Communicating knowledge:

How and why UK researchers publish and disseminate their findings

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Preface

The research on which this report is based was undertaken by a team from Loughborough University and Manchester Metropolitan University. The Research Information Network (RIN) and the Joint Information Systems Committee (JISC) are very grateful to Jenny Fry and Charles Oppenheim (Department of Information Studies, Loughborough University); Claire Creaser, William Johnson, Mark Summers and Sonya White (Library and Information Statistics Unit, Loughborough University); and Geoff Butters, Jenny Craven Jill Griffiths, and Dick Hartley (Centre for Research in Library and Information Management, Manchester Metropolitan University). The RIN and JISC are grateful to the team for the work they have done in helping to shed light on a wide range of issues relating to how researchers decide when, where and how to communicate their findings.

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Finally, we wish to express our thanks to all those researchers who contributed to this work, both in responding to our survey and by attending focus groups. Without them this report could not have been written.

Supporting papers

This report is complimented by four supporting papers which provide detailed descriptions of the methods used, a full analysis of the data, and further details of the findings.

1. Bibliometric analysis
2. Report of focus group findings
3. Report and analysis of researcher survey
4. Literature review

The papers are available at
www.rin.ac.uk/communicating-knowledge

Contents

Executive summary

Researchers are driven by a desire to enhance our knowledge and understanding of the world we inhabit, and to communicate their findings to others. But both governments and other funders are increasingly interested in demonstrating the social and economic returns from their investments in research, and in assessing research performance.

The many different criteria for success, and the lack of any consensus on how success should be assessed or measured, however, mean that researchers often find themselves in receipt of confused or conflicting messages. And they are pulled in different directions in deciding which channels of communication they should adopt.

How researchers publish and why

Researchers publish and disseminate their work in many different ways: through formal publication in books and in learned and professional journals; through conferences and their proceedings; and through a variety of less formal means, now including web-based tools for social networking. The choices they make are underpinned by a number of interrelated motives beyond the simple desire to pass on their findings to those who may be interested in them. These motivations include the desire not only to maximise dissemination to a target audience, but to register their claim to the work they have done, and to gain peer esteem and the rewards that may flow from that. Specific requirements from funders, or institutional guidelines, or pressure from co-authors or collaborators, are much less influential.

In deciding when, where and how to communicate their work, researchers may have to make choices between speedy dissemination to a desired audience, and less speedy publication in a high-status journal. Such choices are made more complex because researchers know that publications serve not only as means of communication. They can be monitored or measured as indicators of quality or impact (in the academic world and more widely). And the difficulty in choosing between different channels of communication is exacerbated because researchers often find the messages they get from different agencies, including universities, conflicting or unclear. But the perception that their work is being monitored and assessed in particular ways, notably by the RAE, has a major influence on how they communicate.

Articles in scholarly journals are more easily ranked and measured using a series of readily-available and increasingly-sophisticated metrics; and it is partly because of that – especially in disciplines where they have not predominated in the past – that they have come to dominate all other forms of publication. Yet there is a rich array of other kinds of output employed and valued by researchers, and many feel uncomfortable with the dominance of the article – particularly the article published in a high-status journal. They are concerned that communications

through other channels – especially those that are better-suited to applied or practice-based research, and to communicating with non-academic audiences – seem to have low status and prestige in the academic world.

The only major exceptions to the dominance of the journal article are the continuing high status attached to monographs and edited volumes in the humanities, and to practice-based outputs in the arts. Yet even in the humanities, journal articles are now by far the largest publication format by volume; although books continue to be highly valued, including in submissions to the RAE, there are increasing concerns about the decline of the book, attributed variously to shrinking library purchase budgets, publishers' reluctance, and by some, to the pressures of the RAE.

Many researchers are confused by the mixed messages they are receiving as to how best to communicate their findings. If they are to make optimal use of the various communications channels open to them, it is essential that researchers should receive more consistent and effective guidance on their use of different channels; and that in framing their messages, funders and others should take account of the value researchers themselves attach to the channels appropriate to their work.

Funders and policy-makers must also take account of the various misperceptions of their policies noted in this report. In particular, if they wish to encourage researchers to publish and disseminate their work through channels other than high-status journals, they will need to give stronger and more positive messages about how these channels will be valued when it comes to assessing researchers' performance.

Disciplinary diversity

The motivations that lead researchers to publish in different formats – particularly in scholarly journals – differ significantly across disciplines. Researchers in the sciences are more likely to see publication in a learned journal as a 'natural' means of communication with their desired audience, while their colleagues in engineering, the humanities and the social sciences are more likely to see it as meeting essentially external requirements for research assessment and career advancement.

In these latter disciplines, therefore, the rise of journals is more closely associated with an environment where there is increasing emphasis on measuring, assessing, and evaluating research, its outputs and impact. Yet in the humanities especially, there is a complex, even contradictory, array of perceptions at work: researchers are producing more articles, partly because they believe that is what they are being told to do; but many resent the limitations (especially the brevity) of the format, and when it comes to the RAE, there is a strong tendency to submit books instead.

Many differences between disciplines relate to the speed with which they move, and the nature and scope of their engagement with non-academic audiences. In computer science, for example, the pace of change means that conferences are particularly important, and these may attract higher prestige than journal articles. Speed of development may also be a factor in the take-up of open access. Repositories have achieved less traction in the humanities and social sciences than in many science and engineering subjects.

In areas where applied research is a prominent feature, the choice between publishing in a prestigious journals and effective dissemination to potential users may be especially difficult. Researchers in areas such as cancer studies, nursing, psychology, education and politics all stress the importance of communication and engagement with practitioners and policy-makers. Tensions between effective dissemination and the prestige attached to publishing in a high-status journal seem to be less acute in the physical and life sciences.

Collaboration and co-authorship

The push from research funders for more collaboration across institutional, national and disciplinary boundaries is reflected in the growing number of multi-authored publications. Multi-authorship is the norm in the sciences and engineering, but much less common in the humanities. Its rise has also been accompanied by difficulties over issues including responsibility for the conduct and validity of the research, the inclusion and exclusion of individual authors, and the order in which authors are listed; and by complaints about some senior researchers abusing their position.

There are important differences of practice in the attribution and listing of authors. Listing in order of contribution is the commonest practice except in the humanities, where alphabetical listing is the norm. There are also notable variations in practice within discipline groups: in some areas, for example, the major or senior contributor may be placed last.

It is important that all who are involved in assessing research – whether via bibliometrics or through peer review – should be well-informed about different conventions and their meaning, and how they are changing. Funders, learned societies and publishers may also wish to consider whether they might take more of a lead in helping to devise guidelines on good practice.

What researchers cite and why

Referencing other work is integral to the process of communicating research findings, and citations can be found in virtually all publications. Researchers cite previous work to establish their knowledge of the context and to provide supporting evidence. But the increasing emphasis on citation data as a means of assessing research performance makes it more important that we understand how researchers decide what to cite.

The major influences on researchers are the perceived authority of the publications and the authors, although there are different views on which of these predominates. Our research does not support the suggestion that personal contact is a major factor in deciding to cite an author. Indeed, *disagreement* with previous findings is among the significant reasons for citing – strongly so in the humanities and social sciences, but in the physical and life sciences too.

Citations are clearly influenced by disciplinary norms. Humanities and social science researchers cite more sources on average, mainly because they write at greater length and cite primary sources as well as the work of peers. They also cite more grey literature and websites, and works with which they disagree. Scientists are more likely to concentrate solely on journal articles.

Citation practice is largely self-taught. Few researchers have been trained beyond any guidance they received as young researchers from their supervisors. They also receive advice from reviewers and co-authors, and they tailor their citations to meet to the real or perceived requirements of specific journals. Advice from reviewers and editors is often received positively, but may be seen as an attempt to promote their own work.

Access to online material has speeded up the process of finding, reading and deciding what to cite. A third of researchers in the life sciences – even more of the younger ones – say that easy accessibility has a major influence on what they cite. In the humanities and social sciences, accessibility has less influence. But citation practice is related as much to researchers' length of experience as to the disciplines in which they work. Younger researchers are more likely to be influenced by the authority of or familiarity with an author, by the standing of the journal and by ease of access to the article. *If such differences persist as younger researchers progress through their careers, funders and others concerned with assessing research performance may need to take account of significant changes in the patterns of citation.*

Another increasing influence is the limits some high-status journals impose on the number of references to be included in an article. *If such limitations continue to increase, one effect could be to lessen the usefulness of citation data for bibliometric and assessment purposes, even in those fields where they are considered robust at present.*

Research assessment and its influence

The influence of the RAE on researchers' behaviours and attitudes should be set in the broader context of their concerns about what they see as an increasing stress from funders and institutions on assessing and evaluating research and its impact (with impact varyingly defined). The RAE is a major concern for researchers, much more important for most of them than other forms of assessment. There are significant differences, however, between what researchers publish and consider to be important, and what is submitted to the RAE.

Researchers' perceptions and understanding of RAE requirements are mediated via universities, which develop their own strategies to maximise their RAE performance. Thus what the funding councils say is not necessarily what researchers hear. A common view is that the RAE is a game researchers have to play; and that it may constrain intellectual autonomy. A quarter of researchers believe that important outputs were not submitted to the last RAE; and many more are concerned about pressures they perceive to seek publication only in high-status journals. With the exception of monographs in the humanities and practice-based outputs in the arts, researchers see the RAE, perhaps wrongly, as a disincentive to any other forms of dissemination. *Since journal articles are the publications most readily measured, and thus most susceptible to evaluation through any system of performance assessment, there is a risk that their dominance will increase.*

Researchers are also concerned about the relationship between the timescales for research and for the RAE. Most believe that it often takes longer than the length of an RAE cycle for the significance and value of research findings to be recognised: they often talk of periods of ten years or more. The proposal that the impact of research beyond the academic and research communities should be a significant feature in the RAE may help to clarify the mixed messages that researchers think they are receiving about the goals they should seek; and the relative priority they should give to criteria for success such as academic quality, speed of dissemination, engagement with non-academic audiences, and wider socio-economic impact. *But the timescales for research, recognition and impact differ widely across different disciplines and kinds of research. Research timescales need to be carefully considered in any arrangements for the assessment of performance.*

Our research has been undertaken in a climate where there has been considerable debate about the format of the Research Excellence Framework (REF) and the role that bibliometrics might play in it. There has been considerable scope for speculation and misconception. Many researchers say that any move to give greater weight to citation analysis will have a significant effect on their behaviour: they will publish more; they will submit their work more often to journals with high impact factors; and they will make their publications open access.

It will also change their citation practice. Many are concerned about the scope for misunderstanding and manipulation of citations, especially in the light of differences in author attribution and citation practice within and across disciplines. Only a small minority say they will cite competitors' work less often; but even while they deprecate citation clubs and circles, nearly two-fifths of researchers say that they will cite their collaborators' work more often. *Possible changes in practice will need to be carefully monitored as the REF develops.*
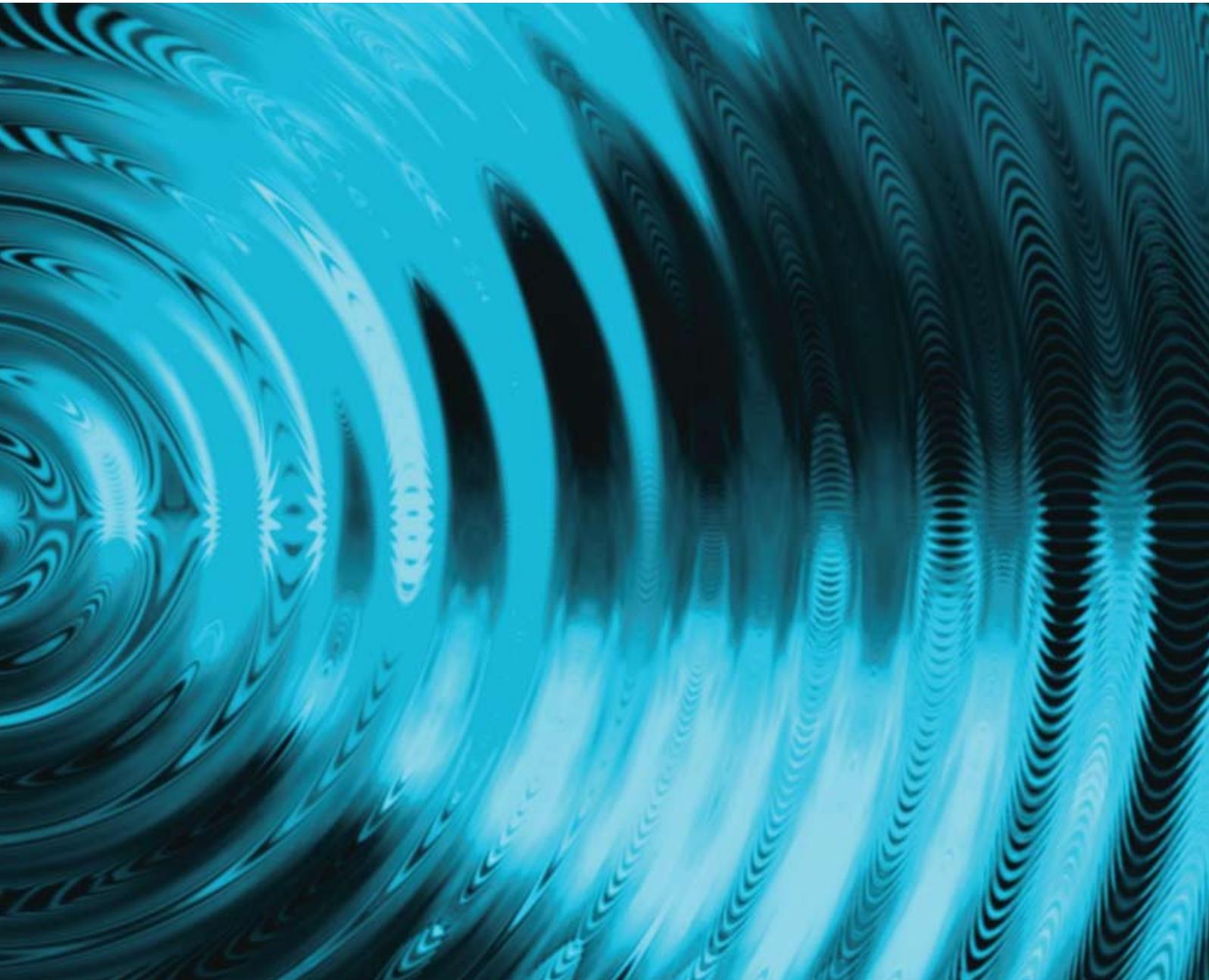
1. Introduction

