (10%). More post-doctoral researchers who responded (54%) believe it is having a positive effect overall, compared with senior researcher/ lecturers (41%) and professors (33%). Conversely, proportionally more professors who responded (15%) believe open access publishing is having a negative effect when compared with researcher/ lecturers (5%) and post-doctoral researchers (3%).

Open access publishing	Total	Under 35	35-45	Over 45
Very Positive effect overall	**17%**	20%	16%	11%
Positive effect overall	**44%**	51%	40%	40%
No effect overall	**23%**	17%	31%	27%
Negative effect overall	**6%**	4%	7%	9%
Very negative effect overall	**1%**	0%	2%	2%
Total positive effect	**61%**	71%	56%	51%
Total negative effect	**7%**	5%	8%	12%
Base:	***768***	*261*	*198*	*183*

*Significant differences between age groups have been highlighted. The green coloured figures are significantly higher than those coloured in red.

The table above demonstrates the differences in opinion amongst the different age groups of respondents. A higher proportion of those aged under 35 years (71%) believe open access publishing is having a positive effect on scientists in terms of encouraging the production of high quality science than those aged 35 to 45 (56%) and over 45 (51%), while significantly more of those aged over 45 believe it is having a negative effect, versus those aged under 35 (12% vs. 5% under 35).

Of the 768 respondents answering this question, 31 provide additional comments regarding open access publishing. Responses are somewhat polarised with similar proportions highlighting a positive (7 comments) and negative (11 comments) impact, with a further 13 offering a balanced argument where comments cover both positive and negative aspects of the scheme.

On the positive side, open access publishing is seen as making science more available to all. Direct access to research for the public could help stimulate greater public interest in science. It also helps correct the exaggerated or inflated claims made about scientific discoveries in the media, as well as making the research more accountable to the public, who pay for it.

> *"Open access is a great idea and very good when implemented." [Professor, male, over 45 (Respondent 649)].*

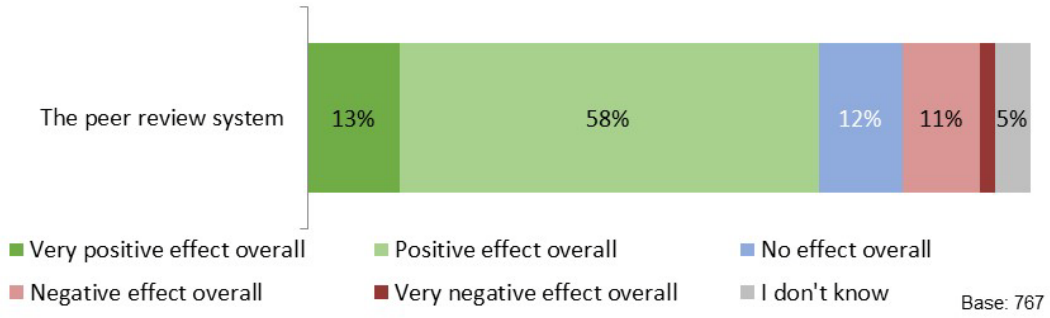
However the cost and quality of journals used to publish findings are perceived by some as a negative. Money that should be spent on scientific research is being diverted towards open access publishing fees, thus affecting the amount of funding available to conduct research. A number of online, open access journals have been created, the quality of which is seen as suspect. A proportion of these respondents feel open access journals tend to be less high quality than traditional journals.

> *"Open Access has many positive features. But it has unforeseen consequences too. In the pre-open access model, a scientific paper had to be important, interesting and comprehensible enough for its value to be sufficiently high that a publisher could sell it." [Professor, male, over 45 (Respondent 442)].*

> *"Open access is a great idea. However the costs are inhibitive. The peer review system is sound, as long as it is maintained at a high quality. Recently a lot of very poor and incorrect papers have been published, containing fundamentally flawed research." [Post-doctoral researcher, male, 36 to 45 (Respondent 192)].*

4.3.5. The peer review system

Q7b. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? The peer review process *(Sample base: 767)*



Over seven in ten (71%) of respondents believe the peer review system in the UK is having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality science. 13 per cent feel it is having a negative or very negative effect overall.

Over 1 in 10 (13%) of those who responded to this question believe the peer review process is having a very positive effect overall. This rises to almost 2 in ten (17%) amongst those aged over 45, and this figure is significantly higher than those aged under 35 (10%).

No significant differences are evident amongst the different subject specialties, organisations, job types, gender or nationality.

The peer review process attracted 33 additional comments from the 767 respondents answering this question, with the majority (25) focussing on negative associations. For some it is seen to favour an old boys' network, where only those who have been previously published in the top journals being allowed to publish again. The process is also seen as time-consuming. Often multiple reviews are conducted and there is a need to meet the requirements stipulated by those conducting the peer review before an article can be published.

> *"Peer review assumes freedom from politics and bias which is often not the case." [Professor, female, over 45 (Respondent 285)].*

> *"The peer review system is flawed. I basically heard from two editors of Nature, that basically only people within the journal get a chance to be published there." [Researcher/ lecturer, female, under 35 (Respondent 215)].*

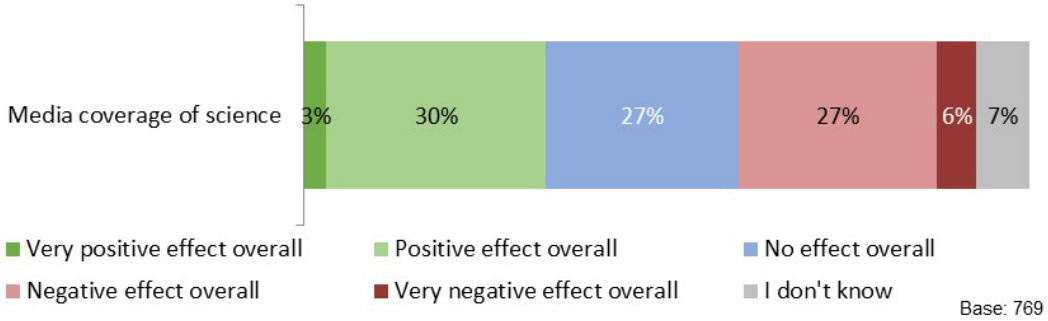
Amongst 8 respondents providing positive comments, this group believe the process is an essential part of maintaining high quality science.

> *"Peer review is very positive in terms of making science rigorous but wastes time (endless rounds of reviews) and makes people do experiments just to humour referees." [Researcher/ lecturer, male, 36 to 45 (Respondent 786)].*

4.3.6. Media coverage of science

Q7c. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? Media coverage of science *(Sample base: 769)*

One third of respondents (33%) believe the media coverage of science in the UK is having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality science. The same proportion cite media coverage as having a negative or very negative effect (33%). This negative effect falls to just under 3 in 10 amongst respondents working in the field of medicine (29%); however, it rises significantly to over 4 in 10 amongst those specialising in engineering (44%).



More British nationals who responded (39%) believe media coverage is having a negative effect compared to non-British nationals (22%).

One third of researcher/ lecturers who responded believe media coverage is having no effect. This is significantly higher than post-doctoral researchers, where only 23 per cent believe this to be the case.

In terms of gender, a significantly greater proportion of female respondents believe media coverage is having a positive or very positive effect (38% vs. 25% male), whilst proportionally more male respondents believe it is having a negative effect overall (39% vs. 30%).

No significant differences are evident amongst the different age groups and research organisations.

Of the 769 respondents answering this question, 63 provide additional comments, with the majority being negative in tone (42). Media coverage is often seen to only consider a catchy story, sensationalise a trivial or interesting finding, or simply misrepresent science to the public.

Over twice the number of female respondents provide negative comments with the general consensus being that media coverage of science can be sensationalised and misleading which can lead to mistrust amongst the general public. Males comment that the media only focuses on catchy stories and question the level of accuracy of the science reported. Broadly in line with the demographic profile of those completing the survey, the largest job type providing negative comments are the post-doctoral researchers, with 14 comments.

> *"Some of the press releases from research groups that I have seen are as unjustifiably sensational as the media reports about them." [Post-doctoral researcher, male, 36 to 45 (Respondent 456)].*

> *"Media coverage encourages only research with a catchy story, not really original or high quality innovative research." [Professor, male, over 45 (Respondent 477)].*

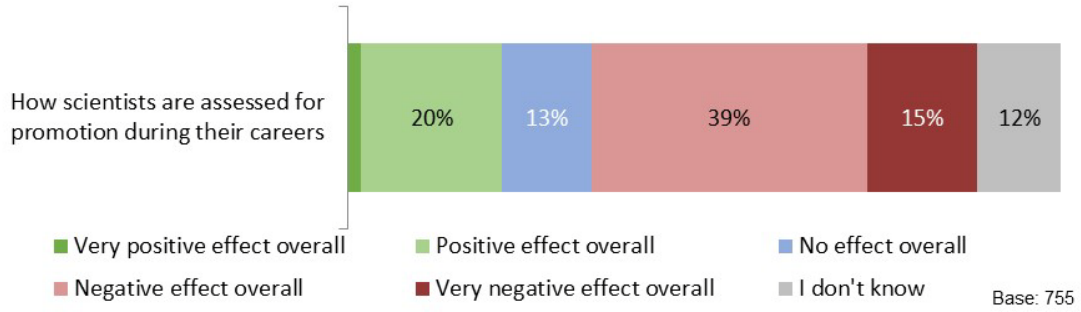
Of the minority of comments attributing positivity to media coverage, this group highlight the resulting awareness raising of science amongst the general public, offering greater recognition for the work of scientists and potentially encouraging more people to consider a career in science.

> *"British [media] coverage is above average compared to the rest of the world." [Professor (Respondent 626)].*

> *"Science is important for a wide range of reasons, encouraging open access and media interest is great so that more people can become interested and can access original sources for themselves." "[Professor, male, over 45 (Respondent 172)].*

4.3.7. How scientists are assessed for promotion during their careers

Q8a. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? How scientists are assessed for promotion during careers *(Sample base: 755)*



Of all of those responding to this question, over one in ten (15%) feel the way scientists are assessed for promotion during their careers is having a very negative effect overall on scientists in terms of encouraging the production of high quality science. This degree of negativity increases to almost one fifth amongst those specialising in the biosciences (19%). This is significantly greater than those specialising in the social sciences where only 6 per cent believe the way scientists are assessed for promotion is having a very negative effect overall on UK science.

A fifth of respondents (22%) believe how scientists are assessed for promotion during their careers is having a positive or very positive effect overall. This rises to almost one quarter amongst those working in the medical field (24%), significantly greater compared with psychologists, where only 9 per cent see this as having a positive effect overall.

A higher proportion of professors who responded (48%) believe how scientists are assessed for promotion is having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality science, compared with senior researcher/ lecturers (19%), researcher/ lecturers (19%), PhD students (17%) and post-doctoral researchers (14%). Conversely, significantly more PhD students (24%), post-doctoral researchers (21%) and senior researcher/ lecturers (19%) who responded believe how scientists are assessed for promotion is having a very negative effect overall, compared with researcher/ lecturers (9%) and professors (7%).

In terms of gender, a greater proportion of male respondents believe how scientists are assessed for promotion is having a positive or very positive effect overall (29% vs. 17% female), whilst proportionally more female respondents believe it is having a negative or very negative effect overall (59% vs. 48%).

When considering the age of those who participated in the survey, a significantly greater proportion of those aged over 45 who responded (32%) feel how scientists are assessed for promotion is having a positive or very positive effect overall, versus those aged under 45 (18%).

No significant differences are apparent between the different organisations and nationalities.

Of the 755 respondents answering this question, 54 provide additional comments, with the overwhelming majority stating a negative effect (53 negative, 1 positive). The current promotion criteria is seen to have changed, mainly due to the REF. The quality of science is now perceived to be assessed much more on metrics, such as journal impact factors and citations. This is viewed as creating a "publish or perish" environment (publish in high impact journals or else). Some talented young scientists are reviewing their occupation choices due to a career path that is too demanding and uncertain.

When considering the demographic profile of those citing negativity towards the way scientists are assessed for promotion; 21 comments are received from post-doctoral researchers (in comparison with 8 researcher/ lecturers, 8 senior researcher/ lecturers and 7 professors) and 22 respondents are aged 36 to 45 (next largest group; under 35 at 12). Post-doctoral researchers feel there is no clearly defined career path in science and opportunities for promotion and progression are limited. Those aged 36 to 45 state the direct correlation between the frequency at which a scientist is published in a journal and the likelihood for promotion is a negative. This is also emphasised by post-doctoral researchers, but to a lesser extent.

> *"The current obsession with journal impact factors has been hugely detrimental to almost every aspect of integrity and honesty in science and in turn influences promotion, education and training and the rush to commercialise anything that might make money."* [Professor, male, over 45 (Respondent 264)].

> *"Short term funding and hence short contracts of employment mean it is difficult to pursue a particular research direction and career path. You often have to change direction to take what is funded and this can have a detrimental effect on pursuing a career."* [Senior researcher/ lecturer, female, over 45 (Respondent 644)].