This report was commissioned by the Research Information Network (RIN) and the Joint Information Systems Committee (JISC) to gather and analyse evidence about:

- the motivations, incentives and constraints that lead researchers in the UK in different subjects and disciplines to publish and disseminate their work in different ways

- how and why researchers cite other researchers' work, and

- in particular, how researchers' decisions on publication and citation are influenced (or not) by considerations arising from research assessment.

It investigates a series of questions in three broad areas:

1. Publication and dissemination behaviour

2. Citation behaviour

3. The perceived influence of research assessment (past and anticipated)

1. Publication and dissemination behaviour

- What factors motivate researchers to publish/disseminate their work using particular channels?

- What are the constraints as well as the incentives behind these motivations?

- What factors influence decisions on the *timing* of publication and dissemination?

- How do patterns vary across different subjects and disciplines?

- How do cross-institutional or international collaborations, or collaborations with industry, affect publication and dissemination behaviour?

- How do they acknowledge the contributions of colleagues, short of co-authorship?

2. Citation behaviour

- What factors influence how researchers choose what work to cite, and why?

- How is this connected to what they decide to read, and why?

- How do they decide what versions of other researchers' material to read and cite?

- How do answers to these questions vary among subjects and disciplines?

3. The perceived influence of research assessment (past and anticipated)

- What place have the perceived requirements of research assessment occupied in the full range of factors that have influenced publication and citation behaviour?

- How have research assessment and its perceived requirements influenced behaviour?

- While acknowledging that the REF has not yet been set up, are researchers, departments and institutions *already* taking into account, in their decisions on publication and citation, the perceived impact of a more bibliometric-based research assessment system?

- How do researchers perceive that a more bibliometric-based research assessment system will affect their decisions on publication and citation in the future?

- On what information are they basing their views?

1.1   Methods

The work on which this report is based has four elements:

- a literature review

- a bibliometric analysis of a sample of published research outputs and the material cited in those outputs

- a series of focus groups and interviews with research-active academics from a cross-section of institutions and disciplines, and

- an online survey of UK academic researchers.

Further information about the methods used is presented in the annex. We believe that taken together they enable us to present a comprehensive view of how researchers communicate their work, and cite the work of others, across the range of disciplines in the UK; and to provide a baseline for further studies. Full details of both the methods and the results obtained in the different elements of the study are presented in a series of supporting papers. They expand on the evidence presented in this report and are available on the RIN website at

www.rin.ac.uk/communicating-knowledge

1.2   Structure of this report

This report presents an overview of our findings in relation to the key research questions set out above. Sections 2, 3 and 4 give a synthesis of the major findings from the four elements of our study, as they relate to the dissemination and publication behaviour of UK researchers, their citation and referencing behaviour, and the effects which research assessment has on these behaviours, respectively.

Section 5 presents a summary of the findings, and highlights points for further discussion and investigation. There are no formal recommendations, but we believe that our findings and the points we highlight should be of interest to the UK higher education funding bodies as they pursue their consultations on the REF and other major research funders, as well as publishers, university managers and research administrators.

2. Public and dissemination behaviour

Researchers are driven by a desire to enhance our knowledge and understanding of the world we inhabit, and to communicate their findings to others.

But they operate in a research and scholarly communications environment characterised by complex relationships between Government, research funders, universities, publishers, learned and professional societies, researchers themselves, and potential users of research findings. The last ten years has seen a significant rise in expenditure on research in UK universities and research institutes; and both governments and other funders are increasingly interested in demonstrating and maximising the social and economic returns they see from that investment.

Managing and assessing the performance of researchers and research institutions thus feature more prominently in the landscape; and researchers are aware of the resulting pressures in all aspects of their work. But there are many criteria for success: quality, prestige and esteem among research peers; impact on practice and innovation, and on society and the economy more broadly; numbers of outputs and speed of dissemination; and so on. There is no agreed list of goals in priority order, nor any consensus on how success should be assessed or measured. Researchers often find themselves in receipt of confused or conflicting messages, and pulled in different directions in deciding which channels of communication they should adopt.

2.1. Output types: researchers' motivations and constraints

It has long been recognised that researchers publish and disseminate their work in many different ways: through formal publication in books and in learned and professional society journals; through conferences and their proceedings; and through a variety of less formal means, now including the web-based tools for social networking. Our evidence reflects that continuing variety, but also the increasing dominance of scholarly journal articles, both in terms of the numbers published, and their centrality to researchers' motivations and perceptions.

In reaching decisions on when, where and how to publish and disseminate their work, researchers are motivated by a number of interrelated factors, beyond the simple desire to pass on their findings to those who may be interested in them. These motivations include the desire not only to maximise dissemination to a target audience, but to register their claim to the work they have done, and to gain peer esteem and the rewards that may flow from that. A number of papers have noted the tensions that may arise: securing career advancement by publishing in a high-status journal, for instance, may pull in a different direction from reaching and influencing a variety of different audiences:

"Fundamentally, my incentive is making a difference, and that isn't necessarily through academic publication." Computer science

"There's a real dilemma there ... You're trying to reach as many people as you can because they're the ones that are going to implement your practice." Cancer studies

"The practice audience is hugely important because all the research we do should influence how nursing is practised, but then there's also the influence on fellow researchers and our peers. So you write for both." Nursing and midwifery

Researchers in some areas have reached decided views on what works and what does not for particular purposes:

"[There is] much more emphasis on peer reviewed journals ... Conferences, working papers and book chapters are pretty much a waste of time ... Books and monographs are worth concentrating on if they help one demarcate a particular piece of intellectual territory." Interdisciplinary

Researchers' choices are also influenced by their awareness that publications serve not only as means of communication. They can be monitored or measured as indicators of quality or impact (in the academic world and more widely). In an environment where managing, assessing and evaluating research performance features ever more prominently – whether through the RAE or by other agencies and mechanisms – this adds further complexity to researchers' choices on when, where and how to communicate their findings. And the complexity is exacerbated yet further by what researchers often see as conflicting or unclear messages from different agencies, including their own universities. But the perception that their work is being monitored and assessed, by the RAE in particular, has a major influence on how researchers communicate.

In computer science and informatics, for example, the speed of change means that researchers believe that presentations to conferences and workshops are a key means of communication; but they also believe – whatever may be said to the contrary – that such outputs are not viewed highly in the RAE. Such perceptions, and the tensions that flow from them, are found in other disciplines too:

"Sadly, I find myself increasingly moving away from publishing in journals which are important and read by a lot of colleagues, to publishing in high status journals instead. This had led to much longer delays [and] thus adversely affects science, but I feel the pressure to do this in order to advance career wise." Medical and biological sciences)

"I've wasted a lot of time trying to publish in high status journals when I could have published in intermediate journals, and got the results out quicker." Cancer studies

"The most important factors are (a) reaching the appropriate audience, and (b) timeliness. Journals are generally slow, and largely go unread. Conferences reach a wider audience, and faster." Engineering

"There is a strong disincentive to do working party and other similar work from an RAE point of view, even though this can be the most effective way of disseminating my type of applied research." Humanities

Researchers sometimes frame discussions of these perceptions and concerns in terms of intellectual autonomy or freedom, or the interests and norms of the discipline:

"There is a strong disincentive to publish edited works and chapters in edited works, even though these are actually widely used by researchers and educators in my field, and by our students." Humanities

In philosophy, some researchers talk of pressures to move away from writing books, even though this may be in the best interests of the discipline and of the advancement of individual careers:

"I think a lot of people wouldn't mind developing their ideas intolarger-scale bodies of work but you're highly discouraged. My younger colleagues aren't in a position to allow their ideas to develop because they've got to get them out before they're even baked."

"[There is] a tension between what you are encouraged to do for the RAE and what you're encouraged to do for career progression, because the norms for career progression, especially if you're ambitious to reach chair, still insist on the book and the monograph in a way that the RAE specifically doesn't."

We noted similar views in other disciplines, particularly those with a strong interest in applied work or in other ways of achieving impact and influence beyond the academic world:

"There are some conferences that the [XXX] service and academics go to and I report directly to the chief there and it's quite frustrating, it will never get included in the RAE. It really frustrates because people actually change policy because of the work I do and for me that's impact, whereas publishing in the journal of a certain impact factor doesn't mean anyone's ever going to read that article or do anything about it." Psychology

"I have colleagues who run prison reading groups and publish in the prison newsletter, and the impact of that is probably quite significant." Psychology

"I know that the impact factor isn't the only measurement of publications work, I know there's a lot of others and ones which are personal to people as well." Cancer studies

"I think the RAE panels have difficulty assessing quite serious academic endeavours which are written in a way to appeal to a wider market." English literature

The RAE features strongly in these discussions. Some of the views expressed may arise from misunderstandings, or from the policies of individual universities rather than the RAE itself. But

they are real and they affect behaviour. On the other hand, some researchers feel strongly that any pressures to modify how they communicate in order to meet the needs of the RAE or other forms of research assessment should be resisted:

"[for an academic] there has to be that autonomy of thought and not being pushed and pulled" politics

2.2. Output types: what do researchers produce and what do they regard as important

We investigated the kinds of outputs being produced by active researchers through a bibliometric analysis of the outputs produced in 2003 and 2008 by a sample of authors who were included in the last two RAEs. A key point to be stressed is how many of these researchers, across all disciplines, did not produce any publications at all in those two years. Despite intensive searches across a wide range of sources, bibliographic databases and websites, we could find no traceable outputs for 52% of our sample in 2003, and for 45% in 2008. Somewhat surprisingly, the proportions of non-publishers were as high in the life sciences and physical sciences as in the humanities and social sciences. The picture of research-active scientists producing at least one article or other output each year is not borne out by our analysis.