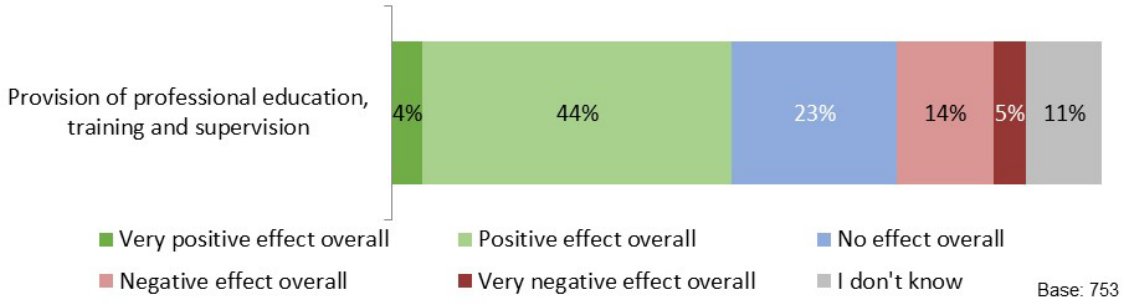
> *"In my personal experience there is no structured path for career progression in academic science."* [Post-doctoral researcher, male, 36 to 45 (Respondent 927)].

> *"Promotion is based on numbers of grants and papers in high impact journals and not on quality of science."* [Researcher/ lecturer, female, 36 to 45 (Respondent 444)].

> *"Being assessed only on publications is not good, it negates large amounts of effort and work in other areas - e.g. supervision of students. More students equals more pressure on academics who are being squashed in all directions."* [Post-doctoral researcher, female, 36 to 45 (Respondent 472)].

4.3.8. Provision of Professional education, training and supervision

Q8b. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? Provision of professional education, training and supervision *(Sample base: 753)*



Of all the respondents, almost half (48%) believe provision of professional education, training and supervision in the UK is having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality science, whilst just under one fifth (18%) disagree and believe it is having a negative or very negative effect overall.

Almost one quarter of all respondents (23%) feel it is having no effect overall. This rises to around 3 in 10 amongst researcher/ lecturers (33%) and senior researcher/ lecturers (30%) who responded, which is significantly greater than post-doctoral researchers (19%). Also, when comparing research staff with non-research staff who responded, a greater proportion of research staff state the provision of professional education, training and supervision is having no overall effect (26% vs. 13% non-researcher).

When considering the subject specialty of the respondents, significantly more of those working in physics (31%) and chemistry (29%) believe the provision of professional education, training and supervision is having no effect overall on scientists in terms of encouraging the production of high quality science, compared with those in the social sciences (14%).

More respondents aged over 35 believe the provision of professional education, training and supervision is having no effect overall when compared with other age groups (36 to 45; 28%, over 45; 26% vs. 17% under 35). More of those aged under 35 feel the provision of professional education, training and supervision is having a very negative effect overall, compared to those aged 36 to 45 (7% vs. 2% 36 to 45).

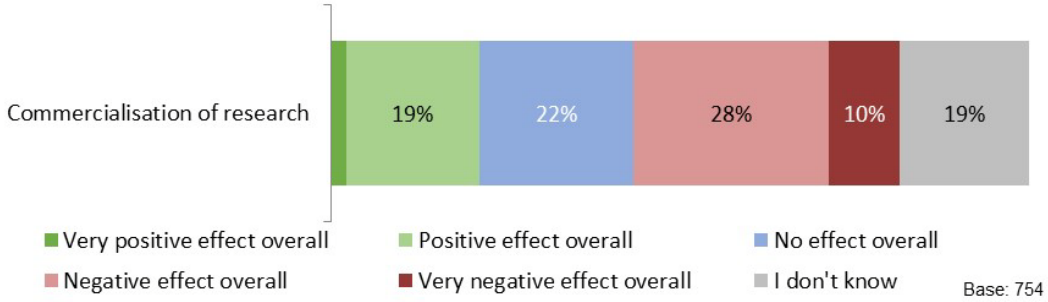
Proportionally more non-British nationals (53%) believe the provision of professional education, training and supervision is having a positive effect overall, versus those who are British nationals (39%).

No significant differences are evident amongst the different organisations and genders.

4.3.9. Commercialisation of research

Q8c. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? Commercialisation of research *(Sample base: 754)*

Around one fifth of respondents to this question feel the commercialisation of research in the UK is having a positive effect overall on scientists in terms of encouraging the production of high quality science. Conversely, almost two fifths believe it is having a negative impact.



Significantly more respondents working within the engineering (31%) and chemistry (30%) fields believe commercialisation of research is having a positive effect overall in comparison with respondents working in physics (15%), psychology (14%), social sciences (14%) and computing (13%). Proportionately more respondents working in the field of computing believe commercialisation of research is having no effect overall versus those in social science (32% vs. 14%).

Almost 4 in 10 professors (38%) believe commercialisation of research is having a negative effect overall, which is significantly more than post-doctoral researchers (22%).

Respondents aged over 45 are both significantly more positive and more negative versus those under 35 years of age when considering the effects of commercialisation of research. A third of respondents aged under 35 don't know what effect commercialisation of research is having. Twenty six per cent of respondents over 45 years of age believe commercialisation of research is having a positive or very positive effect overall, compared with 17% of those under 35. The level of negativity is stronger than the level of positivity exhibited in this age group, with 46% of respondents over 45 years of age believing commercialisation of research is having a negative or very negative effect overall compared with 35% of those under 35, therefore the over 45 age group is somewhat polarised in their views.

No significant differences are evident amongst the different organisations, genders and nationalities.

27 of the 754 respondents answering this question provide additional comments. The majority of those providing additional responses regarding commercialisation of research provide negative comments (20 vs. 7). Respondents are wary of the impact of commercial input into the scientific process, with some feeling that commercial input could bias results, or that the need to produce research that is commercially viable is killing off traditional, "blue-sky" research. For the minority, the positive impact of commercialisation is the offer of additional funding.

> *"Commercialisation of research puts pressure on the research process (e.g. timelines and pressure to produce a 'result') which encourages shortcuts, rushed work and in the worst case scenario possibly*

exaggeration/ manipulation of research findings." [Researcher/ lecturer, female, 36 to 45 (Respondent 312)].

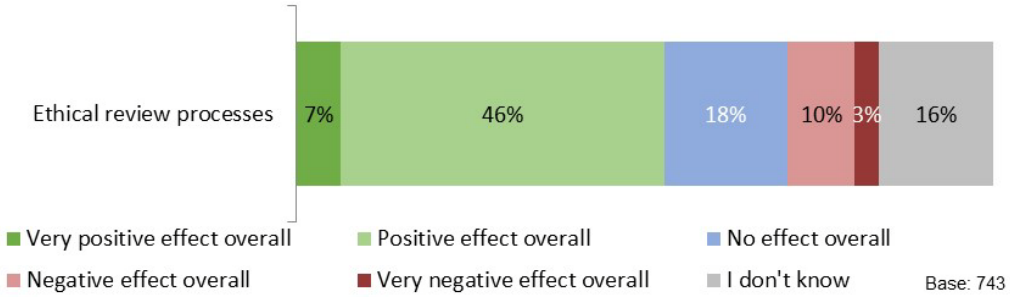
"Commercialisation is narrowing the focus of science and risks introducing bias from pressure to meet sponsor's needs." [Researcher/ lecturer, female, over 45 (Respondent 328)].

"Commercialisation is good and bad, it brings in research but changes the types of research and the openness of a research group." [PhD student, female, under 35 (Respondent 55)].

"The drive for commercialisation is too strong, effectively killing blue sky/ high risk research at most institutions." [Researcher/ lecturer, male, 36 to 45 (Respondent 513)].

4.3.10. Ethical review process

Q9a. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? Ethical review process *(Sample base: 743)*



Over half (53%) of those who responded to this question think ethical review processes in the UK are having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality science. This is especially prevalent amongst respondents within the social sciences (59%), psychology (59%), medicine (57%) and bioscience (53%) specialties, where the level of positivity is significantly higher than those working in the area of physics (38%).

Just over 1 in 10 (13%) respondents believe ethical review processes are having a negative or very negative effect. This figure rises to over 2 in 10 for respondents working in medicine (21%). This level of negativity is significantly higher when compared to respondents working in bioscience (11%), chemistry (10%), physics (7%), and engineering (4%).

More professors (27%) believe ethical processes are having a negative or very negative effect overall, in comparison with senior researcher/ lecturers (12%), researcher/ lecturers (10%) and post-doctoral researchers (9%).

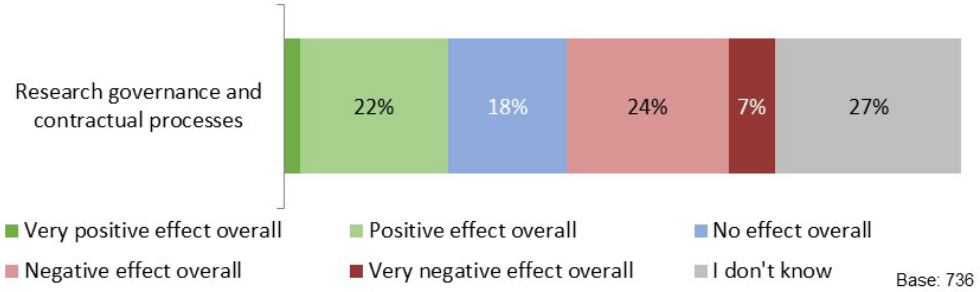
When considering gender, a significantly greater proportion of female respondents believe ethical review processes are having a positive effect overall (53% vs. 39% male). Whilst, proportionally more male respondents believe it is having no effect on the research environment in the UK (25% vs. 12% female).

A higher proportion of respondents aged under 45 believe that ethical review processes are having a positive effect overall, versus those over 45 (under 45; 50% compared with over 45; 38%). Significantly more respondents aged over 45 think that ethical processes are having no effect overall (23% vs. 13% under 35) or at least some negative effect overall (21% vs. under 45; 10%).

No significant differences were apparent amongst the different organisations and nationalities.

4.3.11. Research Governance and contractual processes

Q9b. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? Research governance and contractual processes *(Sample base: 736)*



Around a quarter (24%) of respondents to this question think research governance and contractual processes in the UK are having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality science. However, around 3 in 10 feel that it is having a negative or very negative impact on UK science (31%). This is particularly prevalent amongst professors (44%) and senior researcher/ lecturers (38%) who responded, and less so with post-doctoral researchers (24%).

Also, a significantly higher proportion of respondents working within the field of medicine (42%) believe governance and contractual processes are having a negative or very negative effect overall versus those working within the bioscience (28%) and physics (20%) areas.

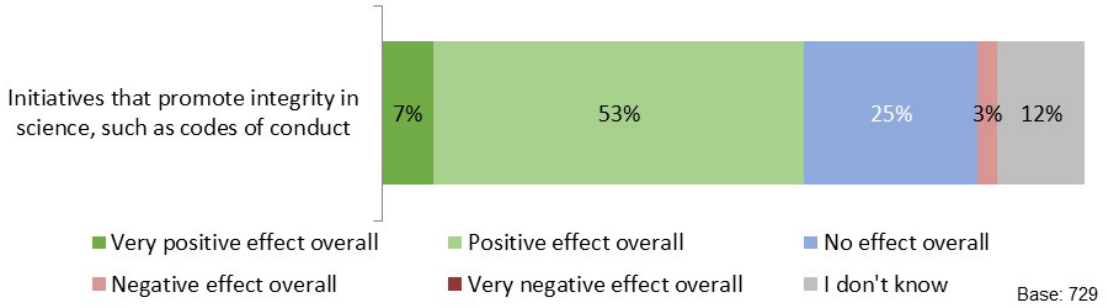
A similar pattern is evident amongst the different age groups with four in ten of those aged over 45 (40%) stating research governance and contractual processes are having a negative or very negative effect overall, in comparison with those aged under 35 (26%).

Significantly, thirty eight per cent of male respondents think that research governance and contractual processes are having a negative effect overall, in comparison with twenty one per cent of female respondents. Significantly more female than male respondents believe that research governance and contractual processes are having a positive or very positive effect overall (28% vs. 21% male).

No significant differences are evident amongst the different organisations and nationalities.

4.3.12. Initiatives that promote integrity in science, such as codes of conduct

Q9c. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? Initiatives that promote integrity in science, such as codes of conduct *(Sample base: 729)*



Sixty per cent of respondents answering this question think that initiatives that promote integrity in science in the UK, such as codes of conduct, are having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality science. This positivity is particularly evident amongst respondents working in the social sciences (68%), medicine (65%) and bioscience (62%), compared with those working in chemistry (49%) and computing (44%). A significantly higher proportion of those within computing (40%) and chemistry (34%) disagree and believe initiatives that promote integrity in science are having no effect overall (versus bioscience; 23%, medicine; 22%, social sciences; 18%).

Significantly more PhD students who responded (14%) feel that initiatives that promote integrity in science are having a very positive effect overall in comparison with senior researcher/ lecturers (3%). Around one third of senior researcher/ lecturers (34%) and professors (31%) who responded believe initiatives that promote integrity in science are having no effect overall. This is significantly higher compared with post-doctoral researchers (20%).