For those who did produce a traceable output in those two years, Figure 1 shows the proportions of each type of output broken down into six disciplinary groups. The dominance of journal articles is clear. Across all disciplines except bio-medicine, the proportion of all outputs accounted for by articles rose between 2003 and 2008, as did the proportions for editorial material, meeting abstracts, and 'other' types of material. On the other hand, the proportions for books, book chapters, conference proceedings and book reviews fell. (Note that the data have been

Figure 1: Outputs by type
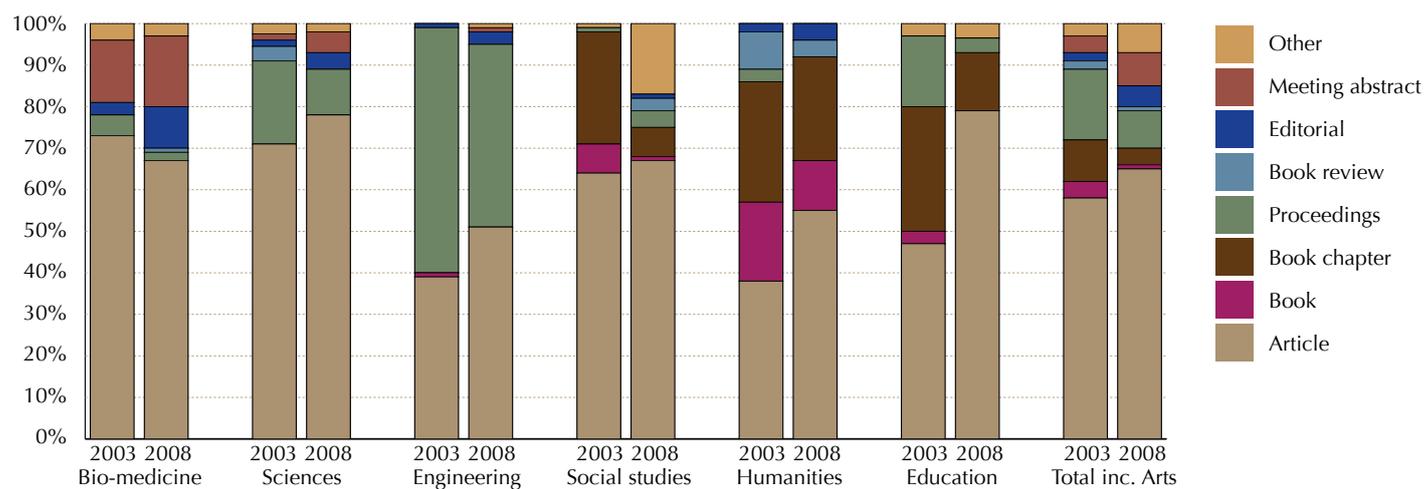
Table 1: Importance of publishing and dissemination channels

Channel (no. of responses)	Very important (%)	Quite important (%)	Not important (%)	Not applicable (%)
Peer reviewed journals journals (843)	94	6	0.1	0.5
Conference presentations/ posters (843)	34	52	13	0.5
Monographs (819)	34	25	32	9
Book chapters (836)	23	60	16	1
Professional journals (821)	19	30	36	14
Open access repository (816)	10	28	41	20
Reports (828)	9	35	44	13
Datasets (819)	8	20	39	33
Working papers (821)	5	27	51	18
Creative works (including exhibitions & performances) (818)	3	8	40	50
Internet blog/forum (816)	2	10	70	18
Other (621)	7	5	19	70

weighted to reflect the population distribution of disciplines, so that changes in the disciplinary distribution do not account for the difference over time).

In the light of these findings and of the discussions in our focus groups, it is not surprising that our survey shows that 94% of researchers consider scholarly journals as 'very important' (Table 1), with just one respondent (from the arts) claiming that they are 'not important'. But it is notable that strong majorities of researchers across all disciplines regard other forms of publication and output as important, especially conference presentations and posters, monographs, and book chapters. And as we shall see, yet other forms of output – including reports, working papers and datasets – are important for significant minorities of researchers in specific disciplines; and more than one third of respondents say that open access repositories are important to their research.

2.3.   Journals

Journal articles are the most frequent form of publication for researchers in all groups of disciplines, and our bibliometric analysis indicates that their dominance is increasing. Since journals are the publication format most commonly associated with assessing research performance – partly because it is on journals that the common bibliometric measures essentially focus – it is not surprising that researchers have also noted an increase in the targeting of publication in journals, based on 'rankings', 'prestige', 'peer review', 'impact factor', or ' citation indices'. This can, however, cause problems in fields where high-status journals are lacking.

Our survey shows (figure 2) that peer reviewed journals are considered 'very important' by over 90% of respondents in all discipline groups, including engineering and computing and the humanities. This is reflected also in comments from researchers:

"What matters is journal articles – refereed journal articles." Economics

"Journal articles will become the dominant mode of research output." Performing arts and music

"The important thing is that you get your work published in a peer reviewed journal, because not only do you want to get your results out there, it's only then that you've got any hope of raising research funds." Cancer studies

Researchers have also noted an increase in the importance of international visibility:

"Increasingly there has seemed to be no point in doing anything other than aiming for top class American publications." Medical and biological sciences

"If you publish in a US based journal citations are much higher than if you publish in a UK journal. I'll be thinking about that next time I submit." Nursing and midwifery

Figure 2: Importance of peer reviewed journals
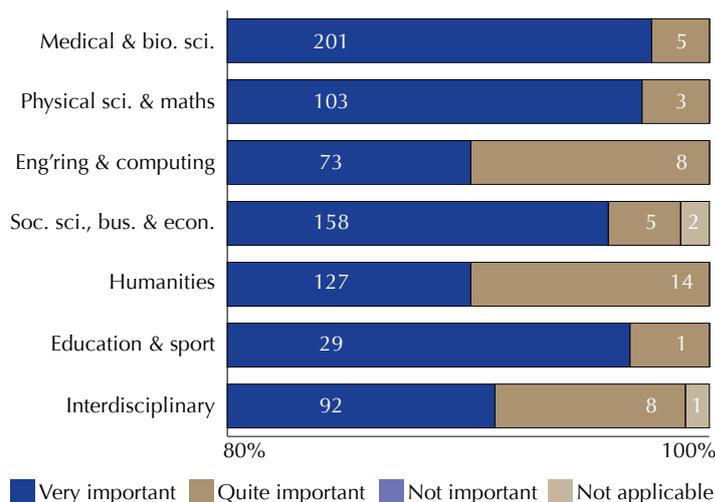
Researchers give career advancement and dissemination to the target audience as the key influence on their decisions to publish in peer-reviewed journals. As Table 2 shows, however, the requirements of research assessment and departmental/institutional guidelines are also important influences. This was reflected in our focus groups, where there was discussion about departmental lists of journals which researchers should target. Pressure from co-authors and collaborators is much less influential; and it is interesting, in the light of the concerns researchers often express about publication delays, that the time from submission to publication is a major consideration for only 20% of them.

Table 2: Influences on the decision to use peer reviewed journals

Influence (no. or responses)	A lot (%)	A little (%)	Not at all (%)
Career advancement (815)	74	18	8
Maximise the dissemination to target audience (807)	63	29	8
Requirements of research assessment (811)	58	29	13
Departmental/institutional guidelines (805)	32	30	38
Research funder requirements (796)	22	35	43
Time from submission to publication/dissemination (801)	20	49	31
Pressure from co authors/ collaborators (800)	20	43	37

There are some notable differences between disciplines in what motivates researchers to publish in peer-reviewed journals, reflecting perhaps the differing levels of dominance that journals have reached as the prime means of communication. In the physical sciences, maximising dissemination to target audiences was the most important influence, whereas in education and sport it was the requirements of research assessment. In the social sciences, institutional guidelines have 'a lot' of influence on publishing in journals for 52% of researchers.

Researchers in all disciplines, but particularly the humanities, feel a pressure to concentrate on publishing journal articles, even though they have not been a predominant form of output traditionally: "it's a tremendous pressure to normalise upon something like a 6,000 word journal article" (performing arts and music). Practice led pieces are often written up as an article or accompanying piece of text in order to meet this requirement.

Some researchers in the humanities point to how the capacity to develop a line of thought and argument is hampered by the shoehorning of work into small articles:

"...its irritating, irritating. Words in scientific journals – 3000 words, 2000 words – it's kind of like writing a shopping list." Philosophy

In other disciplines, there are concerns about the power of journals and their editors to put boundaries around what is acceptable or to exclude innovative thinking:

"Academics are there to extend the boundaries of knowledge and to break down misunderstandings and find new ideas. [But the] editors of academic journals...have huge vested interest in terms of, 'this is what we publish and everybody thinks this is a great journal'. All the people in that area then publish in those sorts of journals and it is self perpetuating." Computer science and informatics

2.3.1. Professional journals

Professional journals play a significant role alongside scholarly journals in some disciplines. In all discipline groups except the physical sciences and the humanities, at least half of researchers believe that are at least "quite" important. They typically serve different purposes from scholarly journals, and the main reason researchers publish in them is to reach a non-academic audience. Only relatively small minorities of researchers see any incentive to communicate through professional journals in terms of esteem or prestige, or the career pressures that come from universities and funders. It is notable, however, that younger researchers are more likely than their more experienced colleagues to give career advancement as one of the reasons for publishing in professional journals.

2.4. Monographs and book chapters

Monographs and edited volumes constitute significant – though declining – proportions of publications in the humanities and the social sciences, but the numbers are negligible in the sciences. As might be expected, our survey shows (Figure 3) that the great majority of researchers in the humanities regard monographs as 'very important', and none as 'not important'. It is notable, however that a majority of researchers in *all* discipline groups, including the sciences, regard monographs as at least 'quite important'. Moreover, book chapters are rated as at least 'quite important' by at least three-quarters of researchers in all disciplines (Figure 4).

As will be clear from Table 3, many researchers in the humanities believe that publishing a monograph is important as a means of communicating their work, but also for their careers:

Figure 3: Importance of monographs

Discipline	Very important	Quite important	Not important	Not applicable
Medical & bio. sci.	10	48	107	36
Physical sci. & maths	20	33	42	7
Eng'ring & computing	10	23	34	11
Soc. sci., bus. & econ.	68	47	34	9
Humanities	126		14	1
Education & sport	5	11	9	1
Interdisciplinary	28	29	34	9
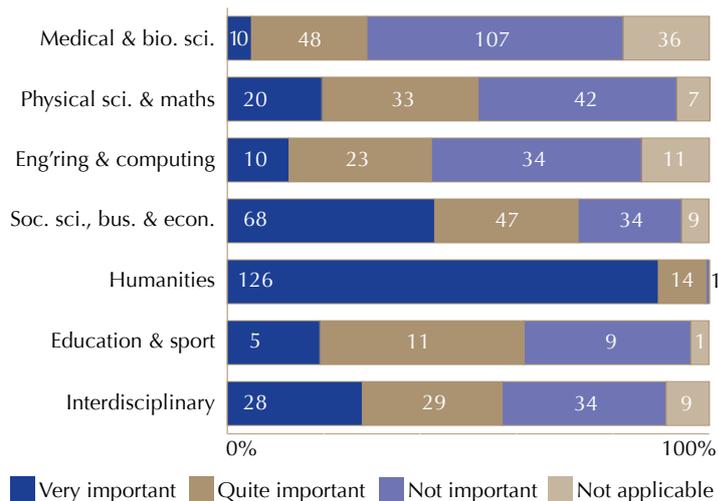
"Monographs remain the single most important mode of dissemination." Humanities

Figure 4: Importance of book chapters

Discipline	Very important	Quite important	Not important	Not applicable
Medical & bio. sci.	27	127	50	1
Physical sci. & maths	9	71	22	1
Eng'ring & computing	9	56	14	2
Soc. sci., bus. & econ.	35	95	29	3
Humanities	75	65		1
Education & sport	7	22	1	
Interdisciplinary	22	64	13	2
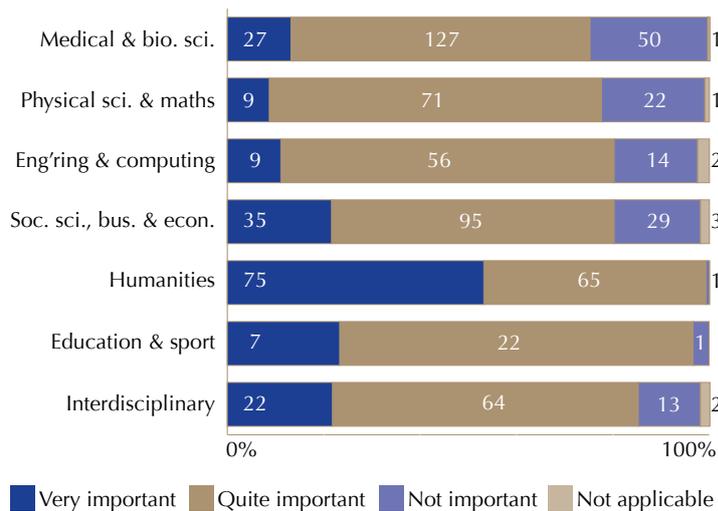
"There's a very strong institutional emphasis on things in hard cover books, so either the monograph or any other collections of essays or collections." English literature

In the sciences, by contrast, few researchers see any career advantage arising from publishing a monograph. Chapters in edited volumes, however, have a slightly higher profile: they are seen both as effective means of dissemination and as having some influence on career advancement by significant majorities of researchers in all discipline groups (Table 4).

Despite the importance researchers in the humanities and at least some areas of the social sciences attach to monographs, reports of their decline or even death have been common in recent years, and were reflected in the comments we gathered. Some researchers attribute the problems to publishers' moves in favour of journals and online publication, others to the RAE and related developments:

"Publishers are increasingly reluctant to publish academic monographs or edited collections...where they cannot see an obvious student/target market." Humanities

"A lot of people have felt the chill wind … If journals are given absolute ranking, then it's going to cause huge problems and the field will get distorted." English literature

Table 3: Influences on the decision to publish monographs

Influence (no. or responses)	A lot (%)	A little (%)	Not at all (%)
Career advancement (378)	50	25	25
Maximise the dissemination to target audience (378)	48	30	21
Requirements of research assessment (377)	34	29	38
Departmental/institutional guidelines (384)	18	25	57
Research funder requirements (367)	13	22	65
Time from submission to publication/dissemination (375)	10	29	61
Pressure from co authors/ collaborators (367)	9	25	66

Table 4: Influences on the decision to use book publishers

Influence (no. or responses)	A lot (%)	A little (%)	Not at all (%)
Maximise the dissemination to target audience (549)	41	42	17
Career advancement (549)	34	44	22
Pressure from co authors/ collaborators (538)	22	38	40
Requirements of research assessment (541)	18	34	48
Departmental/institutional guidelines (539)	10	34	56
Time from submission to publication/dissemination (532)	10	34	56
Research funder requirements (527)	6	25	70

"Psychology has a disproportionate emphasis on peer reviewed papers over books and book chapters. This is a shame because many of the influential works in psychology pre-RAE were books. There is now no incentive for UK researchers to write those books."