A higher proportion of those aged over 45 than under 35 believe initiatives that promote integrity in science are having no effect on UK research (32% vs. 20%).

When comparing research staff and non-research staff who responded, proportionally more non-research staff believe initiatives that promote integrity in science are having some sort of positive effect overall in the UK (68% vs. 58% researcher), whereas significantly more researchers believe they are having no effect overall (27% vs. 15% non-researcher).

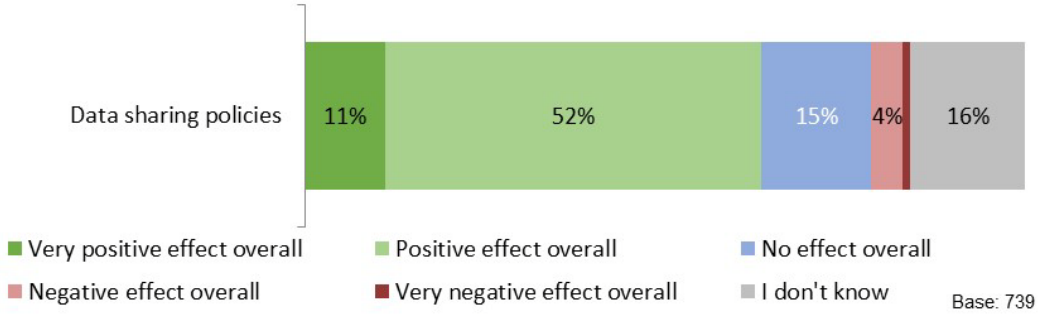
A higher proportion of female respondents believe initiatives that promote integrity in science are having a positive effect overall (58% vs. 48% male). A significantly greater proportion of male respondents state that they have no effect overall (34% vs. 18% female).

When considering the nationality of the respondents, a higher proportion of British Nationals (9%) compared with non-British nationals (3%) who responded believe initiatives that promote integrity in science are having a very positive effect overall.

No significant differences are evident amongst the different organisations.

4.3.13. Data sharing policies

Q9d. What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science? Data sharing policies *(Sample base: 739)*



Almost two thirds of respondents believe data sharing policies in the UK are having a positive or very positive effect overall on scientists in terms of encouraging the production of high quality science, whilst only 5% disagree and state that it is having a negative effect.

The proportion of those working within computing (75%) and bioscience (70%) who think data sharing policies are having a positive or very positive is significantly higher than those working in social science (56%) and chemistry (51%). A significantly higher proportion of psychologists who responded think data sharing policies are having a negative effect overall in comparison with respondents working in the biosciences (10% vs. 3%). Additionally almost 3 in 10 chemists who responded (28%) believe data sharing policies are having no effect overall – this is significantly higher than those working within medicine (15%), social science (13%), bioscience (13%) and computing (5%).

One fifth of male respondents believe data sharing policies are having no effect overall; this is significantly higher than female respondents (20% vs. 12%).

The table below shows that proportionally more post-doctoral researchers (15%) and PhD students (23%) who responded think that data sharing policies are having a very positive effect overall, in comparison with senior researcher/ lecturers (9%) and professors (6%). A significantly higher proportion of professors (64%) who responded think that data sharing policies are having a positive effect overall, versus post-doctoral researchers (47%) and PhD students (44%). One quarter of senior researcher/ lecturers who responded think data sharing policies have no effect overall – a significantly higher proportion than post-doctoral researchers (13%) and PhD students (5%).

Data sharing policies	Total	Post-doctoral researcher	Researcher/ lecturer	Senior researcher/ lecturer	Professor	PhD student
Very Positive effect overall	**11%**	15%	10%	9%	6%	23%
Positive effect overall	**52%**	47%	51%	54%	64%	44%
No effect overall	**15%**	13%	17%	25%	18%	5%
Negative effect overall	**4%**	6%	4%	5%	3%	0%
Very negative effect overall	**1%**	1%	2%	0%	1%	0%
Total positive effect	**63%**	62%	60%	62%	70%	67%
Total negative effect	**5%**	7%	6%	5%	5%	0%
Base:	***739***	*214*	*105*	*114*	*87*	*43***

*Significant differences between job title have been highlighted. The green coloured figures are significantly higher than those coloured in red.
**Caution, low base

When considering the age of respondents, more of those aged under 35 think data sharing policies are having a very positive effect overall than those aged over 45 (15% vs. 7%). Conversely, a higher proportion of respondents aged over 45 believe it will have no effect overall (20% vs. 12% under 35).

No significant differences are apparent between the different organisations and nationalities.

Of the 743 respondents answering the question relating to the ethical review process, research governance, codes of conduct and data sharing policies, 83 provide additional evidence to their response through a verbatim comment (accounting for 11% of those answering the question and nine per cent of the overall survey sample).

The general focus is on the creation of bureaucratic processes (31) and the fact that the features of the UK research environment listed in this question are not taken seriously (30 comments).

Respondents feel features of the research environment such as those of governance, codes of conduct and the need for ethical approval are bureaucratic, repetitive and lead to time wasting. This is particularly so for the ethical review process, which is thought to take too long and is too complicated. It is also felt that these features have not been implemented properly and as a result they are not clearly understood by all and not taken seriously by some. It is often commented that data sharing policies are a good thing, but are misunderstood by researchers or are not really happening.

> *"Many of these processes are essentially tick box exercises which occupy too much of a scientist's limited time to conduct research."* [Post-doctoral researcher, female (Respondent 22)].

> *"Governance has become a bureaucratic monster. Is it not understood, by the authorities that create these things that every minute spent on unnecessary bureaucratic procedures takes us away from research."* [Professor, male, 36 to 45 (Respondent 35)].

> *"All these processes are highly bureaucratic, run by non-scientists often and the money spent on them could actually fund research."* [Senior researcher/ lecturer, female, over 45 (Respondent 433)].

"Data sharing is a lovely ideal, but the idea that someone may just hop along and use your data that you have taken the time and effort to collect is very off putting to me. Until I am thoroughly done with publishing from my data I really don't want some 'publication psychopath' who is aiming only to get a quick paper out of it to bulk up their CV using my work." [Researcher/ lecturer, female, 26 to 35 (Respondent 965)].

4.4. Effects encouraging high quality science

4.4.1. Features having the most positive effect on scientists

Q10. Which features of the UK research environment do you think are having the most positive effect on scientists in terms of encouraging high quality science? *(Sample base: 406)*

Of the 406 respondents answering this question (42% of the total sample), the vast majority highlight the following four areas as having the most positive effect on scientists in terms of encouraging high quality research within the UK:

- Increased collaboration
- Access to funding
- Open access publishing
- The peer review process, governance and ethics in science

More than a quarter of respondents (107) highlight increased collaboration between scientists as having the most positive effect in encouraging high quality research. Scientists from complementary fields are brought together into interdisciplinary teams, in turn providing a greater knowledge base for projects. The support for such interdisciplinary work from funding providers is also noted as a positive. The demographics of those citing increased collaboration as a positive feature is broadly in keeping with the overall profile of those completing the survey (i.e. more female than male respondents highlight this (66 vs. 38); post-doctoral researchers (30) and researcher/ lecturers (19) provide the highest number of comments; the majority are under the age of 45 (under 35s: 48 comments) and (36 to 45s: 33 comments)).

> *"In terms of encouraging high quality science, any initiative that encourages the sharing of data, collaboration, openness in publishing (such as open access publications), and public outreach work such as science festivals and talks [is positive]."* [Post-doctoral researcher, female, under 35 (Respondent 435)].

> *"Collaborations - an open, friendly environment where people work together to achieve things faster rather than competing needlessly. Additionally I think that the emerging interdisciplinary (e.g. bio-maths department split PhD programmes) efforts though facing teething problems now will be very valuable in the future."* [PhD student, female, 18-25 (Respondent 965)].

> *"The UK's traditional strength [is] in collaborative research and innovation. The UK excels at maximising the impact of its research with a limited budget - we are highly cost-effective! The fact that we have flexibility (at least within fellowship schemes) to pursue new research avenues as they arise [is a positive]."* [Senior researcher/ lecturer, female, 36 to 45 (Respondent 311)].

A fifth (82) of those responding to this question note access to funding for projects as a positive with some highlighting the UK funding system as being well run, in comparison with poorer overseas equivalents. The increase in competitively allocated funding also encourages people to produce their best work in proposals. More professors (20) state this than post-doctoral researchers (19), this is one of the few occasions where professors are the most represented group, and this may be due to their experience with the funding system and greater involvement in the process.

When compared with the overall demographic profile of those completing this survey, no other notable differences in response are seen in this area (by age, gender, etc.).

> *"Funding of basic research - though dwindling - is still prevalent enough to allow research which is driven by the interests of curiosity. As this research is essentially performed to satiate the researcher's inquisitiveness, it is almost always of a high quality, and should be supported further."* [Post-doctoral researcher, male, under 35 (Respondent 803)].

> *"Grant funding on the whole encourages excellence and allows individuals to flourish. This must be continued since this brings a strong competitive edge to UK science when compared to the rest of the world."* [Other, female, over 45 (Respondent 898)].

> *"The fact that funding agencies, RCUK, charities, etc. in the UK still provide funds by way of a peer review system that I believe still has integrity is the most positive aspect."* [Professor, male, over 45 (Respondent 264)].

> *"[The] system is not too hierarchical there is pressure but not comparable to what other countries (e.g. China) are experiencing, foreign talent is welcome. [We are a] "light touch" as far as regulations are concerned."* [Professor, female, over 45 (Respondent 585)].

Of the 406 respondents answering this question, 59 believe open access publishing is having a positive effect on the UK research environment. Open access publishing is cited as increasing the exposure of research data and findings making them more readily available to those in academia as well as the general public (who are not typically involved in research). Respondents also highlight the greater media coverage of research (as a result of open access publishing). A greater proportion of female respondents comment on the positive impact of open access publishing when compared with their male counterparts (39 comments amongst females, 16 by males).

Broadly in line with the profile of those taking part in the study, more post-doctoral researchers (18) highlight open access publishing; under 35s are the most represented age group (27); 16 comments for 36 to 45s.

> *"The move towards open access [publishing] (although the peer review process still relies on researchers giving up their time for the good of science and publishers make a huge amount of money from this), greater data sharing and media scrutiny will raise quality, ethical standards and openness in my field."* [Post-doctoral researcher, female, under 35 (Respondent 434)].

> *"Encouragement of and funding for open access. We are a very privileged country in terms of internet, infrastructure, resources, and it is important to share this."* [PhD student, female, under 35 (Respondent 55)].

Fourteen percent of those answering this question (55) cite the peer review process, governance and ethics in science as positive features encouraging high quality science in the UK. The need to have work and funding applications peer reviewed is felt to have a positive effect on the quality of science. Some respondents comment on the positivity surrounding the UK peer review system, in contrast to other regions where peer review is not present (these regions are not named however). Ethical standards in the UK system are also felt to be high (in comparison to other, unnamed, regions). Female respondents are more likely to express their opinion on the positive effects of the peer review system, governance and ethics in science when compared to male respondents (34 comments, compared to 18 for males).

When compared with the overall profile of those completing the study, no other notable differences in response are seen in this area (i.e. post-doctoral researchers provide the most comments (15); the age groups of those stating the peer review process/ governance/ ethics are evenly spread).

> *"Integrity of Sciences and Ethics of Science has gained a lot of attention recently: this is good"* [PhD student, male, under 35 (Respondent 111)].

> *"The integrity and work of seniors and peers - through our behaviour we all set and maintain the bar and standards, and I strongly believe this is the most important thing"* [Senior researcher/ lecturer, female, 36 to 45 (Respondent 966)].

Q11. How are [the features in Q10] having a positive effect? *(Sample base: 353)*

Over a third (36%) of those taking part in the study, provided a response to this question. The majority highlight the following as the main reasons for the positive effect:

- Increased collaboration
- Research transparency and data sharing
- Research variety and freedom to investigate interesting areas
- Access to funding and financial resources

Almost a quarter of respondents (22%) cite increasing collaboration as the reason for this positive effect. Primarily through funding, the system in the UK is now geared towards supporting interdisciplinary research and the greater focus on collaboration leads to less feeling of isolation among researchers. There is a greater emphasis on communication between researchers, with respondents being more inclined to share methodologies and make data more readily available. As a result of increased collaboration, new discoveries can be made by teams of researchers working together, rather than competing against each other. Also, the nature of the UK system, having large numbers of good universities in close proximity, fosters collaborative efforts. Collaboration leads to an explosion of ideas, and more innovation in research.

The demographics of those citing increased collaboration is broadly in keeping with the profile of those completing the survey (e.g. more females than males (40 vs. 33); post-doctoral researchers (22) and researcher/ lecturers (19) provide the highest number of comments; the majority of respondents are under the age of 45 (under 35s: 31 comments) and (36 to 45s: 28 comments).

> *"Interaction between various scientific groups is stimulating and promotes creativity. Feeling that you are part of a greater team and sharing and learning to communicate your science to other scientific communities"* [Post-doctoral researcher, female, 36 to 45 (Respondent 45)].

> *"[Collaboration] forces individual researchers to consider their work from the point of view of others in terms of novelty, rigour and importance."* [Senior researcher/ lecturer, male, over 45 (Respondent 348)].

> *"It's very easy to find experts in most fields in the UK - this makes it a fertile place to try out new ideas and get feedback from a wealth of experienced researchers while being encouraged to break new ground."* [Researcher/ lecturer, male, 36 to 45 (Respondent 424)].

"Large research groups created by peer interactions foster a broader perspective in research and guarantee a broader dissemination of results and methods." [Post-doctoral researcher, male, 36 to 45 (Respondent 711)].

Of the 353 respondents answering this question, 41 (12%) highlight research transparency and data sharing. Respondents believe transparency and sharing are creating a culture of communication among researchers, and institutions, and allows for the dissemination of results. It is also felt that research can now be accomplished more quickly and more cost effectively as a result of the re-use of data rather than duplicating research and collecting data afresh. Some feel it will also decrease the prevalence of data fraud as increased transparency will enable greater scrutiny of research findings. However, for the benefits of this to be realised within the research community, respondents feel the selective release of data is not acceptable and that all data should be made available to everyone, not just within academic research, but spreading more widely into commercial applications and the general public.

Female respondents and those aged under 35 are more likely to focus on this transparency when compared to male respondents (26 comments, compared to 13 for males), and those aged over 35 (36 to 45: 10 comments and over 45: 6 comments).

"Publishing raw data helps prevents fraud, torturing data for results and dodgy statistical practices." [Other, male, over 45 (Respondent 93)].

"Having papers available for a wider range of people means that money isn't wasted on replicating studies unnecessarily, and allows people to find studies that may be relevant to researchers which they may not have come across otherwise. It also allows for transparency as to what was done in a study, and how this lead to the findings." [Other, female, under 35 (Respondent 815)].

"Many times data may be collected by teams that do not have the time, resources, or abilities to fully analyse it. Making the data available to other groups maximizes the usefulness of any data set." [PhD student, male, under 35 (Respondent 607)].

One tenth of those answering this question (37) claim the variety in research and the freedom to investigate any area researchers see fit as contributing to this positive effect. Respondents feel this encourages creative thinking, leading to the publication of a vast array of findings as well as encouraging researchers and institutions to follow more ambitious (even collaborative) projects. When combined with the additional security of acquired funding, respondents' state it is possible for researchers to undertake more high-risk, longer term projects which may take several years to produce outputs but are aimed at *"tackling the big questions"*.

When comparing those highlighting 'variety and freedom' with the overall demographic profile of those partaking in the study, a greater proportion of professors cite this (10) when compared to; post-doctoral researchers (9), researcher/ lecturers (7), senior researcher/ lecturers (5) and PhD students (3). Also, male respondents (18) who are over 45 (13) are more likely to state this when compared to female respondents (15) and those under 45 (under 35: 11 and 36 to 45: 10).

"Encourage more ambitious scale of project in which each institution works to its strengths. Over time, collaborations also facilitate movement of researchers." [PhD student, female, under 35 (Respondent 799)].

"Scientists with secure funding can focus on the research aspect of their projects instead of the finances to fund it. Working in a stimulating environment motivates scientists to think deeper and give the best of them." [Post-doctoral researcher, female, under 35 (Respondent 441)].

"Allows investigators to pursue higher-risk lines of research. Also facilitates the development of long-term research projects which may take several years to produce outputs." [Senior researcher/ lecturer, male, 36 to 45 (Respondent 288)].

"Freedom gives the chance to let your mind wander. Collaboration gets you places more quickly and often to places none of you could reach alone." [Senior researcher/ lecturer, male, 36 to 45 (Respondent 689)].

Eight percent of those answering this question (27) focus upon access to funding and financial resources. Female respondents are around 6 times more likely to suggest this as the main effect, when compared with males (22 vs 4). *"No work can be done without funding"* – Access to funding is regarded as the 'life-blood' of research, without which, research would not be possible. Respondents are fully aware of this and therefore depend on resources such as pilot project grants, interdisciplinary grants and project grants to support high risk research proposals, collaboration across multiple fields and individual researchers.

A proportion of these respondents (focussing on funding and resources) highlight the positivity in the competitive approach to acquiring funding, arguing that it pushes researchers to produce their best work. However, amongst others, it is felt excessive pressures through competing for funding leads directly to a compromise in research quality.

A minority comment on the need for greater flexibility within research budgets; research should always be the driver of funding (rather than the other way around). There should also be an incentive to promote and publish negative data, currently such data is being hidden. Sharing negative data would ensure the same mistakes are not made by others doing similar research, thus making the whole research process more efficient and as a result more cost effective.

"Competitive grant funding and peer review publications should be positive in theory but the pressure to publish and receive grants has gone too far, compromising quality. Good quality science seems to be something that comes about from personal drive and is in spite of the current "system' not because of it." [Researcher/ lecturer, female, under 35 (Respondent 498)].

"Flexibility in funding is key, as it allows us to follow new hypotheses as they arise (and, more importantly, to drop old ones as they are disproven), rather than having to deliver a specific programme of work as outlined in a project proposal." [Senior researcher/ lecturer, female, 36 to 45 (Respondent 311)].

"Science budget ring fence provides a degree of security to UK scientists who would otherwise think about moving overseas for at least part of their careers." [Post-doctoral researcher, female, 36 to 45 (Respondent 193)].

"Flexible funding programmes allow the researchers to let their results guide the research without being tied to rigid plans." [PhD student, female, under 35 (Respondent 780)].

4.4.2. Features having the most negative effect on scientists

Q12. Which features of the UK research environment do you think are having the most negative effect on scientists in terms of encouraging high quality science? *(Sample base: 482)*

Of the 482 respondents answering this question (50% of the total sample), the vast majority highlight the following four areas as having the most negative effect on scientists in terms of encouraging high quality research within the UK:

- The amount of funding available
- The pressures of the REF to be the first to publish results
- Lack of structured career progression
- The way scientists are assessed

Almost a third of respondents (150) highlight the amount of funding available as having the most negative effect on encouraging high quality research. Respondents feel the amount of available funding has decreased recently, and there is greater emphasis on winning funding to progress in their field and careers. Respondents also find themselves tailoring their work in order to meet funding calls, rather than getting their own work funded. Respondents comment upon the negative impact of short term funding cycles, which do not offer job security for junior researchers and in turn increase the use of short term contracts for staff. It is also perceived that the pot of funding money is constantly decreasing, resulting in greater competition to secure what is available.

More respondents over the age of 45 (51 comments) focus on the amount of funding available when compared to the overall age profile of those responding to this survey.

The remaining demographic profiles of those citing the amount of funding available, is broadly in keeping with the profile of those completing the survey (e.g. more females than males (84 vs. 61); post-doctoral researchers (46) provide the highest number of comments, this may be because post-doctoral researchers, as opposed to lecturers (23), senior lecturers (22) and professors (20) are often reliant upon funding for their positions.

> *"I think the targeting of specific areas by research councils means that often 'sexy' science gets funded rather than something high quality that might not have so many buzz words in it."* [Post-doctoral researcher, female, under 35 (Respondent 928)].

> *"Increased red tape and reduced funding availability."* [Female, 36 to 45 (Respondent 765)].

> *"Not enough funding for "unfashionable" research."* [Female, 36 to 45 (Respondent 200)].

> *"The current funding environment means that many high quality projects are simply not funded, and therefore the research is never started."* [Senior researcher/ lecturer, female, 36 to 45 (Respondent 480)].

Almost a quarter (111 comments) of those responding to this question note the pressures of the REF to be the first to produce results as a negative with some citing there is a "publish or perish" culture in the UK. Therefore, more pressure is exerted onto researchers early in their careers, in particular, to secure

funding money and produce articles for more prestigious journals. The nature of the REF, with its focus on researcher outputs of individuals is seen to drive much of this pressure.

As the age of those focusing on this area increases, the number of comments falls, with 43 under 35's commenting; 37, 36 to 45's and 29 from the over 45 age group. This could reflect the sense of increased pressure among early career researchers, or those new to academia, to publish in order to try and secure a permanent position.

When compared with the overall demographic profile of those completing this survey, no other notable differences in response are seen.

> *"I think the extremely high pressure for Nature / Science papers in order to be even considered for group leader / lecturing positions is extremely negative*" [Post-doctoral researcher, female, under 35 (Respondent 101)].

> *"Continual push to publish in 'high impact' journals to satisfy local requirements to optimise performance in government initiated reviews (REF etc)."* [Post-doctoral researcher, male, under 35 (Respondent 242)].

> *"Extreme pressure to produce. Leads to the risk of fast and dodgy work. Gone are the days when people can chase big questions until they solve them."* [Senior researcher/ lecturer, male, 36 to 45 (Respondent 873)].

> *"Largely REF and the imposed competition between universities and researchers. This is driving the quality of clinical research in this country down."* [Professor, male, under 35 (Respondent 32)].

Twenty three percent of those answering this question (111) focus upon career structure and progression. Respondents state that researchers have to win funding in order to retain their jobs which is especially difficult for those in the early stages of their career. It is also difficult to win funding without having good publications, or a track record, which early career researchers simply do not have. Temporary contracts create a lot of stress among researchers, and contributes to the short-termism culture that is present in research. It is felt that in order for a researcher to retain their job, one needs research output, which leads to a focus on quick, short-term research, or cutting corners to produce results sooner. Respected, authoritative research often takes time, which is currently not a luxury afforded to many.

Female respondents are around twice as likely to suggest this as the main effect, when compared with males (70 vs 37).

In-line with the overall demographic profile of the respondents taking part in the survey, no other notable differences in response are seen in this area; as expected those aged under 35 comment most (50) compared to those over 35 (36 to 45: 36 comments and over 45: 25 comments). Post-doctoral researchers provide the most comment (45), whilst very few professors comment on this (11 comments). Again, these demographic indicators are not surprising given the salience among early career researchers for progression.

> *"Career progression too dependent on papers as measure of researcher success."* [Researcher/ lecturer, male, under 35 (Respondent 584)].

> *"[There is a] constant tie-in of research 'productivity' with job security."* [Senior researcher/ lecturer, female, 36 to 45 (Respondent 528)].

"From personal experience, there is a lack of financial support for scientists that means that post-doc salaries are relatively small compared to other professions which have equivalent training expectations." [Female, 36 to 45 (Respondent 539)].

"Lack of long term opportunities for young scientists, lower salaries than other average professional jobs." [Post-doctoral researcher, female, under 35 (Respondent 621)].

Of the 482 respondents answering this question, 102 believe the way scientists are assessed is having a negative effect on the UK research environment. The REF seems to have created a culture where respondents feel they are measured on the amount of funding they win, and how many journal articles they publish. Respondents feel it is not always easy or appropriate to measure the influence of science based on journal impact factors, or funding won. Respondents feel many ideas take time to develop, and commercial, real-life applications may not be seen for many years. This approach encourages a culture of short-termism.

The demographic profile of those citing the impact of metrics and assessment of scientists is broadly in keeping with the profile of those completing the survey (e.g. more females than males (63 vs. 45); post-doctoral researchers (32) provide the highest number of comments; the majority of respondents are under the age of 35 (48 comments). This could reflect the increased focus among early career researchers for the correct outputs in order to justify a permanent position.

"Bureaucratic processes assessing research quality focus on metrics such as number of publications or impact factors do not fully appreciate the requirements of key stakeholders." [Senior researcher/ lecturer, male, under 35, (Respondent 705)].

"There is no doubt that the metrics regularly used to judge the success of researchers can encourage researchers into unethical practices. This might be deliberate, although it is rare." [Senior researcher/ lecturer, male (Respondent 212)].

"Demand for 'outcomes' and 'impact' and so on. Commercialisation - both people wanting to make money and governments wanting to know how research will benefit the economy." [Post-doctoral researcher female, 36 to 45 (Respondent 755)].

"Obsessions with impact factors, publication mania and a naive scientism." [Professor, male, over 45 (Respondent 296)].

Q13. How are [the features in Q12] having an effect? *(Sample base: 439)*

Over four in ten (45%) of those taking part in the study, provided a response to this question. The majority highlight the following as the main reasons for the negative effect:

- Short termism
- Securing funding
- Losing talent
- Pressure to publish and metrics

Almost three in ten (28%) cite a short-termism culture in the UK, felt to be caused by metrics used to assess research and pressure to create impact. This results in fewer new ideas, a decrease in the time

available to plan good research, greater adherence to "safer" research topics and people cutting corners in research. Safer research areas are those expected to produce faster results, or almost guaranteed results, and those areas that are seen as more likely to win funding i.e. hot topics, or headline topics.

Although post-doctoral researchers comment most (31 comments), a significant proportion of professors also comment (24); which is one of the few occasions where professors are one of the most represented groups. Professors feel the current system encourages short term research proposals and safe research, geared towards commercial development, rather than high risk research in unexplored, often unattractive areas.

When compared with the overall demographic profile of those completing this survey, no other notable differences in response are seen.

> *"I don't think high quality research can actually be identified at the funding or publication stages. It takes time to see the context and value of research. So to fund a promise of quality research, rather than to pay for work done, makes the system biased in favour of established researchers rather than measurable quality."* [Post-doctoral researcher, female, under 35 (Respondent 386)].