"I was explicitly told, 'we don't give you research time to write books'. I feel angry actually just thinking about it." Philosophy

By contrast, some researchers cite the RAE as a driver for certain kinds of book-writing:

"The pressure to produce a monograph (often regardless of quality) has increased greatly because of the RAE." Humanities

"I think book chapters are becoming more frequent as a book with several contributors is easier to produce within the RAE cycle than a single author original work." Social sciences

And many researchers see a continuing demand for monographs, emphasising the esteem attached to them:

"Once you have published a book you have a certain standing in the field, you then get asked to do things for volumes, for handbooks [which] are quite substantial in the profession. They're one of the main ways in which I deal with getting disseminated." Philosophy

2.5. Conference presentations and posters

Conference presentations and proceedings feature strongly in the outputs of researchers in a range of disciplines, especially engineering and computing, and education. They are considered as 'very important' or 'quite important' means of dissemination by more than three-quarters of researchers in each of the

disciplinary groups in our survey. There are some variations between disciplines (Figure 5): in engineering and computing 57% of researcher regard them as 'very important', but in the humanities only 17% regard them as such.

Presentations are now commonly made available via the web, but it is worth noting that the analysis of our sample of active researchers indicates that the proportion of all outputs accounted for by conference *proceedings* actually fell between 2003 and 2008 in all disciplinary groups except social sciences. Many researchers see conferences increasing in importance:

"if anything, an even greater use of conferences – for rapid publication" computer science and engineering

The major reason for producing conference presentations and posters is naturally the desire for rapid dissemination:

Figure 5: Importance of conference presentations/posters

	Very important	Quite important	Not important	Not applicable
Medical & bio. sci.	82	100	23	1
Physical sci. & maths	42	55	9	
Eng'ring & computing	46	32	3	
Soc. sci., bus. & econ.	45	86	34	1
Humanities	24	87	26	1
Education & sport	11	18	1	
Interdisciplinary	33	55	14	1
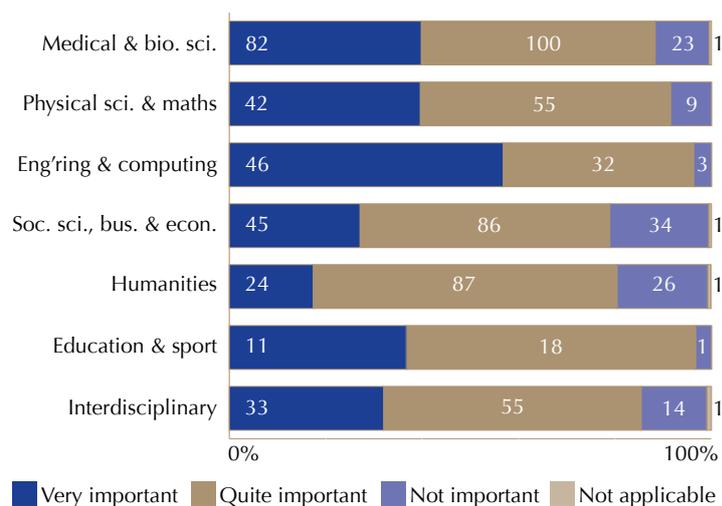
"I think disseminating at conferences gives you the opportunity to get some stuff out there to the wider professional domain, often a lot quicker than if you want to publish something." Cancer studies

Researchers attend conferences for similar reasons:

"You go to conferences to see what's really happening because they are more forefront." Computer science and engineering

There are some significant variations between disciplines in the influences underlying decisions to make conference presentations. These are related in part to their frequency and importance in the different disciplines, but also perhaps to

Table 5: Influences on the decision to disseminate through conference presentations/posters

Influence (no. or responses)	A lot (%)	A little (%)	Not at all (%)
Maximise the dissemination to target audience (736)	67	26	8
Career advancement (736)	54	33	14
Time from submission to publication/dissemination (714)	28	31	42
Departmental/institutional guidelines (732)	23	38	40
Research funder requirements (707)	23	34	43
Pressure from co authors/collaborators (714)	21	40	39
Requirements of research assessment (711)	17	31	32

concerns coming from funders in some areas about the need for more effective dissemination to non-academic audiences. Thus, researchers in the life sciences and medicine are more susceptible to influence from their funders and institutional guidelines in deciding on conference presentations as compared with their colleagues in other disciplines. And such differences may be reflected in positive and negative views of conferences:

"Very good hard conferences are much harder to get a paper into than a vast majority of journals." Computer science

"Too much emphasis on conferences – largely pointless scientifically speaking." Medical and biological sciences

Even in engineering and computing some researchers detect a movement away from smaller, non-refereed conferences, partly as a result of the RAE:

"I have moved away from workshops and conferences because they are perceived in the RAE as not as good as peer-reviewed journals. Also moving to more prestigious conferences rather than the most appropriate ones for the same reason."

2.6. Perceptions of trends in publishing and dissemination

The bibliometric data from 2003 and 2008 shows a statistically significant increase in the average number of outputs per author over the period across all disciplines, notably in biomedicine and the social sciences. As noted earlier, there has been a drift towards journal papers, meeting abstracts and editorial material, and a corresponding decline in books, book chapters and conference proceedings. But many researchers believe that the increased volumes of publication in recent years are the results of an environment characterised by an increasing emphasis on assessing and evaluating performance, which brings with it pressure to publish too much, too soon and in inappropriate

formats. And some believe that quality is being compromised in the pursuit of increased output:

"It is being increasingly driven by factors that have nothing to do with the quality of research or the needs of a readership." Humanities

"[There is a] growing trend towards emphasising quantity over quality." Social science, business and economics

The pressures mean that:

"Work [is] being published before properly researched/ completed." Humanities

"The number of conferences and journals of poor quality is steadily increasing." Interdisciplinary

"[There is a] move towards publication in so called letter journals." Physical sciences

On the other hand, some respondents to our survey saw the problem less as declining standards, but as increasing demands in a competitive dissemination market:

"It's getting increasingly more difficult to be published. Reviewers ask for more and more work, even if the manuscript is already double the usual size...[and they] rarely see positives nowadays – just look for the negatives. Constructive criticism is now rare." Medical and biological sciences

2.6.1. Web presence and open access

Many reports have pointed to more widespread awareness (if not necessarily deeper understanding) among researchers' of open access, particularly in some areas in the biological and physical sciences. There is some pressure on researchers from funders and from universities to make use of open access repositories, and previous surveys have indicated that a majority of researchers are prepared to respond to positively to such pressures. But

uptake of open access options – either through publication in open access journals or through deposit of articles in open access repositories – has been slower than many would have hoped. Our survey shows that over 60% of researchers believe that open access repositories are either 'not important' or 'not applicable' to the dissemination of their research. This may reflect researchers' concerns – shown in earlier studies – that open access outlets will be not be rated highly by peer reviewers – either in the RAE or on interview panels – or in any bibliometric analysis.

There are, however, significant disciplinary differences: 52% of physical sciences and mathematics researchers say open access repositories are 'important' or 'very important'; whereas only 25% of humanities researchers say the same.

The most prevalent influence on the decision to use open access repositories was maximising dissemination to the target audience (47% saying it has a lot of influence, 22.% a little influence). The requirements of research assessment has the least influence (77% saying it had none at all). There is some evidence, however, of an increase in awareness of funders' and institutions' policies relating to open access, prompted by the desire to reach wider audiences as rapidly as possible:

"Open access is win/win. It improves recognition but it also maximises the usefulness of your work." Medical and biological sciences

There is also evidence of the need for a web presence, across a range of disciplines:

"Most major projects these days have some kind of web presence, usually self published, but they may publish elements of their work online as well." Performing arts and music

"I'm supposed to stick things on the web; that's part of my funding, so that's both in terms of contributable blogs and maintaining websites." Philosophy

2.7. Collaborative research

There has been much comment on the increase in co authorship, reflecting both inter-institutional and inter-departmental collaboration. Some have seen evidence that the number of authors per paper may have levelled off in recent years. But analysis of the outputs of our sample of research-active authors shows a statistically significant increase in collaboration between 2003 and 2008: a rise from 76% to 86% in the percentage of multiple authored outputs; from 62% to 73% in co- authors from more than one institution; and from 54% to 62% in co-authors from other countries.

2.7.1. Disciplinary differences and pressure for collaboration

There are important disciplinary differences in levels of collaboration and co authorship, and analysis of the outputs of our sample of research-active authors reflects this, with the highest levels of multiple authorship – at well over 90% – in bio medicine and the physical sciences. Cross-institutional and international co-authorship is also highest in those disciplines, but less common in engineering. By contrast, single authorship remains predominant in the humanities, where less than a quarter of publications are co-authored.

Our analysis also shows significant increases in collaboration and co-authorship between 2003 and 2008 across most disciplinary groups, with the most significant increases in the physical sciences and social sciences. Our focus groups noted the increased push from funders for collaboration, within and across disciplines, institutions and international boundaries:

"I think there will be an increasing number of collaborative publications coming out of that and that is driven by where you are getting your funding from and how you get it."
Biomolecular chemistry

The English literature focus group saw similar pressures in feedback from the RAE:

"One thing that came back is that we were too individualistic and they wanted to see more collaborative work than monographs."

The group also noted an increased push for collaboration with non academic institutions such as museums and libraries as well as with institutions across Europe.

The rise in multi authorship has sometimes given rise to difficulties over issues including responsibility for the validity of the research, the inclusion or exclusion of individual on the author list, and the order in which co-authors are listed. There have been claims of 'unscrupulous senior collaborators' abusing and bullying junior researchers and using their seniority to 'distort the membership and order of authors on publications and conference presentations' (Kwok 2005, p.554). Some of these concerns were reflected in our focus groups:

"You can get into collaboration with 20 people and then you've got issues about how to do it – like coming up with a name for the group, so it's either such a person on behalf of x research team, or it's a kind of acronym for the research project, or by the x group."
Nursing and midwifery

2.7.2. Attribution of authorship – current practice

There are significant differences of practice in the ordering of multiple authors, ranging from alphabetical ordering, to placing the senior author first or last, to the use of indicators of contribution levels, and many variations between. Acknowledgement and attribution of contributors may also involve the use of footnotes and formal acknowledgements to explain the nature and scope of their contributions, which may fall short of inclusion in the author list. Table 6 shows survey responses by discipline group as to how authors are listed and attributed.

Table 6: Order of authors by discipline

	Percentage of authors by discipline								
	Medical & Biological Sciences	Physical Science & Maths	Engineering & Computing	Social Sci. Business & Economics	Humanities	Education & Sport	Inter-disciplinary	All incl. Arts	Sig. p<
Order according to contribution where 1st =greatest	63	44	64	60	33	73	68	56	0.01
Ordered alphabetically	10	45	36	58	69	57	36	41	0.01
Student=1st, Supervisor=2nd	42	32	49	14	3	37	27	27	0.01
1st author=main writer/ researcher, last=most senior grant holder, middle ranked by contribution	50	25	33	8	6	7	29	25	0.01
1st author=main writer/ researcher, then by contribution	27	19	27	17	3	30	19	19	0.01
Use of Acknowledgements	23	14	22	12	14	23	20	18	0.05
1st author=main writer/ researcher, then alphabetical	5	15	11	8	4	27	10	9	*
1st author=main writer/ researcher, last=most senior/ grant holder, middle ranked alphabetically	7	7	9	3	3	3	13	6	*
Use of footnotes	5	2	5	4	13	3	7	6	*
Use of indicators of contribution levels	11	5	0	3	5	0	10	6	*
Supervisor=1st, Student=2nd	8	2	6	7	3	3	8	6	*
1st author=most senior/grant holder, then by contribution	9	3	2	8	1	13	3	5	*
1st author=most senior/grant holder, then alphabetical	3	3	2	3	4	10	3	4	*
Other	6	7	4	4	3	13	3	5	*
Not applicable–no experience of collaborative publication/ dissemination	0	0	0	5	15	0	2	4	*
Total number of responses	n=205	n=106	n=81	n=164	n=140	n=29	n=102	n=840	

Percentages in each column sum to more than 100%, since respondents noted more than one practice in each discipline
*Insufficient data to test apparent differences between disciplines

The listing of authors in order of contribution (with first author providing the greatest contribution) is the most frequent practice in most disciplines except for the humanities where alphabetical order is the norm. But it is notable that in physical sciences, mathematics and social sciences alphabetical ordering and ordering by contribution are almost equally common. Notable also are the differences of practice within discipline groups. In medical and biological sciences, in physical sciences and maths, and in engineering and computing, ordering by contribution may frequently be modified by placing the senior researcher or grant-holder last. And while the most common practice with papers arising from research undertaken by students is to place the student first in the author list, a significant minority in medical and biological sciences and in social sciences place the supervisor first.

Table 7 shows that in most discipline groups decisions on attribution and ordering the list of authors are made collectively; but there is a wide variety of other practices too, and it is by no means uncommon – except in the humanities – for the decision to be left to the main author or principal investigator.

The views and comments we gathered from researchers show an even richer variety of practice within as well as across disciplines. In physics, for example, in addition to listing in alphabetical order

Table 7: How the order of authors is allocated

Subject discipline (no. of responses)	Collective decision of the authors (%)	It varies from output to output (%)	Main author decides (%)	Subject custom & practice (%)	Principal investigator decides (%)	Other (%)	Don't know (%)
Medical & biological sciences (205)	42	16	12	6	20	3	0
Physical sciences & mathematics (106)	38	12	17	20	10	2	1
Engineering & computing (81)	43	10	30	6	10	1	0
Social sciences, business & economics (160)	39	21	16	11	3	3	7
Humanities (136)	32	15	7	21	2	5	18
Education & sport (29)	52	24	17	3	3	0	0
Interdisciplinary (101)	43	21	16	9	7	2	3
Total, inc. Arts (830)	39	17	15	11	9	3	5

or in order of contribution or importance, a combined approach may be used:

"You have the person who writes the paper and then two other people who might have contributed work and everyone else is alphabetical"

Rotation is an accepted method for some, but there are many other practices:

"We just took it in turn and we didn't really get angst as to who wrote each publication."

"The first author is the person who wrote the paper, who physically typed it and the last author is the grant holder." Cancer studies

"1st author = main writer/researcher, then mix of contribution and alphabetical, perhaps grouped by institution." Physical sciences

Misunderstandings can arise from differences in practice across disciplines, sometimes to the advantage of more than one of the authors:

"In psychology the main contributor goes first but in psychiatry it's last. And psychologists seem to think that's very generous without realising."

Sometimes, however, the different conventions can cause friction,

"I've published in with medical colleagues and said just put me last without realising I was overstating myself." Psychology

Our bibliometric analysis shows no significant change in practice between 2003 and 2008. But many researchers are conscious of changes over recent years:

"When I started out the convention was strictly alphabetical, there was no pecking order. But now of course everyone's jostling [to be] the lead author." Biomolecular chemistry

In the humanities, co-authorship is still much less common, but where it does occur researchers see a move away from the tradition of alphabetical listing:

"It's becoming more like science where the order of names is deemed to suggest something about the contribution to the paper, so I think people will now pay attention to this more than they did ten years ago. That maybe is a result of RAE type pressures."

Such changes can lead to tensions surrounding conventions and "ancient practices that are now rather tricky":

"Fraught with difficulty ... I don't think it's dealt with all that well ... There's a lot of underlying conflict." Nursing and midwifery
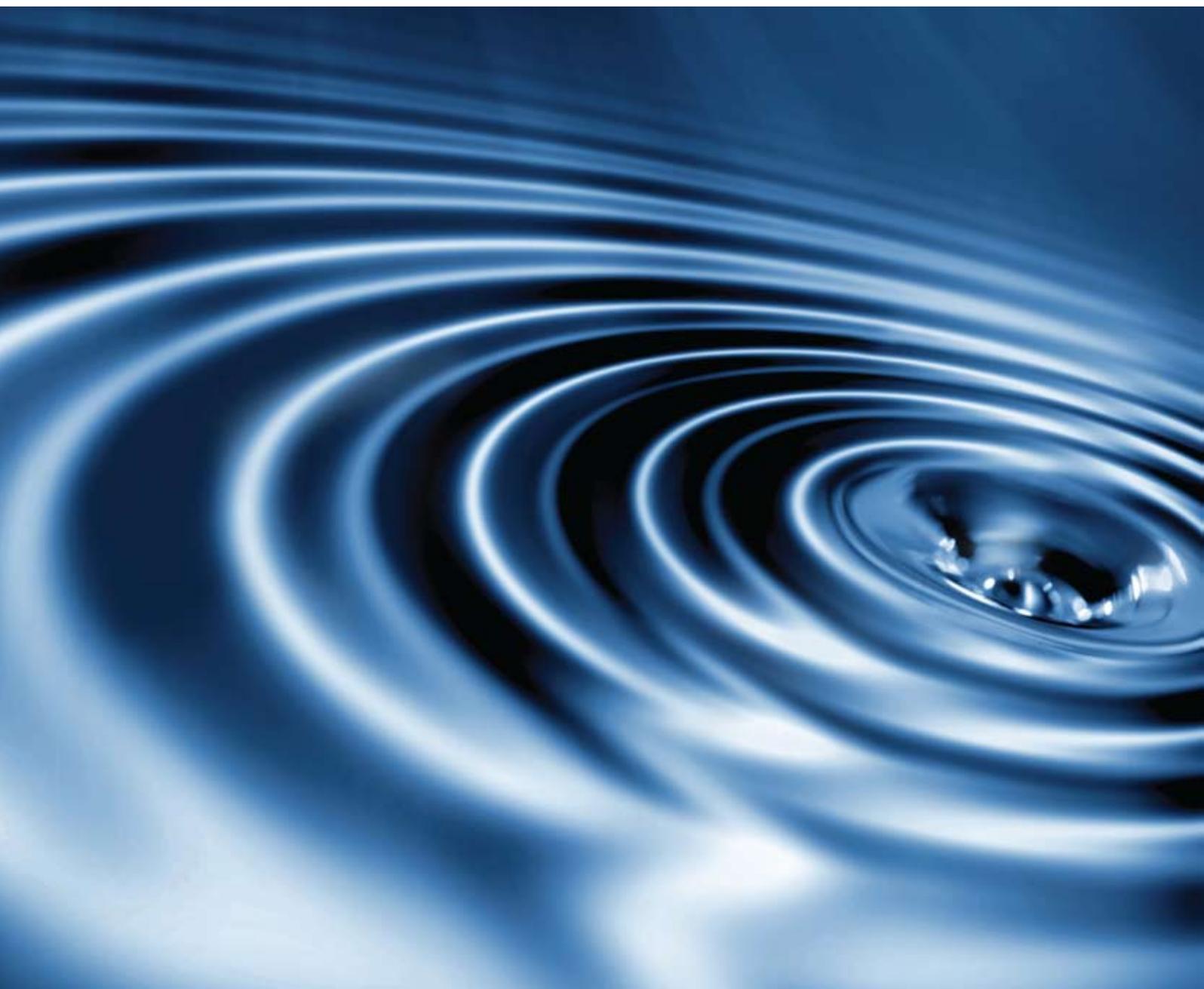
3. Citation behaviour

3.1. How scholars are citing

Citation is part and parcel of the job of communicating research findings, across all disciplines. Our analysis of the textual outputs of a sample of active researchers shows that the vast majority of all forms of output included citations of the work of other researchers: only meeting abstracts were unlikely to include a citation. Humanities and social science researchers include more citations than their colleagues in other disciplines, mainly because of their tendency to write at greater length (in articles as well as books) than their colleagues in other disciplines.

Journal articles are the form of output that authors cite most frequently by far, but they also cite many other forms. It is also noticeable, however, that the number of books cited fell heavily

Table 8: Average number of citations per output, by type of material cited

Type of material cited	2003 Mean	Std. Error	2008 Mean	Std. Error	Significant difference between years?
Articles	20.0	0.94	24.3	0.83	p<0.01
Books	11.6	1.89	5.5	0.53	p<0.01
Conference outputs	0.9	0.15	0.8	0.09	No
Grey literature	2.1	0.35	1.2	0.12	p<0.05
Websites	0.3	0.06	0.3	0.10	No
Theses	0.2	0.03	0.2	0.02	No
In press	0.2	0.02	0.1	0.02	No
Other	2.0	0.38	1.2	0.17	p<0.05
Total	37.1	2.60	33.7	1.14	No

between 2003 and 2008 (Table 8). The reasons for this are not clear.

The number of citations is influenced, of course, by disciplinary norms and the policies of individual journals. Some high status journals impose word limits which reduce the number of references that can be included:

"You only have room for ten to fifteen citations, then you try to cite the ones from that journal or other high impact journals." Physics

"Many journals limit the amount of space for reference lists, and it is often necessary to remove highly relevant and important references." Medical and biological sciences

There are signs that such limitations are becoming more widespread. If they do so, one effect could be to lessen the usefulness of citation data for bibliometric and assessment purposes, even in those fields where they are robust at present.

3.2. Motivations and influences

The prime motivations for citing other people's work shown in our survey, across all disciplines, are the authority of the cited material or of the author, and a perceived requirement to reference a method, theory or argument. This tallies with the findings of earlier, mostly narrowly-focused, studies which have highlighted citation as a means of establishing the context of a topic, and providing supporting evidence. Discussions in our focus groups often focused on the need to acknowledge previous work:

"I want to cite the seminal work in the area, because that shows I have done the background stuff." Nursing and midwifery

But the discussions also reflected differing views on the primacy when making decisions on citation of the standing of the author or of the paper:

"It's the paper and its quality, not the authors, that are important and influence me to cite it or not. I don't cite friends or colleagues unless their work is relevant." Medical and biological sciences

"I cite the papers of the people I respect and who I happen to know do good work." Physics

Earlier studies have suggested that personal contact or familiarity can be a major factor in choosing to cite an author's work. A large majority (66%) of researchers in our survey, however, said that personal knowledge of the author had little or no influence on their citations. But behaviour does change over the course of a research career. Early career researchers are more likely to cite more and to be influenced by the authority of the author cited:

"...as I've gone on, I tend to cite far less often [than earlier in my career] and I only cite if it has actually had a direct influence on the particular thing I have written."

On the other hand, disagreement with a source is also a significant reason to cite, particularly in the humanities and the social sciences as well as the physical sciences. Overall, only 7% of researchers say that disagreement with the cited material is not among the reasons for citation:

"Citing somebody often indicates opposition / disagreement, rather than esteem and I am as likely to cite and critique work that I do not rate highly as work I value." Humanities

"Even if they are rubbish, I still need to reference them to acknowledge that I think they are rubbish." Politics

But researchers are also beginning to wonder whether, in an

environment where bibliometrics and citation counts are seen as growing in importance, it might lead to authors getting credit for poor-quality work:

"REF may well change my behaviour. Less likely to cite those I disagree with!" Humanities

3.2.1 Training, guidance and tactics

Only a minority of researchers report that they have received any training or guidance on what and what not to cite, and this is consistent across all disciplines:

"I've learned how to do it as a result of being a scholar for a number of years." Economics

Most researchers seem to be self-taught, though about a third of younger researchers have received some guidance, usually from their institution or PhD supervisor. But over 50% of researchers report receiving more general advice and guidance on citation practice, most frequently from editors and reviewers (62%) and from co-authors (57%). Such guidance is more frequently reported in the scientific disciplines, where co-authorship is common, than in the humanities and social sciences.

Many researchers welcome any guidance they can get on tailoring their citations to meet the requirements – perceived or actual – of journals and their editors. Thus they will tailor citations to increase their chances of publication in a particular journal, citing articles published in that journal or by those they think may referee their work:

"[I] tend to tailor the number of citations to what you think the editor of a particular journal will accept." Cancer studies

"Inevitably authors try and guess who may act as referee and then cite their work extensively. I do." Interdisciplinary

"When reviewers come back with comments, they suggest papers maybe that I might have missed or they think are relevant. But I

don't see that as an imposition, I see that as a way of helping to get the paper published." Economics

Others perceive a darker side to the guidance they receive, seeing it as a way to increase citations from a particular journal or even reviewer:

"Yes, reviewers, sometimes discreetly suggest something that would be useful to look at, and sometimes it's transparent that they are pointing to stuff from the same journal." Psychology

"Reviewers frequently suggest inclusion of their own publications – albeit anonymously – even when they are of little relevance." Physical sciences

Some researchers perceive pressure from US journals to cite US work. Others report a tension between their desire to recognise and cite older publications and pressures to cite more recent work.