> *"[The features in Q12 are] encouraging research behaviours which seek short term gains (e.g. for grants and papers) rather than long-term, robust and replicable research, which leads to increases in knowledge."* [Professor, male, over 45 (Respondent 860)].

> *"[There is] far too much short-termism and following of the latest, fashionable behaviour."* [Professor, female, over 45 (Respondent 302)].

> *"Pursuing research which is in an early stage, unpopular area, unusual, interdisciplinary, contentious, high risk, expensive, not on agenda of funders and accrues slowly over time is effectively career suicide."* [Professor, female, over 45 (Respondent 179)].

Of the 439 respondents answering this question, 86 (20%) highlight the availability of funding and the efforts put into funding proposals. Respondents believe researchers spend a lot of time preparing funding proposals, taking time away from other, research specific activities. Respondents specifically comment upon the sheer amount of bureaucracy involved in smaller research projects, claiming these are often on a par with larger undertakings, and hence smaller projects are often penalised when trying to win funding.

Respondents believe that overall, there is less funding available, and with increased competition to acquire this, researchers tailor their research in order to secure funding rather than carrying out the original research they had in mind. Some re-iterate their belief that UK research is beginning to be driven by money rather than cutting edge, innovative research.

Male respondents are more likely to focus on funding when compared to female respondents (42 versus 38). Males tend to state that funding related schemes are good in principle however in practice they are not beneficial and do not promote scientific development. A greater proportion of female respondents focus on "safe" research which has a higher probability of showing results rather than high-risk, blue-sky research.

When compared with the overall demographic profile of those completing this survey, no other notable differences in response are seen.

"A lack of funding means many good projects are not financed, and individuals and institutions that should be collaborating are competitors instead." [Female, Over 45 (Respondent 202)].

"Academics battling for money? Researching only what [funders are] interested in? Research becoming ridiculously petty, bent on undermining each other just for the sake of undermining. It's depressing." [PhD student, female, under 35 (Respondent 614)].

"Researchers tailor the research to what the funding bodies want not to how the best research may be conducted." [Female, under 35 (Respondent 586)].

Twenty one percent of those answering this question (91) focus on the short term culture within UK research. Short-term contracts create a "brain drain" as many good scientists choose not to remain in academia, preferring to work in roles in industry with greater security. Many accomplished, young researchers are put off a career in science by the demoralising effects of working as PhD students or post-doctoral researchers in high-pressure environments.

Female respondents are around twice as likely to suggest this as the main negative effect, when compared with males (57 vs. 32).

"The Post-Doc structure disadvantages those who cannot keep moving for family reasons, which particularly affects women." [Researcher/ lecturer, female, over 45 (Respondent 328)].

"The move towards fewer, larger grants makes it tough for PIs to support a lab group including Post-Docs, technicians and students in the long run. The group has to shrink and then grow if funding is renewed. This leads to loss of skills base and knowledge transfer. In particular loss of Post-Docs and technicians means less support for PhD students. Many skilled Post-Docs and young PIs are being forced out of science due to lack of continuous career opportunities." [PhD student, female, under 35 (Respondent 920)].

"A lot of bright minds exit science (especially women) [due to] loss of creativity [and] psychological effects such as depression." [Post-doctoral researcher, female, 36 to 45 (Respondent 45)].

"Fewer PhD means fewer scientists. The highest drop-out rate from science is at the Post-doc level - we need to retain these scientists." [Researcher/ lecturer, female, 36 to 45 (Respondent 254)].

Around one fifth of those answering this question (84) claim the pressure to publish and assessment metrics are the reason for the negative effect. Again, respondents mention the effect of the REF, where it is seen to reward past achievements, creating a culture of focusing on individuals and creating pressure to publish work. The pressure to publish leads to short-cuts, less rigour and less long-term research. It also puts unnecessary pressure on scientists to produce work of a specific standard, when not all good or useful work can necessarily be published in these types of journals.

The demographic profiles of those citing pressure to publish and assessment metrics, is broadly in keeping with the profile of those completing the survey (e.g. more females than males (46 vs. 38); post-doctoral researchers (28) provide the highest number of comments; those under 35 are the largest age group commenting (43), compared to 36 to 45 year olds (36) and over 45s (17)).

*"An obsession with 3*and 4*research produces a risk-avoiding culture and people reluctant to pursue areas that may be of interest but that might not result in immediate 'high quality' returns."* [Female, Over 45 (Respondent 17)].

"By making people need to save their living above any other consideration. Publish or perish, so publish, whatever." [Post-doctoral researcher, male, under 35 (Respondent 325)].

"A continuous pressure to output papers without an emphasis on quality over quantity, and the knowledge that if, as a researcher with a two-year contract, you don't obtain results that are good enough to publish for whatever reason, your career is as good as over does not create an environment for good quality science. It goes against the principles of collaboration, of sharing knowledge, and doesn't provide any stability in the lives of the scientists who are doing the research." [Post-doctoral researcher, female, under 35 (Respondent 435)].

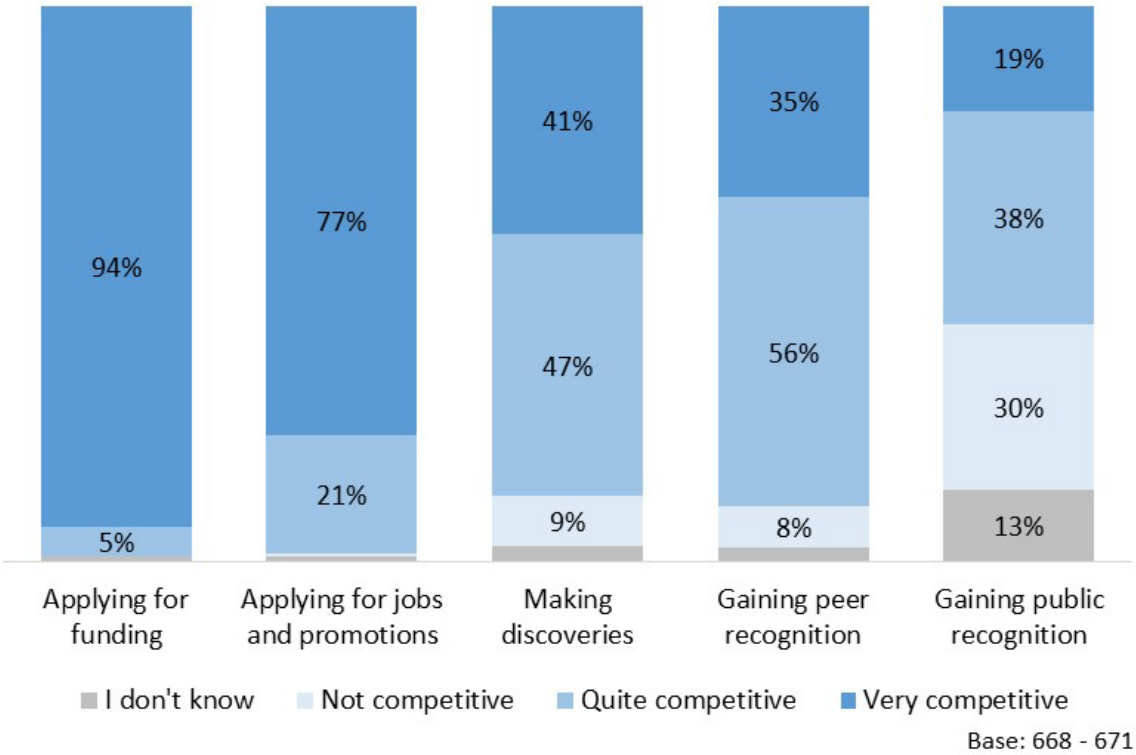
"[It] encourages distortion and exaggeration of research findings so as to gain 4 papers. Distortion of the importance and quality of research by favouring publication in "vanity" journals. This further distorts career progression - one paper in Nature does not make a career!"* [Professor, male, over 45 (Respondent 249)].

4.5. Effect of competition

4.5.1. Effect of competition on the production of high quality science

Q14. How competitive do you think these different aspects of working as a scientific researcher are? *(Sample base: 668-671)*

The vast majority of respondents (over 9 in 10) feel that applying for funding is very competitive, whilst over three quarters of respondents state that applying for jobs and promotions is very competitive. Around 9 in 10 think making discoveries and gaining peer recognition is competitive. Over half of respondents suggest there is some level of competition in gaining public recognition. Conversely, 3 in 10 believe gaining public recognition is not competitive.



A significantly higher proportion of respondents working within bioscience feel applying for funding is very competitive, compared to those working within social science (95% vs. 87% social science). Significantly more psychologists who responded (16%) believe there is no competition when making discoveries, versus those within bioscience (7%). Over one third of respondents say gaining recognition from peers is very competitive (34%). A significantly higher proportion of those working in psychology (39%), medicine (37%) and biosciences (34%) perceive the peer recognition landscape to be very competitive, versus engineers (18%).

Applying for jobs and promotions is felt to be very competitive amongst senior researchers/ lecturers (86%), PhD students (85%) and post-doctoral researchers (82%) who responded, all significantly higher than professors (63%). However, more professors who responded say that applying for funding is quite competitive (36% vs 13% senior researcher, 13% PhD student, 18% post-doctoral researcher and 21% researcher). While almost half of respondents feel making discoveries is quite competitive, this figure

decreases to one third amongst professors – this is significantly lower than senior researcher/ lecturers (51%) and post-doctoral researchers (50%).

Proportionally more respondents aged under 35 (96%) think applying for funding is very competitive in comparison with those aged over 45 (90%). This is also evident regarding gaining public recognition, with 25% of those under 35 years stating it is very competitive, compared with 15% of those over 35. Significantly more respondents under 35 years feel making discoveries is quite competitive (51%), compared to those over 45 (40%).

Respondents aged under 45 say applying for jobs and promotions is very competitive (81% vs. 69% over 45), whilst significantly more of those aged over 45 state this is quite competitive (28% vs. under 35; 18%).

No significant differences in the level of competition are evident amongst between genders and nationalities.

Of the 671 respondents answering this question, 41 also supplemented their response by providing verbatim comments. This equates to 6% of those answering the question and 4% of those completing the survey.

There is a general consensus amongst those commenting that too much competition is seen to go against the ethos of scientific discovery. Respondents perceive that excessive competition discourages scientists to pursue a career in research. Too much competition may also affect the public's perception of scientific research and the public recognition of good science. In addition, respondents indicate that a focus on headline chasing can detract from good scientific work.

> *"Public recognition often bears little resemblance to importance of achievements."* [Professor, male, over 45 (Respondent 504)].

> *"Being a scientific researcher is as risky a job as going into financial trading. The competition is always high, the job is never secure until you're at the top and money is always the number one priority."* [Post-doctoral researcher, female, under 35 (Respondent 237)].

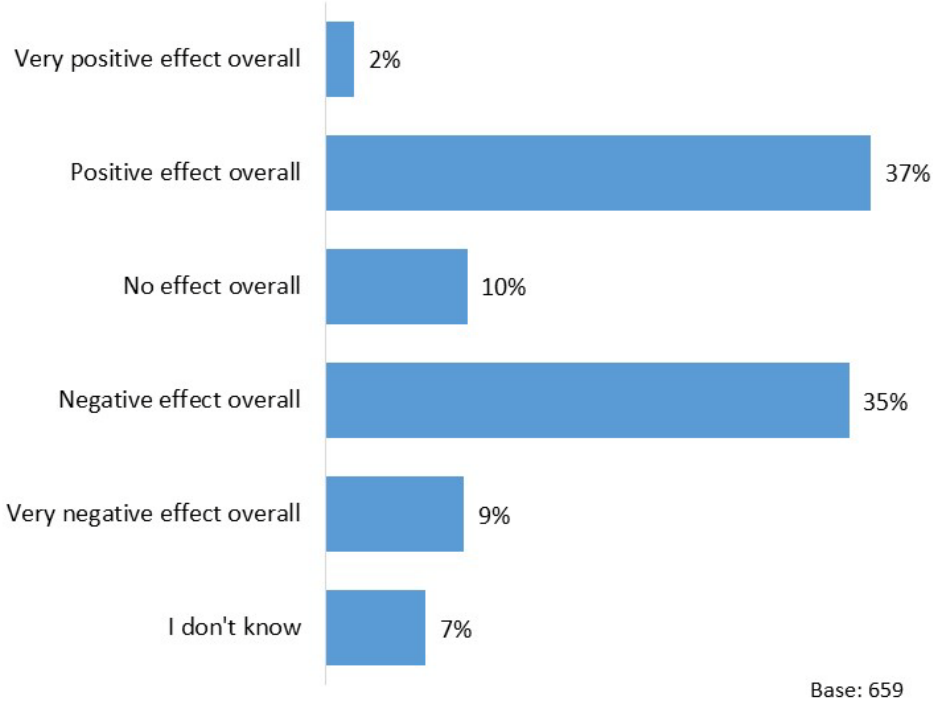
> *"Making discoveries is relatively easy, even though it is intellectually & technically very challenging. Getting work published or funded is much, much harder."* [Professor, male, over 45 (respondent 143)].