Researchers are also aware of the scope for gaming, for example raising the number of one's citations by writing highly controversial articles, and also for 'citation circles':

"It would be easy to get a racket in bioethics – if you want to get a lot of citations you say it's fine to eat babies or something!" Philosophy

"With my collaborators and colleagues I have been organising so as to facilitate mutual citation." Interdisciplinary

"There are about six citation circles that I am aware of … which is part of the corruption of the game of course!" Economics

3.3. Availability and reading influences on citation

There has been some debate about the extent to which citation is influenced by the availability of published works online. In our survey, only 24% of respondents said that accessibility had

a 'high' level of influence on their behaviour. There were some variations by discipline, ranging from 14% in the humanities to 32% in the medical and life sciences. There were also notable variations by length of research career: researchers with 25 years' experience or more are significantly less likely to be influenced by accessibility than researchers with less than 5 years' experience. These results may reflect changing expectations with regard to online access.

Several researchers commented on the ease with which online material can be found and cited:

"It speeds up the process of finding, reading, and deciding to cite." Social science, business and economics

"People cite the journals that are easy to access." English literature

"I am most likely to cite papers that are online and easy to find." Medical and biological sciences

But there are some concerns that this may have some damaging consequences:

"If I can't get the papers I'm interested in, I quote the papers I can … Our practices have shifted from pulling piles of things off stacks, to sitting at your desk looking at what's there. It's probably made our research poorer in many ways." Psychology

Some researchers are especially concerned by a decline in their reading of books, though it is not clear whether this stems from fewer books being available as library purchase budgets decline; or from a focus on material available online – where books feature much less strongly than journals; or from simple lack of time: "it's only really summer holidays that I get the time to do that. I can read a journal article in an hour but obviously it takes a little longer to read a book" (philosophy). Whatever the reason, our bibliometric analysis does seem to show a significant decline in the citation of books as distinct from journal articles and other forms of output.

Research assessment

We have noted at various points how researchers' behaviours and attitudes are influenced by what they perceive as an increasing stress on assessing and evaluating research and its impact (whether in terms of recognition by peers or socio-economic impact); and by the RAE in particular.

For a significant minority of researchers (38% of those who responded to our survey) assessment of their research by major funders other than the higher education funding bodies is seen as equally or even more important than the RAE. But for the clear majority of researchers, the RAE is the dominant concern. In this section we investigate in detail the relationships between the patterns of what is published, valued and used by researchers, and what is submitted to the RAE.

4.1.   Publication outputs

All the evidence we have gathered shows that, alongside the dominance of articles in scholarly journals, a rich array of other forms of published outputs are produced and valued by researchers. This is reflected in our analysis of the different kinds of output actually published by researchers in 2003 and 2008, which is drawn, as we have noted above from a sample of researchers entered into the RAEs of 2001 and 2008. In Figure 6 we set that alongside an analysis of the different kinds of output submitted to those two RAEs. Journal articles predominate in all disciplinary groups except the arts and, to a lesser extent, the humanities; and that dominance has grown.

The analysis also shows, however, that there are significant differences between what is produced and published, and what is submitted to the RAE. Moreover, forms of output – including book chapters, conference papers, reports and working papers – that are considered important by significant proportions of researchers in each discipline group (see Section 2.2) feature less prominently in submissions to the RAE.

In the sciences and engineering, journal articles feature much more strongly in submissions to the RAE than they do in researchers' overall outputs, while conference proceedings, along with other publications (including reports, working papers, editorials and so on) feature much less strongly. Part of the explanation is that conference papers and proceedings may be superseded by subsequent journal articles; and that other outputs may be regarded as peripheral or may not report the results of original research. It should be stressed, however, that in many disciplines, notably but not only engineering, conference papers are regarded as of prime importance: "top conferences are tougher to get into than most journals and are regarded more highly". And often the perceived pressure to publish journal articles in addition to or instead of conference papers may come from the RAE itself, or from institutional guidelines associated with it.

Figure 6: Comparison of outputs produced with those submitted to RAE
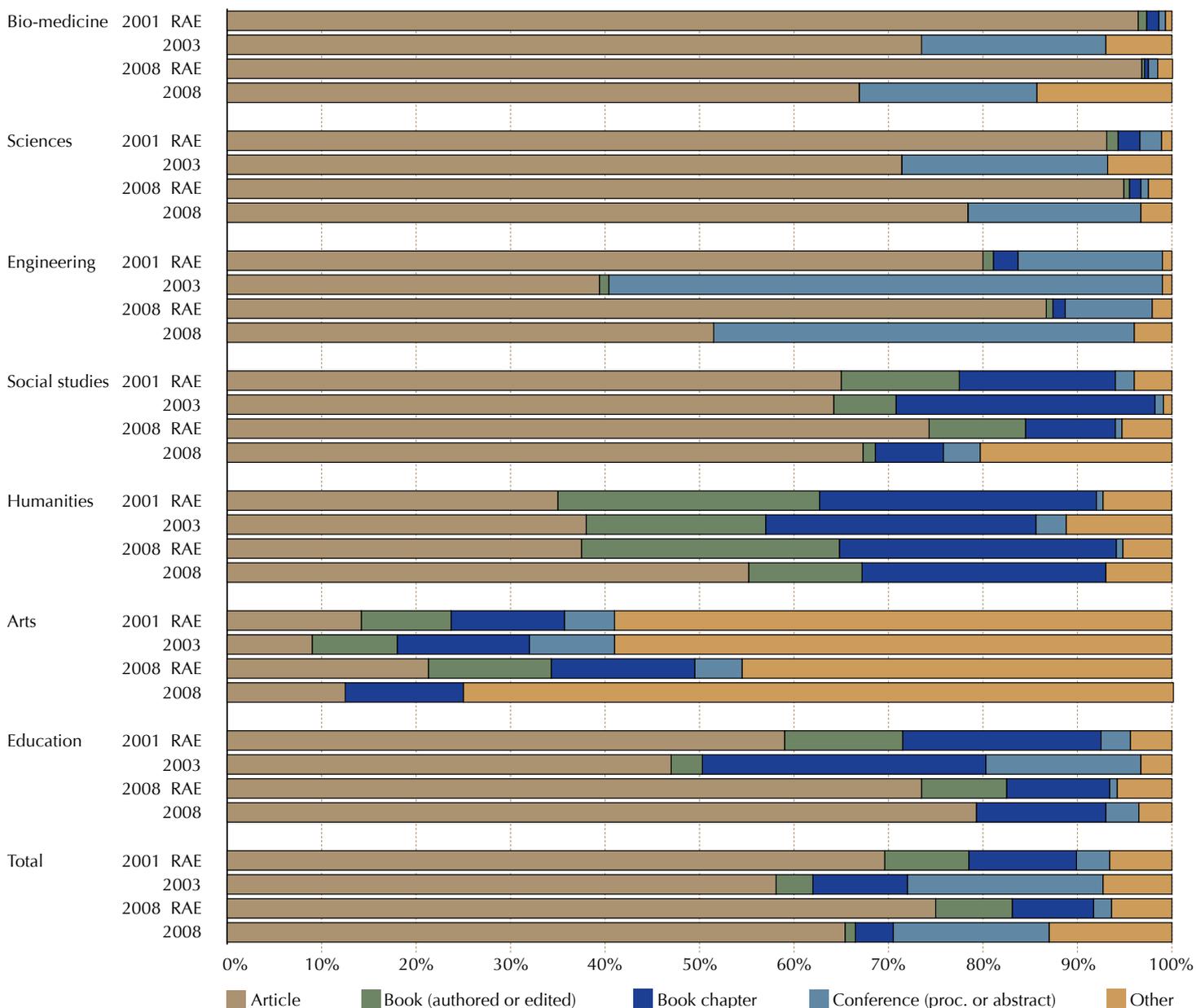
In the social sciences and in education the proportions of articles published and submitted to the RAE are more closely aligned; but it is also noticeable that books feature much more strongly in submissions to the RAE than they do in researchers' overall outputs. The same is true in the humanities, where in contrast to all other discipline groups except education, articles do not feature as much in RAE submissions as they do in overall outputs. Thus while the vast majority of humanities researchers regard journal articles as 'very important', they value books even more.

The high proportions of 'other' outputs in the arts reflects the creative nature of many of the constituent disciplines, and a wide range of non-text outputs – artefacts, compositions, exhibitions, performances and so on – and the acceptance of such outputs in the RAE as the basis for assessing research performance.

4.2. RAE rules, institutional policies, and how they are perceived

We have already noted in Section 2 the perception widespread among researchers that the RAE and the related policies of their institutions put pressure on them to publish in journals with a high impact factor rather than in other journals that would be more effective in reaching their target audience, or to use other channels altogether. Some researchers seek actively to ignore such pressures, but many view the RAE as a game they are forced to play:

"[I] move toward targeting a specific audience rather than journals with greater impact factor – trying to influence/build a field rather than collect 'points' for anything like the RAE." Interdisciplinary

"One may not like the game, but we're on the playing field." Economics

"A game to play in terms of getting a good rating, and then there's doing research …You just need to ensure that you have sufficient trump cards to play." Computer science

Researchers' understanding of RAE rules and institutional policies thus play an important part in influencing behaviours. Sometimes they may when taken together leave scope for misunderstanding or confusion. A quarter of all researchers – more in education, but fewer in physical sciences – believe that the 2008 RAE excluded specific research outputs that they considered important, in the form of books, book chapters and edited works, articles in professional or specialist journals, and material accessible for public consumption (Figure 7). In fact, the RAE rules meant that few if any types of output were inadmissible; and the guidelines sought to make clear that all types submitted would be treated equally. The messages that researchers received from their institutions (whence most researchers got their information about the RAE), however, were often not so clear-cut. The resulting misunderstandings among researchers point to the importance of effective communication of rules and policies.

Figure 7: Do you believe that the 2008 RAE submission rules exclude any research outputs?

Yes, very much (8%)

Yes, some (17%)

Don't know (32%)

No (43%)
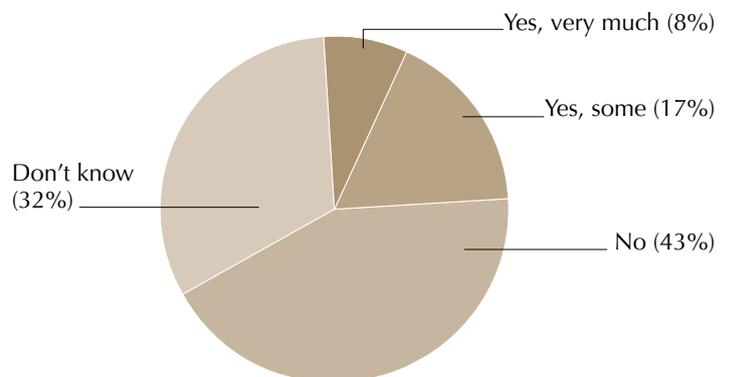
The term 'game-playing' is sometimes used pejoratively, to imply criticism of legitimate institutional policies and strategies; but all institutions that take part in the RAE have an interest in seeking to maximise their performance. Moreover, institutions adopt different strategies to suit their situation, and researchers are very conscious of the implications of the policies both of their own and of competing institutions.

Many researchers, however, are uncomfortable with the implication that institutional and departmental strategies may constrain their autonomy, and some are concerned about institutions' reluctance to allow researchers to move into new areas of work:

"Unfortunately the RAE categories and decisions are, at least in my institution, permeating decisions about research activity ... They're increasingly looking for RAE publications; in a sense, monitoring people's research and parts of their careers." English literature

"[There] is actually an institutional constraint which is put on from the universities, a mass pressure to stay within your field of expertise." Politics

Institutional policies may prioritise publication in journals with high impact factors although the generic RAE guidelines and the panels actually stated that publication in such journals would not be a factor in their assessment of quality. Nevertheless, some of the complaints about excluding certain kinds of output clearly arise from institutional policies in this area:

"You've got [what] the panel thinks but also what the institution thinks. So there are two games to play. There's a lot of politics in it." Biomolecular chemistry

"Head of Research in my institute actively discouraged book chapters and reviews because they were not seen as prestigious for RAE." Physics

There are particular concerns about the pressures on younger academics to build up a portfolio of published work for RAE purposes, and also about the difficulties that can arise in applied subjects and in the creative arts. For applied researchers, outputs such as working papers and reports, or publications in professional journals, may be particularly valuable in reaching their target audiences, but may be perceived by institutional managers as less highly-regarded for RAE purposes. In some cases, however, researchers were more positively engaged with institutional policies:

"In our university there was, generally an approach that it had to be the right journal for the paper and a respected journal, but we weren't looking at impact factors and saying, let's fly over that one because the impact factor's too low." Nursing and midwifery

In the creative arts, even though practice-based outputs predominated in submissions to the RAE, there were many concerns about what would be deemed acceptable:

"There is a difference between your research output and what you indicate in the RAE. Because you can play a different game." Performing arts and music

"I wasn't sure how my practice might be perceived in terms of how it was documented and validated and so I held back putting the practice into my submission." Performing arts and music

"I have colleagues in creative writing who are bringing [out] really innovative sonnet books. They're getting massive reviews...[but] they just don't know what to do with it."

In other cases, researchers' concerns relate to decisions on which unit of assessment they would be entered into, and in which journals it would therefore be appropriate to publish:

"If we'd known that the three of us who went into sociology as social psychologists we could've been publishing in sociology journals." Psychology

4.3. Research timescales

The timescales for research are often long, and usually unpredictable. The length of time before the outputs of research are recognised, acknowledged and cited is even longer and more unpredictable. In the humanities in particular, monographs can take several years to produce, at least two or three years before they are likely to be cited, and often much longer before they are recognised as important or significant. In the sciences, delays in securing recognition of the significance of research findings may lead to difficulties in getting especially innovative work even published.

Table 9: Impact of research compared to the research assessment cycle

Does the impact of the research in your discipline take longer than a single research assessment cycle to emerge?	Usually (%)	Sometimes (%)	No (%)	Don't know (%)
Humanities (138)	40	37	11	12
Interdisciplinary (97)	26	35	17	23
Physical sciences & mathematics (105)	23	47	12	18
Social sciences, business & economics (164)	22	34	22	22
Engineering & computing (75)	21	39	16	24
Medical & biological sciences (201)	17	40	16	26
Education & sport (30)	17	47	17	20
Total including Arts (823)	24	39	16	21

A large majority of researchers in all groups of disciplines believe that it may sometimes take longer than the length of an RAE cycle for the significance of research to be recognised; and a quarter of them believe that it 'usually' takes longer than an RAE cycle (Table 9). Not surprisingly, the proportions of researchers who believe this are highest in the humanities, but even in faster-moving disciplines like the physical sciences nearly a quarter of researchers think that it 'usually' takes longer than an RAE cycle. When invited to comment on how long it takes for impact to emerge and be recognised, researchers across a range of disciplines often mention periods of ten years or more:

"Some very good work was done back in the 1970s – it ain't forgotten and it's come back again now and turns out to be correct." Physics

4.4. Anticipation of future research assessment

Our research was carried out over a period coinciding with the implementation and subsequent public discussion of the REF pilot exercises, but before the final consultation paper on the REF was published (September 2009). Initial reports and consultation documents in 2007 and 2008 suggested that bibliometrics would play a prime role. But reports and presentations in the spring and summer of 2009 suggested that bibliometric data, normalised by discipline and output type, would be used to inform an expert review process, and would be used only in disciplines or subject areas where they are appropriate. In a climate where there has been considerable debate about the format of the REF, where the original proposals have been subject to significant change, but the final format is far from clear to most researchers, there has been considerable room for speculation and misconception.

Even in the absence of a clear understanding of the form that the REF will finally take, institutions are naturally seeking to develop

their strategies in relation to it, in areas ranging from bibliometric expertise to the development of publication databases. But only a quarter of researchers are aware of their institutions' strategies, with less-experienced researchers being the least likely to be well-informed.

Many researchers, especially younger ones, are clear, however, that a move to any system based even in part on citations will have a significant effect on their publication and dissemination behaviour. Thus 22% say it will lead them to produce more publications; 33% that it will lead them to submit their work more often to high-status journals; and 43% that it will lead them to make their research freely-available on open access. Researchers in physical sciences and maths are the least likely to see a move to open access, perhaps because many of them have made the move already.

The views of many researchers can be succinctly summarised in one comment:

"Researchers are not fools. Whenever the targets have changed in the past, academics' behaviour has adjusted to the target. So I expect publishing behaviour to be changed to align with the requirements of the REF." Education and sport

But any greater emphasis on bibliometrics is also likely to change citation practice. Thus nearly 22% of researchers are concerned that the REF will lead to unproductive and unprofessional game playing, such as citation clubs and self-citation; and 38% say that they will cite their collaborators' work more often. On the other hand, only a very small minority (6%) say that they will cite competitors' work less often.

Many researchers are also concerned about the variations in author attribution and citation practice across disciplines, and the implications these have for comparisons between them and their colleagues in other disciplines, and for cross-disciplinary work. There are concerns also that publications targeted at audiences beyond the academic and research communities, where citations are not normally needed or expected, may be further downgraded.

5. Summary and conclusions

The main findings and conclusions of our research are summarised below according to the key questions we sought to address.

We believe that our findings should be of interest to all the groups of actors and stakeholders involved in producing, disseminating and evaluating academic research, including the higher education funding bodies, research councils, university senior managers and research administrators, and researchers themselves. We hope that our findings may help to illuminate some of the issues raised in the continuing discussions about the framing of the REF.

5.1. Publication and dissemination behaviour

Researchers are driven by a desire to enhance our knowledge and understanding of the world we inhabit, and to communicate their findings to others. But they operate in an environment where both governments and other funders are increasingly interested in demonstrating the social and economic returns from their investments in research, and where assessment of research performance features ever prominently. Moreover, the many different criteria for success, with no consensus on how success should be assessed or measured, mean that researchers often receive confused or conflicting messages. They are pulled in different directions in deciding which channels of communication they should adopt.

5.1.1. Factors that influence how researchers choose to communicate their work

Our evidence suggests that only about half of the active researchers in most disciplines – and fewer in some – produce any publication or other traceable output in any one year. But researchers in general publish and disseminate their work in many different ways, and in reaching decisions on which channels and formats to use they are motivated by a number of interrelated factors beyond the simple desire to pass on their findings to those who may be interested in them. These motivations include the desire to register their claim to the work they have done, and to gain peer esteem and the rewards that may flow from that. Other considerations, such as research funders' requirements, institutional or departmental guidelines, or pressure from collaborators and co-authors, are much less influential.

Many researchers believe the current environment puts pressure on them to publish too much, too soon, and in inappropriate formats. In deciding when, where and how to communicate their work, researchers may have to make choices between speedy dissemination to a desired audience, and less speedy publication in a high-status journal. Such choices are made the more complex because researchers are increasingly aware that publications serve not only as means of communication. They can be monitored or measured as indicators of quality or impact (in the

academic world and more widely). And the difficulty in choosing between different channels of communication is exacerbated by messages from different agencies – including universities – that researchers often perceive as conflicting or unclear. But the perception that their work is being monitored and assessed, by the RAE in particular, has a major influence on how researchers communicate.

In this environment, articles in scholarly journals are increasing their dominance over all other forms of publication and dissemination, both in numbers and in the importance researchers attach to them. Publication in a prestigious journal is both an effective form of communication and a means to secure recognition and esteem, with all the benefits that flow from them. But journals and the articles they contain are also the form of publication most easily measured, ranked and assessed, and thus most used in the measurement of research performance; this may well reinforce their dominance still further.

There is, however, a rich array of other kinds of output employed and valued by researchers, many of whom are uncomfortable about the dominance of journals. In some disciplines, particularly in applied and practice-based research, other forms of publication and dissemination may be more effective in reaching and influencing audiences beyond the research community. Researchers often wish to communicate their work as quickly as possible to a wide range of audiences, using working papers, reports, and especially presentations at conferences, the proceedings of which may later be published (but are often thought to have low status and prestige in the academic world).

Only a relatively small minority of researchers, however, as yet make much use of open access repositories, or of blogs, wikis and other web-based tools to publish and disseminate their work For those who do use open access repositories, it is notable that the key influences are the desire to reach key audiences speedily: funder requirements have relatively little influence.

The number of books being published has not increased. Nevertheless, monographs not only retain their central position in the minds of researchers in the humanities, but are regarded, along with book chapters, as important forms of publication by substantial minorities of researchers in all discipline groups. Many express concern, however, about the decline of monographs and edited collections, attributed variously to shrinking library purchase budgets, publishers' reluctance, but also the pressures of the RAE. Nevertheless, while some researchers in the humanities and social sciences complain of inappropriate pressure to publish articles rather than books, a majority feel that monographs remain the single most important mode of dissemination, one around which they build their careers.

Many researchers are confused by the mixed messages they are receiving as to how best to communicate their findings. If they are to make optimal use of the various communications channels open to them, it is essential that researchers should receive more consistent and effective guidance on their use of different channels; and that in framing their messages, funders and others should take account of the value researchers themselves attach to the channels appropriate to their work.

Funders and policy-makers must also take account of the various misperceptions of their policies noted in this report. In particular, if they wish to encourage researchers to publish and disseminate their work through channels other than high-status journals, they will need to give stronger and more positive messages about how these channels will be valued when it comes to assessing researchers' performance.

5.1.2. Disciplinary differences

We have already noted the increasing dominance of journal articles. But the motivations that lead researchers to publish in scholarly journals differ significantly across disciplines. In

the physical and life sciences, they are more likely see scholarly journals principally in terms of effective dissemination. In the humanities, social sciences and engineering, by contrast, they are more likely to see journals principally in terms of the requirements of research assessment or gaining the recognition that supports advancement in their careers. Indeed, in these disciplines, and in education and sport in particular, it appears that the rise of the journal article is closely associated with the perceived requirements of research assessment. In the humanities, however, there seems to be a complex and even contradictory interplay of motivations and perceptions at work: researchers are producing more articles, and regard them as very important, driven in large part by research assessment requirements. Yet many of them dislike the constraints of the article format ("like writing shopping lists") and resent the pressure to publish them. And when it comes to the RAE, there is a strong tendency to submit monographs and book chapters in preference to articles.

Many of the differences between disciplines and subject fields relate to the speed with which they develop, and the nature and scope of their engagement with non-academic audiences. In computer science, for example, pace of change means that conference and workshops presentations are particularly important: they may attract higher prestige than journal articles, although there are concerns that they may not be so regarded in the RAE. In other disciplines, however, conference presentations and proceedings feature much less prominently in the profile of published outputs; in the humanities they feature hardly at all. Nevertheless, they are regarded as 'very important' by between 30% and 40% of researchers in all discipline groups except the social sciences and the humanities, where the proportion falls to 17%.

Speed of development and engagement with wider audiences may also be a factor in differences between disciplines in the take-up

of open access. In the physical sciences in particular, but also in the other sciences, engineering and education, open access repositories are seen as important by significant numbers of researchers. In the humanities and social sciences, they have so far achieved significantly less traction.

In areas where applied research is a prominent feature, the choices between publication in prestigious scholarly journals and effective dissemination to potential users of research findings may be especially difficult. Thus researchers in cancer studies, and nursing and midwifery, describe something akin to a moral obligation to "make material very accessible to staff on the ground". And researchers in education, psychology and politics similarly describe the importance of engagement with practitioners and policy-makers. In the humanities, by contrast, concerns are more likely to arise in relation to the value attached to work aimed at a general audience. And in many areas of the biological and physical sciences, where journal publication is most dominant, such tensions appear to be much less prevalent.

Both monographs and edited collections are much more prominent in the humanities, and to a lesser extent the social sciences, than in other discipline groups. The vast majority (88%) of researchers in the humanities, along with 43% of their colleagues in the social sciences, regard monographs as 'very important'. They do so because they value the scope provided by monographs to develop ideas and arguments, and to present and analyse evidence, at length. Many humanities researchers also see a shift from single-authored monographs towards collaborative work and edited collections, although this is not yet evident in the bibliometric data.

5.1.3. Collaboration and co-authorship

Collaboration has become an increasingly significant part of the research landscape, along with the co-authorship that flows from it. Researchers feel an increased push both from the research

councils and from RAE panels to get them to collaborate across institutional, national and disciplinary boundaries. Our analysis indicates that the numbers of multi-authored publications continue to increase.

The rise in multi-authorship has sometimes given rise to difficulties, with debate over issues including responsibility for the conduct and validity of the research, the justification for the inclusion of researchers in the author list, and the ordering of authors in individual publications; and complaints about unscrupulous senior researchers abusing their position.

Levels of collaboration and co-authorship differ very significantly across disciplines. They are the norm in the physical and life sciences, medicine and engineering, but much less common in other subjects and disciplines. In the humanities, most research is still undertaken by individual researchers, and single authorship remains the norm, despite the perceived pressures from the Arts and Humanities Research Council and from RAE panels.

There are also important differences of practice in the attribution and listing of multiple authors, ranging from alphabetical ordering, to placing the senior author or the principal investigator first, to placing him or her last, to the use of indicators of contribution levels, and many variations between. Listing in order of contribution is the most popular practice in most disciplines except the humanities, where alphabetical ordering is the norm. But there are notable differences of practice within discipline groups. Thus ordering by contribution may often be modified by placing the senior researcher (or main contributor or principal investigator) last. Moreover, while our bibliometric data showed no significant shift in practice between 2003 and 2008, researchers are increasingly aware of the need to negotiate with colleagues, and of the difficulties and misunderstandings that can arise from variations in practice across disciplines. *It is clearly*

important that all those who are involved in the assessment of research outputs – whether via bibliometrics or through peer review – should be well-informed about the different listing conventions and their meaning, and about how they are changing. There may also be scope for funders, learned societies and publishers to take more of a lead in helping to devise guidelines on good practice.