There was some confusion amongst a number of respondents (11) in regards to their understanding of what was meant by competitive in the question wording.

4.5.2. Effect of competition on the production of high quality science

Q15. What kind of effect do you think competition in science is having on the production of high quality science? *(Sample base: 659)*

When considering the effect competition in science is having on the production of high quality science, there is a polarisation in the data with similar proportions of respondents stating this has a positive effect and a negative effect overall. Almost four in 10 (39%) believe competition is having a positive or very positive effect overall on the production of high quality science, however 45% disagree and believe competition has a negative or very negative effect overall.



There is an apparent gender imbalance, with a significantly greater proportion of male respondents stating that competition in science is having a positive or very positive effect overall on the production of high quality science (45% vs. 35% female). Significantly more female than male respondents believe competition is having a negative or very negative effect overall (49% vs. 38% male). Considering the gender of researchers in senior roles (80 females in professor and senior researcher/ lecturer roles, and 91 males) a significantly greater proportion of male researchers in senior roles (55%) feel that competition is having a positive or very positive effect overall (vs. 34% female researchers in senior roles). However, proportionally more female researchers in senior roles (50%) compared with males (29%) believe that competition is having a negative or very negative effect overall on the production of high quality science.

A significantly greater proportion of professors believe competition in science is having a positive or very positive effect overall on the production of high quality science, compared to people in other roles, as shown in the table below.

Effect of competition in science on the	**Professor**	Senior Researcher/	Researcher/	Post-Doctoral

production of high quality science		Lecturer	Lecturer	Researcher
Very positive effect overall	**7%**	2%	0%	1%
Positive effect overall	**53%**	31%	42%	34%
No effect overall	**9%**	17%	9%	8%
Negative effect overall	**20%**	35%	35%	41%
Very negative effect overall	**9%**	12%	7%	11%
I don't know	**3%**	2%	7%	6%
Total positive effect	**60%**	33%	42%	35%
Total negative effect	**29%**	48%	42%	51%
Base:	***77***	*99*	*98*	*195*

*Significant differences from the professor job title have been highlighted. The green coloured figures are significantly higher than those coloured in red.

When considering the age of respondents, a significantly greater proportion of those aged 36 to 45 (14%) believe competition in science is having no effect overall on the production of high quality research, in comparison with those aged under 35 (7%).

No significant differences were evident between the different scientific subject areas, organisations and nationalities.

Of the 310 respondents who provided comments when invited to give reasons for their answers to this question (47% of those answering the question and 32% of the total sample), the vast majority highlight the following three areas:

- Research activity
- People
- Research funding

Overall, there are 221 comments that are either positive or negative. Of these, 179 are negative and 42 are positive. Broadly in line with the demographic profile of those completing the survey, a greater proportion of female respondents tend to provide both positive and negative comments, although the ratio of negative comments is more pronounced (negative: female 107 vs. male 69, positive: female 27 vs. male 15). Roughly a quarter of positive comments are from female post-doctoral researchers (10 out of 42). When considering the different job categories, similar proportions cite positive and negative effects in each job type, although slightly more are received from post-doctoral researchers (12 positive and 48 negative). However, post-doctoral researchers are overrepresented in the sample. The age of those providing additional comments are in-line with the overall demographic profile of the sample.

Research activity

Within the research activity category, competition is seen to have an effect in six major ways. It promotes higher quality research, it encourages the rushing of research, it results in less collaboration, it results in scientists adopting a first versus best approach, and it encourages scientists to chase headlines. Finally, *traditional* competition is viewed as constructive.

Competition in research activity is perceived to create an environment promoting the production of higher quality research (41), with three times as many males compared to females mentioning this.

The competitive element also has some negative associations, 24 respondents indicate that competition has led to a reduction in research collaboration, in particular, the sharing of data or methodologies. Twice as many of those aged under 35 say this, compared to the other two age groups, and three times as many females as males state this.

20 respondents comment that competition can lead to people rushing to get research finished, and this is seen as an overwhelmingly negative aspect of competition in this area. Some feel the level of competition has led to less rigour (15), cutting corners (7) and the pushing of non-results in science (12), combined with the faking of data (12). This may be because people feel *"worried about getting scooped"* (14).

28 respondents note that headline chasing has increased in prominence, as it is perceived people *"shouting the loudest"* stand a better chance of gaining promotion, and securing funding. Some respondents note that this makes it more difficult for *"nice"* people (4), and leads to more selfish behaviour (11). Only two professors and two PhD students raise this comment, the other job categories are evenly represented among the remainder of respondents.

20 respondents cite that competition results in people adopting a first versus best approach, where it is considered an advantage if you are the first to publish in an area, rather than to publish the best work in an area. Overall, the race to be first is viewed negatively by those commenting, with only two positive comments. Four times as many females than males comment on this.

In total, 63 respondents (29%) raise poor research practices as an effect of competition in science, including rushing to get research finished, less rigour, cutting corners, the pushing of non-results, the faking of data, and adopting a first versus best approach.

18 respondents comment that *"traditional"* competition, those competing with other researchers to produce useful results, is constructive. However, typically this type of comment also includes some brief mentions that competition for funding is not beneficial (10). Twice as many males as females comment on this issue.

Respondents feel there is favouritism toward larger research groups (13), together with it being perceived as being easier for established researchers (13). Most often these comments are made in relation to securing funding money.

Overall, respondents fall into two camps when considering competition and research quality. As people strive to outperform others the research quality both improves and advances more rapidly. Or it declines, as people rush their research, are tempted to mislead or fabricate data, and respondents are more wary of collaboration for fear of having their research scooped by those at another institution.

> *"Competition is important in order to get the highest quality, but too much competition leads to reduced quality (eg, choosing less original, safer projects and lack of energy put into grant once it is received) and lower collaboration."* [Senior researcher/ lecturer, female, 36 to 45 (Respondent 438)].

> *"I think in theory competition should be healthy however I don't think it is, rather it means people do not share ideas/data/thoughts in the same way so that high quality science can be done for the greater good. Rather it is about getting the recognition for yourself as your career/funding is dependent on publications etc."* [Senior researcher, female, 36 to 45 (Respondent 580)].

> *"Whilst competition is healthy and on some level is necessary to identify the best scientists and the best research, the acute lack of funding, the obsession with generating high-impact papers, and the*

inherent instability present in the current climate hinders collaboration, stifles creativity and is extremely off-putting to pursuing a career in science." [Senior researcher/ lecturer, female, 36 to 45 (Respondent 311)].

"Even being the first to publish wrong data is better than being second to publish correct data." [Senior researcher/ lecturer, female, 36 to 45 (Respondent 28)].

"Never mind the quality, just get it published." [Senior researcher/ lecturer, female, over 45 (Respondent 198)].

"The rush to publish means experiments are not as complete as they would otherwise be due to the fear of being scooped and therefore losing the 'my lab was the first to....' badge in a grant application." [Senior researcher/ lecturer, female, over 45 (Respondent 502)].

"Depends on whether it is natural competition between individuals wanting to reach a certain level of understanding first (this is natural and positive), or whether it is competition forced on scientists from outside for monetary reasons / undue pressure to produce publically accessible research." [Researcher / lecturer, under 35 (Respondent 288)].

"I think that competition in science is good since it means that the pointless, 'stamp-collecting' research in principle does not get done." [Other, male, 36-45 (Respondent 125)].

<u>People</u>

Within the People category, two major themes emerge; the feeling competition encourages the best from individuals, but that it can result in higher dropout rates.

28 respondents cite that competition brings out the best in people, as it *"spurs them on"*, as they *"strive to be the first and push harder"*. 12 respondents consider this to be a positive, and only three of comments were negative. The remaining half of those commenting on this were more general and not clearly positive or negative. Broadly in-line with the demographic profile of those completing the study; the under 35 age group has twice as many respondents as either of the other age groups; post-doctoral researchers and lecturers are also represented twice as much as the other job categories.

Meanwhile, 20 respondents noted that competition leads to a higher dropout rate, as people move away from the profession, *"many of our most able students leave for other professions"*. This may be due to stress which had a number of mentions (14). Respondents also highlight that *"career progression is difficult"* (15), and that there is *"less job security"* (10). This is perceived to be another negative aspect of competition amongst those answering this question. Those under 35 are four times more likely to state this than those over 45, possibly because it is a more salient issue for those at the start of their career. A large number of post-doctoral researchers make this comment, while only three senior lecturers, one lecturer and no professors cite it, again this could relate to the saliency of this issue for these groups.

"I think some level of competition is good to motivate people and allow the most capable to be awarded positions and funding. However, the extreme level of competition for funding and jobs at the moment means that many extremely talented and capable people are losing out on opportunities and leaving science because they have no career progression prospects." [Senior researcher/ lecturer, female, 36 to 45 (Respondent 480)].

"I've seen so many good - mostly female - scientists drop out, discouraged, as they don't shout as loud as their peers and get passed over." [Senior researcher/ lecturer, female, under 35 (Respondent 51)].

Research funding

27 respondents note that funding cuts have led to a reduction in the amount of money available to finance science, as such there is greater competition to secure this finite resource. The vast majority of those commenting on this issue view this as a negative.

Some respondents indicate that in order to secure research funding it can take a considerable investment of time (13), and that researchers tend to gravitate toward *"safer research topics"* (12), which are more likely to win funding. These beliefs can often be linked to comments regarding a lack of creativity and innovation in science, as individuals take a more cautious approach.

> *"You have to be good to win the funding to do the research."* [Senior researcher, lecturer, female, under 35 (Respondent 521)].

Competition for funding money has led to people chasing headlines, which is pursuing research that has more public impact or interest, often at the cost of producing quality research. Respondents bemoan that funding seems diverted to these *"safe"* areas of science, or popular research areas, and that truly useful research thus struggles to secure financial backing. Research on safe topics areas has led to a reduction in break-through research, which is often riskier as it is more difficult to fund. Established researchers find it easier to secure funding, but for those at an early stage in their career without financial support it is difficult to progress in their career.

The lack of availability of funding means more competition for jobs, resulting in fewer early career researchers maintaining their position. There is a sense of reduced job security and difficulties in career progression, which ultimately results in individuals leaving the industry. Stress is also a common element in this situation.

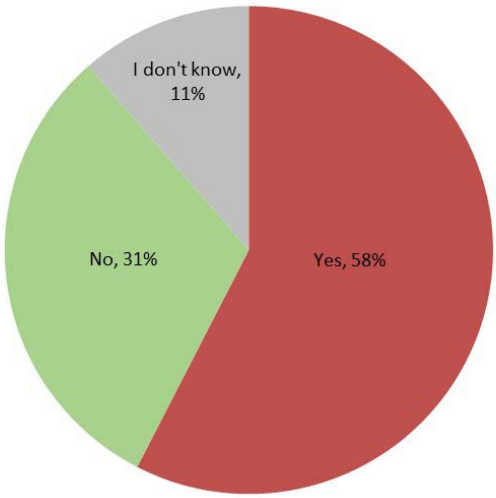
Gaining research funding takes a lot of investigative time away from researchers, and with limited money available, finance is not always guaranteed. It is also time consuming in identifying "new" propositions because an unsuccessful grant is not allowed to be resubmitted. Whilst competition for funding is viewed by some as detrimental, others see competition as a necessary evil in order to allocate limited financial resources, and therefore funding applications seem as good as any other option.

4.6. Compromising on research integrity and standards

4.6.1. Integrity in general

Q16. In your experience, have you ever been aware of scientists feeling tempted or under pressure to compromise on research integrity and standards? *(Sample base: 664)*

Almost 6 in 10 respondents are aware of scientists feeling tempted or under pressure to compromise on research integrity and standards (58%), whilst almost a third are not aware of this (31%).



Base: 664

No significant differences are evident amongst the specialties, organisations, job titles, age, gender and nationalities.

Of the 664 respondents answering this question, 252 provide additional evidence to their response through a verbatim comment (accounting for 38% of those answering the question and 26% of the overall survey sample). Poor methodology and data fraud are most frequently mentioned by respondents, with both being citied over 70 times.

Data fraud

Almost two-fifths of those commenting (96) cite the pressure to publish can encourage the use of fake data, altering data, omitting data, manipulating data, or *"cherry picking"* the best results to report. Whilst respondents do not admit to the practice, they typically report that they knew of it happening, or suspected cases where it may have happened. Some respondents refer to famous cases of researchers faking data and there is familiarity with websites such as Retraction Watch, which tracks retractions in journals. Respondents also note that some people report incomplete results, often due to pressure to publish results quickly, in order not to get scooped by other researchers.

When compared to the overall demographic profile of those completing this survey, no other notable differences in response are seen.

"All are at risk of making subtle changes to aspects of work and whilst not blatant fraud, it could influence findings or interpretation of findings. Selective statistics or omitting details that you know are relevant but were not demanded at peer review are obvious examples. Sometimes the individual may not be consciously aware they are doing it. Therefore, we must keep questioning our methods, standards and interpretations at every step." [Researcher/ lecturer, male, 36 to 45 (Respondent 408)].

"I am aware of a case where a researcher was discouraged by the PI from contacting experts in related fields to ensure the study information was accurate. The same PI also asked a researcher to analyse data and present the results in a way which benefited the PI's personal agenda." [Respondent 834].

"I am aware of others who have been tempted to edit their data to get the 'right' results. I am also aware of data-trawling exercises to 'find' interesting results." [Female, over 45 (Respondent 129)].

Poor methodology

A third of respondents (79) feel there is pressure to report positive results, rather than negative. Therefore, when conducting or reporting research individuals may feel compelled to focus on positive outcomes, and disregard negative ones. Researchers rushing to publish results may not conduct appropriate replications of their work. Respondents suggest that occasionally they are given a data set and told to run a variety of statistical tests to identify different outcomes, or run different statistical tests on the same data, to see which test gives the best results.

The demographic profiles of those citing pressure to utilise poor methodologies is broadly in keeping with the profile of those completing the survey (more females than males (42 vs. 34); post-doctoral researchers (29) provide the highest number of comments; those under 35 are the largest age group commenting (43) compared to 36 to 45 year olds (17) and over 45s (18)).

"Some researchers didn't repeat their experiments and used their replicates as independent experiments. Others left out data when it didn't match what they would expect." [Post-doctoral researcher, female, under 35 (Respondent 541)].

"I've seen scientists switch subjects between groups to bring results more into alignment with what will sell better to funders / journal editors / press officers, etc. to the extent that final conclusions have been different to those initially drawn." [Post-doctoral researcher, male, under 35 (Respondent 242)].

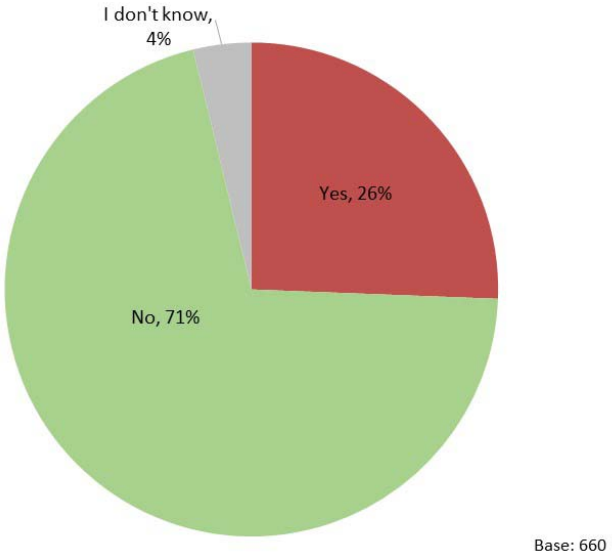
"Enormous pressure to produce positive results rather than negative, because of the preference to publish positive [results] rather than negative." [Post-doctoral researcher, female, under 35 (Respondent 193)].

"Due to financial restrictions, researchers will not necessarily repeat experiments often enough to be sure that the effect they report is actually reproducible. This is especially true in animal research, where researchers also have to justify the use of animals and the costs are high." [Post-doctoral researcher, female, 36 to 45 (Respondent 260)].

4.6.2. Personal integrity

Q17. Have you personally ever felt tempted or under pressure to compromise on research integrity and standards? *(Sample base: 660)*

Around one quarter of respondents have felt tempted or under pressure to compromise on research integrity and standards (26%), although over 7 in 10 have never felt this way (71%).



71% of respondents who work in a university setting said they have never been tempted or under pressure to compromise on research integrity - this is significantly more than those working in a research institution (59%).

More young, junior respondents state they have felt tempted or under pressure to compromise on research integrity and standards. A higher proportion of post-doctoral researchers who responded (32%) and those aged under 35 (33%) stated they had felt tempted or under pressure to compromise on research integrity and standards, in comparison with researcher/ lecturers (20%) and those aged above 35 (21%).

Similarly, proportionally more male respondents stated they had felt tempted or under pressure to compromise on research integrity (30% vs 22%; female).

No significant differences are evident amongst the different specialties and nationalities.

Of the 660 respondents answering this question, 149 provided additional evidence to their response through a verbatim comment (accounting for 23% of those answering the question and 15% of the overall survey sample).

No themes here garnered more than 25 responses, but respondents comment on poor methodology (22), data fraud (24), cutting corners (20) and exploitation (25).

Respondents do feel pressured, but do not openly admit to compromising on integrity or standards. The categories reported here mirror those of Q16 above. Temptation to compromise research integrity and standards is often driven by time pressures, although some respondents suggest that post-doctoral researchers or PhD students are placed under pressure by direct supervisors.

There is no further demographic analysis of this question because the sample size is too small.

4.7. Changing the UK research environment to facilitate high quality research

Q18. Is there anything you would like to change about the UK research environment in order to encourage the production of high quality science? *(Sample base: 456)*

Almost half (47%) of those taking part in the study, provided a response to this question. The majority highlight the following areas they would like to change about the current UK research environment:

- Funding issues
- Career structure and progression
- Changing the focus of evaluation

Funding issues

Respondents (192) tend to comment on perceptions of skewed funding, where funding is concentrated in large research centres and there is favouritism toward the 'Golden Triangle' of London, Oxford and Cambridge, or Russell Group universities. Respondents also express a desire for more cross-disciplinary funding to be made available, and more funding for riskier or 'blue sky' projects. Some note that funding seems to be awarded to safer research projects, where results are almost known in advance, but this approach hampers scientific development. More useful knowledge comes from "risky" research, where results are unknown or unexpected at the start of the research. There is an aspiration for funding to be made available over longer time periods, this is because there is a general feeling that good science takes time. Some respondents suggest a more diversified funding model would be beneficial, with money available for researchers at all stages of their career.

Relative to the overall profile of those taking part in the survey, a greater proportion of males are likely to voice these opinions than females.

When compared to the overall demographic profile of those completing this survey, no other notable differences in response are seen.

> *"Recently there has been a tendency to allocate large funds to 'research centres' with the idea that multiple institutions can use those facilities. In practice, this doesn't occur (e.g. there is no funding available to send researchers to these facilities)."* [Researcher/ lecturer, male, under 35 (Respondent 496)].

> *"Science is research. An exploration into the unknown. Stop treating it like a manufacturing exercise. Stop quantifying and comparing every step of the process. Allow risky as well as less-risky projects."* [Professor, male, over 45 (Respondent 649)].

> *"Longer contracts so more ambitious projects can be undertaken. Grants that do not tie you to doing exactly what you specified on application but allow you to follow the science."* [Post-doctoral researcher, female, 36 to 45 (Respondent 789)].

> *"I think the move towards identifying a narrow theme and then having a funding call in this area is a problem. Too much funding will go to cliques and those in the circle and not necessarily those with the best ideas or doing the highest quality work."* [Professor, male, over 45 (Respondent 224)].

Career structure and progression

37% of those answering the question cite career structure and progression as an area for change. Respondents tend to comment on the limited opportunities women have for career breaks, unclear progression paths for those who want to remain researchers (rather than becoming lecturers with teaching responsibility) and the post-doctoral contract system whereby researchers typically operate on short-term (e.g. 3-4 year) contracts and have to keep applying for funding to stay employed. A result the scientific community loses a lot of well-qualified post-doctoral researchers because they simply can't sustain their funding. An experienced post-doctoral researcher can often be harder to fund than a PhD researcher, even though the post-doctoral researcher has greater accumulated knowledge. There is also a general consensus in the need for better trained researchers, especially in statistics.

Almost twice as many females comment on this, compared to males (104 versus 60). This may be due to females having a greater need for a career break.

The remaining demographic profiles of those stating diversity issues is broadly in keeping with those completing the survey (post-doctoral researchers (67) provide the highest number of comments; those under 35 are the largest age group commenting (72).

> *"The career pathway needs serious work. Its organisation is closer to a Ponzi scheme than a modern progressive workforce. Outreach and equality campaigns are rendered almost entirely pointless by the fact that over 99% of all those entering the field (i.e. PhD candidates) are forced out. Almost any other field where multi-year training was required would be horrified to have such an awful staff retention figure."* [Post-doctoral researcher, female, under 35 (Respondent 633)].

> *"UK Universities should not focus on training endless PhDs/D.Phils for jobs that do not exist and for a career that very few people want, given the lack of job security."* [Post-doctoral researcher, male, under 35 (Respondent 567)].

> *"Less pressure to publish regularly and A LOT more job security would go a long way towards ensuring that researchers take the time necessary to conduct research thoroughly, as well as giving the space to follow up on original (risky) ideas that have high potential."* [Post-doctoral researcher, female, under 35 (Respondent 321)].

Changing the focus of evaluation

Respondents commenting on this issue (112) tend to focus on the use of evaluation by such things as the REF and Impact factors of journals. It is felt that this has increased short-termism in science, and a more holistic approach to evaluation would be more helpful.

When compared to the overall demographic profile of those completing this survey, no other notable differences in response are seen.

"Stop this ridiculous obsession with impact. Some of the best scientific discoveries had no obvious use when they were initially reported. There are many scientists out there who have changed our understanding of the world but have comparatively poor publication records." [Senior researcher, lecturer, male, over 45 (Respondent 159)].

"There is a good deal of pressure on researchers to achieve 'good and novel' data. There needs to be better recognition of good quality research that yields negative unsexy results." [Professor, male, over 45 (Respondent 54)].

"The reliance on the REF to determine funding leads to safe science. It is only now, midway through my career that I feel in a position where I can follow up some high-risk but potentially very high reward ideas that could take years to deliver. I had to spend too much time playing the RAE and REF game to get into a position where I feel I can do my best science." [Professor, male, 36 to 45 (Respondent 491)].

4.8. Additional comments

Q26. Please use this space to provide any other comments about the issues raised in this survey. *(Sample base: 89)*

Of the 970 respondents taking part in the study, 89 provide an answer to this question (9%). Support for the survey and governance issues are most mentioned by respondents, both are discussed over 20 times.

Over two-fifths of respondents (44%) left favourable comments on the importance of the survey, and offered 'thanks' for carrying out the survey. However, these comments are tempered by scepticism regarding whether the survey results will have any influence.

> *"Timely issue but I have no expectations of any change as a result…"* [Senior researcher, female, over 45 (Respondent 71)].

> *"I hope these results are taken seriously. We need a change in the way things are going in this country."* [Professor, male, under 35 (Respondent 32)].

> *"Glad this study is taking place, it raises some important issues. I hope the results will be widely communicated and presented to government at the highest levels."* [Female, 36 to 45 (Respondent 255)].

Around a quarter (24%) cite governance issues, with the majority of these discussing the frameworks within which research is conducted (e.g. REF, Impact) and their negative effects.

> *"The processes around science should encourage different ways of thinking and innovation. Processes such as the REF and measures of impact take away thinking time."* [Post-doctoral researcher, female, 36 to 45 (Respondent 472)].

> *"The current drive to improve the quality of research in this country is having the reverse effect."* [Professor, male, 36 to 45 (Respondent 35)].

> *"Neo-liberal economic thinking is increasingly becoming apparent at work, and it is not good for science."* [Researcher/ lecturer, female, under 35 (Respondent 853)].

> *"Universities need a major shake-up and a more professional approach, since they are essentially large companies with multi-billion pound turnover."* [Female, over 45 (Respondent 898)].

Appendix

Percentage that respond to each question by discipline, organisation and job title

Question 4
What motivates you in your work as a scientist?

Number answering quantitative element of question: 790 (81% of total sample)

	Percentage of total survey responses	Percentage of survey responses to quantitative Q4
Bioscience	55%	56%
Medicine	27%	28%
Physics	8%	8%
Chemistry	12%	12%
Engineering	6%	7%
Computing	6%	6%
Psychology	8%	9%
Social sciences	8%	9%
Other specialties	20%	20%
University	79%	82%
Research institution	14%	14%
Other organisation	20%	19%
Post-Doctoral Researcher	28%	30%
Researcher/ Lecturer	13%	14%
Senior Researcher/ Lecturer	13%	15%
Professor	10%	11%
PhD Student	6%	6%
Other job titles	23%	23%
Base	*970*	*790*

Question 5
Please select five words from the list below that best describe your understanding of 'high quality research'

Number answering quantitative element of question: 777 (80% of total sample)
Number providing a verbatim comment: 35 (5% of total sample and 4% of those responding to the quantitative element of this question)

	Percentage of total survey responses	Percentage of survey responses to quantitative Q5	Percentage of survey responses to verbatim Q5
Bioscience	55%	55%	60%
Medicine	27%	28%	29%
Physics	8%	8%	14%
Chemistry	12%	12%	14%
Engineering	6%	7%	17%
Computing	6%	6%	6%
Psychology	8%	8%	9%
Social sciences	8%	8%	11%
Other specialties	20%	20%	34%
University	79%	81%	83%
Research institution	14%	14%	23%
Other organisation	20%	19%	26%
Post-Doctoral Researcher	28%	29%	23%
Researcher/ Lecturer	13%	14%	14%
Senior Researcher/ Lecturer	13%	15%	11%
Professor	10%	11%	34%
PhD Student	6%	6%	6%
Other job titles	23%	24%	11%
Base	*970*	*777*	*35*

Question 6
What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science?

Number answering quantitative element of question: 774 (80% of total sample)
Number providing a verbatim comment: 131 (14% of total sample and 17% of those responding to the quantitative element of this question)

	Percentage of total survey responses	Percentage of survey responses to quantitative Q6	Percentage of survey responses to verbatim Q6
Bioscience	55%	55%	57%
Medicine	27%	28%	28%
Physics	8%	8%	10%
Chemistry	12%	12%	13%
Engineering	6%	7%	8%
Computing	6%	6%	8%
Psychology	8%	9%	8%
Social sciences	8%	9%	14%
Other specialties	20%	20%	26%
University	79%	81%	85%
Research institution	14%	14%	14%
Other organisation	20%	20%	20%
Post-Doctoral Researcher	28%	30%	25%
Researcher/ Lecturer	13%	14%	12%
Senior Researcher/ Lecturer	13%	15%	21%
Professor	10%	12%	18%
PhD Student	6%	6%	5%
Other job titles	23%	24%	19%
Base	*970*	*774*	*131*

Question 7
What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science?

Number answering quantitative element of question: 769 (79% of total sample)
Number providing a verbatim comment: 94 (10% of total sample and 12% of those responding to the quantitative element of this question)

	Percentage of total survey responses	Percentage of survey responses to quantitative Q7	Percentage of survey responses to verbatim Q7
Bioscience	55%	55%	68%
Medicine	27%	28%	32%
Physics	8%	8%	10%
Chemistry	12%	12%	13%
Engineering	6%	7%	9%
Computing	6%	6%	4%
Psychology	8%	9%	9%
Social sciences	8%	9%	10%
Other specialties	20%	21%	22%
University	79%	81%	84%
Research institution	14%	14%	17%
Other organisation	20%	19%	22%
Post-Doctoral Researcher	28%	29%	26%
Researcher/ Lecturer	13%	14%	14%
Senior Researcher/ Lecturer	13%	15%	19%
Professor	10%	12%	18%
PhD Student	6%	6%	5%
Other job titles	23%	24%	18%
Base	*970*	*769*	*94*

Question 8
What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science?

Number answering quantitative element of question: 757 (78% of total sample)
Number providing a verbatim comment: 97 10% of total sample and 13% of those responding to the quantitative element of this question)

	Percentage of total survey responses	Percentage of survey responses to quantitative Q8	Percentage of survey responses to verbatim Q8
Bioscience	55%	55%	61%
Medicine	27%	28%	27%
Physics	8%	8%	6%
Chemistry	12%	12%	18%
Engineering	6%	7%	6%
Computing	6%	6%	7%
Psychology	8%	9%	9%
Social sciences	8%	9%	9%
Other specialties	20%	21%	25%
University	79%	81%	85%
Research institution	14%	14%	16%
Other organisation	20%	20%	20%
Post-Doctoral Researcher	28%	30%	34%
Researcher/ Lecturer	13%	14%	14%
Senior Researcher/ Lecturer	13%	15%	17%
Professor	10%	12%	17%
PhD Student	6%	6%	3%
Other job titles	23%	24%	16%
Base	*970*	*757*	*97*

Question 9
What effect are these features of the UK research environment having on scientists in terms of encouraging the production of high quality science?

Number answering quantitative element of question: 744 (77% of total sample)
Number providing a verbatim comment: 83 (9% of total sample and 11% of those responding to the quantitative element of this question)

	Percentage of total survey responses	Percentage of survey responses to quantitative Q9	Percentage of survey responses to verbatim Q9
Bioscience	55%	55%	57%
Medicine	27%	29%	46%
Physics	8%	8%	7%
Chemistry	12%	12%	10%
Engineering	6%	7%	7%
Computing	6%	6%	7%
Psychology	8%	9%	11%
Social sciences	8%	9%	18%
Other specialties	20%	21%	22%
University	79%	81%	87%
Research institution	14%	13%	12%
Other organisation	20%	20%	23%
Post-Doctoral Researcher	28%	29%	18%
Researcher/ Lecturer	13%	14%	19%
Senior Researcher/ Lecturer	13%	16%	16%
Professor	10%	12%	24%
PhD Student	6%	6%	4%
Other job titles	23%	23%	19%
Base	*970*	*744*	*83*

Question 10
Which feature/s of the UK research environment do you think are having the most positive effect on scientists in terms of encouraging high quality science?

Number providing a verbatim comment: 406 (42% of total sample)

	Percentage of total survey responses	Percentage of survey responses to verbatim Q10
Bioscience	55%	56%
Medicine	27%	31%
Physics	8%	8%
Chemistry	12%	12%
Engineering	6%	7%
Computing	6%	6%
Psychology	8%	10%
Social sciences	8%	10%
Other specialties	20%	19%
University	79%	84%
Research institution	14%	13%
Other organisation	20%	18%
Post-Doctoral Researcher	28%	26%
Researcher/ Lecturer	13%	15%
Senior Researcher/ Lecturer	13%	17%
Professor	10%	15%
PhD Student	6%	6%
Other job titles	23%	21%
Base	*970*	*406*

Question 11
How are they having a positive effect?

Number providing a verbatim comment: 353 (36% of total sample)

	Percentage of total survey responses	Percentage of survey responses to verbatim Q11
Bioscience	55%	56%
Medicine	27%	32%
Physics	8%	7%
Chemistry	12%	11%
Engineering	6%	7%
Computing	6%	6%
Psychology	8%	11%
Social sciences	8%	11%
Other specialties	20%	19%
University	79%	84%
Research institution	14%	13%
Other organisation	20%	19%
Post-Doctoral Researcher	28%	27%
Researcher/ Lecturer	13%	15%
Senior Researcher/ Lecturer	13%	16%
Professor	10%	15%
PhD Student	6%	6%
Other job titles	23%	21%
Base	*970*	*353*

Question 12
Which feature/s of the UK research environment do you think are having the most negative effect on scientists in terms of discouraging high quality science?

Number providing a verbatim comment: 482 (50% of total sample)

	Percentage of total survey responses	Percentage of survey responses to verbatim Q12
Bioscience	55%	57%
Medicine	27%	30%
Physics	8%	8%
Chemistry	12%	12%
Engineering	6%	7%
Computing	6%	7%
Psychology	8%	9%
Social sciences	8%	8%
Other specialties	20%	20%
University	79%	82%
Research institution	14%	13%
Other organisation	20%	19%
Post-Doctoral Researcher	28%	28%
Researcher/ Lecturer	13%	15%
Senior Researcher/ Lecturer	13%	16%
Professor	10%	13%
PhD Student	6%	5%
Other job titles	23%	22%
Base	*970*	*482*

Question 13
How are they having a negative effect?

Number providing a verbatim comment: 439 (45% of total sample)

	Percentage of total survey responses	Percentage of survey responses to verbatim Q13
Bioscience	55%	56%
Medicine	27%	29%
Physics	8%	7%
Chemistry	12%	11%
Engineering	6%	7%
Computing	6%	7%
Psychology	8%	10%
Social sciences	8%	8%
Other specialties	20%	20%
University	79%	83%
Research institution	14%	13%
Other organisation	20%	19%
Post-Doctoral Researcher	28%	28%
Researcher/ Lecturer	13%	16%
Senior Researcher/ Lecturer	13%	16%
Professor	10%	13%
PhD Student	6%	5%
Other job titles	23%	22%
Base	*970*	*439*

Question 14
How competitive do you think these different aspects of working as a scientific researcher are?

Number answering quantitative element of question: 672 (70% of total sample)
Number providing a verbatim comment: 41 (4% of total sample and 6% of those responding to the quantitative element of this question)

	Percentage of total survey responses	Percentage of survey responses to quantitative Q14	Percentage of survey responses to verbatim Q14
Bioscience	55%	55%	61%
Medicine	27%	29%	32%
Physics	8%	8%	2%
Chemistry	12%	13%	12%
Engineering	6%	7%	2%
Computing	6%	6%	7%
Psychology	8%	9%	12%
Social sciences	8%	9%	12%
Other specialties	20%	21%	22%
University	79%	81%	83%
Research institution	14%	14%	15%
Other organisation	20%	20%	24%
Post-Doctoral Researcher	28%	30%	24%
Researcher/ Lecturer	13%	15%	10%
Senior Researcher/ Lecturer	13%	15%	12%
Professor	10%	12%	34%
PhD Student	6%	6%	5%
Other job titles	23%	23%	15%
Base	*970*	*672*	*41*

Question 15
What kind of effect do you think competition in science is having on the production of high quality science?

Number answering quantitative element of question: 659 (68% of total sample)
Number providing a verbatim comment: 325 (34% of total sample and 49% of those responding to the quantitative element of this question)

	Percentage of total survey responses	Percentage of survey responses to quantitative Q15	Percentage of survey responses to verbatim Q15
Bioscience	55%	55%	62%
Medicine	27%	29%	28%
Physics	8%	8%	9%
Chemistry	12%	12%	13%
Engineering	6%	7%	6%
Computing	6%	7%	7%
Psychology	8%	9%	8%
Social sciences	8%	9%	7%
Other specialties	20%	21%	20%
University	79%	81%	81%
Research institution	14%	14%	15%
Other organisation	20%	20%	21%
Post-Doctoral Researcher	28%	30%	28%
Researcher/ Lecturer	13%	15%	15%
Senior Researcher/ Lecturer	13%	15%	17%
Professor	10%	12%	11%
PhD Student	6%	6%	7%
Other job titles	23%	23%	23%
Base	*970*	*659*	*325*

Question 16
In your experience, have you ever been aware of scientists feeling tempted or under pressure to compromise on research integrity and standards?

Number answering quantitative element of question: 664 (68% of total sample)
Number providing a verbatim comment: 252 (26% of total sample and 38% of those responding to the quantitative element of this question)

	Percentage of total survey responses	Percentage of survey responses to quantitative Q16	Percentage of survey responses to verbatim Q16
Bioscience	55%	55%	60%
Medicine	27%	29%	29%
Physics	8%	8%	6%
Chemistry	12%	12%	11%
Engineering	6%	7%	6%
Computing	6%	6%	6%
Psychology	8%	9%	9%
Social sciences	8%	9%	9%
Other specialties	20%	21%	18%
University	79%	81%	85%
Research institution	14%	14%	12%
Other organisation	20%	20%	20%
Post-Doctoral Researcher	28%	30%	26%
Researcher/ Lecturer	13%	15%	17%
Senior Researcher/ Lecturer	13%	15%	15%
Professor	10%	12%	13%
PhD Student	6%	6%	7%
Other job titles	23%	23%	22%
Base	*970*	*664*	*252*

Question 17
Have you personally ever felt tempted or under pressure to compromise on research integrity and standards?

Number answering quantitative element of question: 660 (68% of total sample)
Number providing a verbatim comment: 149 (15% of total sample and 23% of those responding to the quantitative element of this question)

	Percentage of total survey responses	Percentage of survey responses to quantitative Q17	Percentage of survey responses to verbatim Q17
Bioscience	55%	55%	58%
Medicine	27%	29%	28%
Physics	8%	8%	6%
Chemistry	12%	12%	8%
Engineering	6%	7%	7%
Computing	6%	6%	9%
Psychology	8%	9%	11%
Social sciences	8%	9%	9%
Other specialties	20%	21%	24%
University	79%	81%	81%
Research institution	14%	14%	17%
Other organisation	20%	20%	24%
Post-Doctoral Researcher	28%	30%	30%
Researcher/ Lecturer	13%	15%	14%
Senior Researcher/ Lecturer	13%	15%	15%
Professor	10%	12%	13%
PhD Student	6%	6%	7%
Other job titles	23%	23%	22%
Base	*970*	*660*	*149*

Question 18
Is there anything you would like to change about the UK research environment in order to encourage the production of high quality science?

Number providing a verbatim comment: 455 (47% of total sample)

	Percentage of total survey responses	Percentage of survey responses to verbatim Q18
Bioscience	55%	57%
Medicine	27%	31%
Physics	8%	8%
Chemistry	12%	12%
Engineering	6%	6%
Computing	6%	7%
Psychology	8%	9%
Social sciences	8%	9%
Other specialties	20%	21%
University	79%	82%
Research institution	14%	13%
Other organisation	20%	20%
Post-Doctoral Researcher	28%	28%
Researcher/ Lecturer	13%	13%
Senior Researcher/ Lecturer	13%	17%
Professor	10%	13%
PhD Student	6%	5%
Other job titles	23%	24%
Base	*970*	*455*

Question 26
Please use this space to provide any other comments about the issues raised in this survey.

Number providing a verbatim comment: 88 (9% of total sample)

	Percentage of total survey responses	Percentage of survey responses to verbatim Q26
Bioscience	55%	59%
Medicine	27%	39%
Physics	8%	7%
Chemistry	12%	15%
Engineering	6%	6%
Computing	6%	3%
Psychology	8%	7%
Social sciences	8%	11%
Other specialties	20%	25%
University	79%	76%
Research institution	14%	15%
Other organisation	20%	26%
Post-Doctoral Researcher	28%	25%
Researcher/ Lecturer	13%	9%
Senior Researcher/ Lecturer	13%	15%
Professor	10%	21%
PhD Student	6%	6%
Other job titles	23%	25%
Base	*970*	*88*