5.2.   Citation practice

Researchers include citations in virtually all their publications: referencing previous work is part and parcel of the job of communicating research findings. Researchers cite previous work in order to establish their knowledge of the context, and to provide supporting evidence. Since journal articles are the dominant form of publication, they are also the form most often referenced in citations, especially in the sciences; other forms are cited much less frequently.

In choosing what to cite, researchers are influenced by the authority of the work, and of the authors, but there are conflicts of view as to which is the most important. Some researchers say "it's the paper and its quality, not the authors, that influence me". Others say that they cite the work of people they respect. But our research does not support the claim that personal contact is a major factor in choosing to cite an author's work: a large majority of researchers told us that personal knowledge of the author had little or no influence on their citations. Indeed *disagreement* with previous publications or findings is among the significant reasons for citation in all disciplines: strongly so in the humanities and social sciences, but evident in the physical and life sciences too.

Despite the importance of citations, only a minority of researchers have received any training in choosing what to cite. Most researchers are self-taught on this important issue,

though younger researchers may have had some guidance from supervisors. But researchers do receive informal advice from reviewers and co-authors on a wide range of issues relating to citation practice. They also see the need to tailor their citations to meet the requirements – perceived or actual – of specific journals and their editors. And while some of them regard the guidance they receive from journal editors and reviewers as a positive help, others have experience of what they perceive as cynical attempts by reviewers to promote their own work.

5.2.1. How is citation related to accessibility?

Access to material online has greatly facilitated the process of finding, reading and deciding what to cite. The risk is that researchers will *only* cite what is easily findable online, or even that they will cite what they have simply skimmed. A third of researchers in the life sciences say that easy accessibility has a major influence on what they cite, and the proportion rises among younger researchers. In the humanities and social sciences, easy accessibility has less influence. Some researchers, however, are worried by a decline in their reading of books. The reasons for this are not clear, but our bibliometric analysis does show a significant decline in the citation of books as distinct from other publications.

5.2.2. Differences by discipline and experience

Citation practices are clearly influenced by disciplinary norms and the policies of individual journals. Researchers in the humanities and social sciences cite more sources on average in their publications than their colleagues in the sciences and engineering, mainly because they write at greater length (in articles as well as books) and cite primary source material as well as the published findings of their peers. They are also more likely to cite grey literature and websites, and works with which they disagree;

and less likely to be influenced by the currency and accessibility of the works they cite. Their colleagues in the life sciences and physical sciences, on the other hand, are more likely to concentrate their citations solely on journal articles.

In general, however, it is notable that citation behaviour and motivations are related as much to researchers' age or length of experience as to the disciplines in which they work. Younger researchers are more likely than their more experienced colleagues to be influenced in choosing what to cite by their knowledge of the author, and by the standing of the journal and ease of access to the article. *If such differences persist as younger researchers progress through their careers, funders and others concerned with assessing research performance may need to take account of significant changes in the patterns of citation.*

Researchers in a number of disciplines are also aware that some high-status journals impose limits on the number of references that can be included in an article, and there are signs that such limitations are becoming more widespread. *If they do so, one effect could be to lessen the usefulness of citation data for bibliometric and assessment purposes, even in those fields where they are considered robust at present.*

5.3. Research assessment and its influence

5.3.1. How have the requirements of the RAE affected behaviour?

Our findings demonstrate how researchers' behaviours and attitudes are influenced by what they perceive as an increasing emphasis on the part of funders and institutions on assessing and evaluating research and its impact, varyingly defined. The

influence of the RAE should be set in this broader context. It is a major concern for researchers: a common topic of conversation and much more important for most of them than other forms of assessment. There are significant differences, however, between what is produced and published, and what is submitted to the RAE. Moreover, forms of output – including book chapters, conference papers, reports and working papers – that are considered important by significant proportions of researchers in all disciplines feature less prominently in submissions to the RAE.

Researchers' perceptions and understanding of RAE rules and requirements are mediated via their universities. What they hear is not necessarily what the higher education funding bodies say. For universities develop their own positions and strategies that may be at odds with the formal requirements of the RAE. Researchers' understanding of those requirements is often imperfect. But a common view is that the RAE, along with the measures institutions take to maximise their performance in it, constitutes a game they have to play; and that this can act as a significant constraint on intellectual autonomy. A quarter of researchers believe that important outputs were not submitted to the last RAE; and many more are concerned about the pressures they perceive to target publication in high-status journals as their main – even sole – form of output and dissemination. The RAE and related institutional policies thus have a major influence on researchers' decisions to publish in scholarly journals, and in which particular journals they seek to publish. Conversely, with the exception of monographs in the humanities, researchers see the RAE as a disincentive to any other forms of publication and dissemination. *Since journal articles are the form of publication most readily measured, and thus most susceptible to evaluation through any system of performance assessment, there is a risk that their dominance will increase.*

Many researchers are also concerned about the relationship between the timescales for research and the RAE. Some see it as constraining them to stay within their field of expertise, rather than taking up new areas of research where it may take some time to build a reputable portfolio of publications. A strong majority are concerned that it often takes longer than the length of an RAE cycle for the significance and value of research findings to be recognised: across a range of disciplines they often talk of periods of ten years or more. The proposal that the socio-economic impact of research should be a significant feature in the RAE may help to clarify the mixed messages that researchers perceive as coming to them about the relative priority they should give to criteria for success (including academic quality, speed of dissemination, engagement with non-academic audiences, and wider socio-economic impact). *The timescales for research, recognition and impact differ widely across different disciplines and kinds of research. Research timescales need to be carefully considered in any arrangements for the assessment of performance.*

5.3.2. Likely impact of bibliometric assessments and of REF

Our research has been undertaken in a climate where there has been considerable debate about the format of the REF, but where many researchers have picked up the message that bibliometrics are to play a much greater role in research assessment than they have previously. The original REF proposals have been subject to significant change, of course, but its final format – and institutional strategies in relation to it – are far from clear to most researchers. There has been considerable room for speculation and misconception, though researchers and universities seem as yet to have given relatively little thought to the implications of the proposals to assess socio-economic impact as well as research quality in the REF.

Many researchers are clear that any move to a system based even in part on the analysis of citations will have a significant effect on their publication and dissemination behaviour: they will publish more; they will submit their work more often to journals with high impact factors; and they will make their publications open access.

It will also change their citation practice. Many are concerned that publications targeted at audiences beyond the academic and research communities, where citations are not normally needed or expected, will be further downgraded. Many are also concerned about the scope for misunderstanding and manipulation of citations, especially in the light of the differences in author attribution and citation practice within and across disciplines. Thus nearly a quarter of researchers express concern that REF will lead to unprofessional game playing such as citation clubs. Only a small minority say they will cite competitors' work less often; but even while they deprecate citation clubs and circles, nearly two-fifths of researchers say that they will cite their collaborators' work more often. *Possible changes in citation practice will need to be carefully monitored as the REF develops.*

5.3.3. Disciplinary differences

Researchers across all disciplines regard the RAE as of major importance, but those in the physical and the life sciences and in education are slightly more likely than their colleagues in other disciplines to regard assessments by other major research funders as equally or even more important. In relation to the RAE itself, scientists and engineers, along with researchers in education and sport, show slightly less concern than their colleagues in the humanities and social sciences that the time taken for research to be recognised as important is often longer than an RAE cycle. Nevertheless, a substantial majority of researchers in all disciplines believe that sometimes may be the case. Again,

researchers in all disciplines believe that important outputs were not submitted to the last RAE; but it is notable that nearly half researchers in education and sport believe that to be the case, compared with around one in six of their colleagues in the humanities and the physical sciences.

In relation to the REF and its implications, it is notable that physical scientists are even less likely than their colleagues in other areas to be aware of any institutional strategies, or to have been involved in discussions about them; whereas social scientists show much more signs of awareness and involvement. There are no major differences between disciplines in the changes in behaviour they foresee as a result of the REF. The single exception is that physical scientists foresee much less of a shift to open access, perhaps because they have made the shift already.
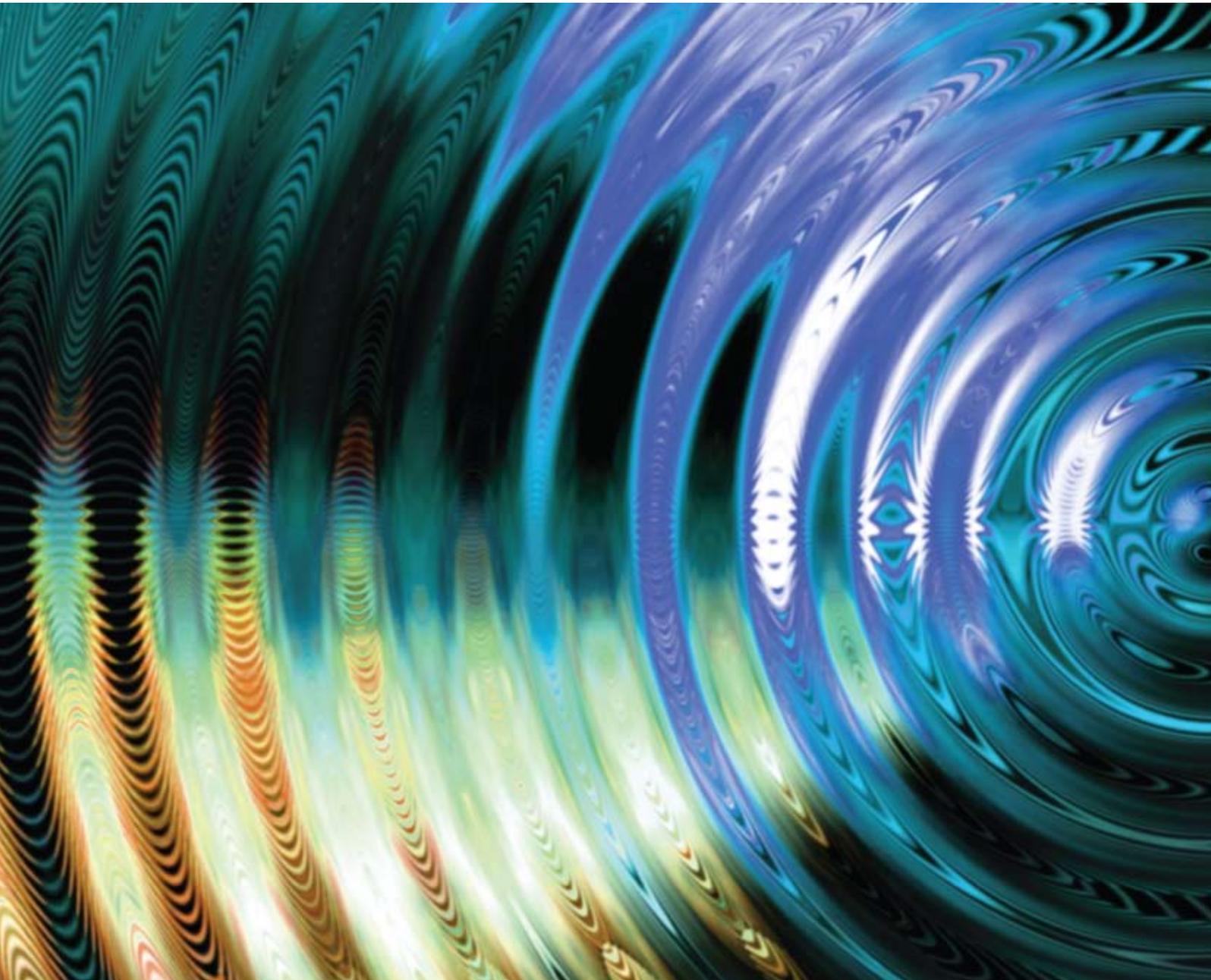
Annex: Notes on methodology

Literature review

An extensive review of existing academic and 'grey' literature was undertaken, utilising the resources available through the libraries of the partner institutions as well as website searches to identify previous research in this area, and to obtain a broad perspective on the issues we sought to address, including institutional policies and other external influences. Early results informed our evidence-gathering, and the review continued throughout the project period.

Bibliometric analysis

The research team sought to compare the publication and dissemination behaviour of researchers as reported in the focus groups and survey with behaviours evidenced by published research outputs. A bibliometric analysis was carried out, focusing on examination of the traceable research outputs and of the material cited therein, from a sample of researchers whose work was submitted to the RAEs in 2001 and 2008. A random sampling design was used, so that inferences could be made about the national picture, and broad comparisons drawn between disciplines, and over time.

The analysis faced a number of challenges, not least the resources needed to collect data at this level of detail. The ideal for this type of analysis would be to look at a five or even ten year trend, analysing data from each year, but the timescale of this project, and available resources, were insufficient to do this. Instead, a pragmatic approach was adopted, restricting the analysis to two snapshot years. In outline, the method was as follows:

- Two years' data were selected for analysis, from separate research assessment periods – 2003 and 2008

- Two samples of authors were drawn from RAE submissions for 2001 and 2008, and lists obtained of their published research outputs in 2003 and 2008 respectively

- Outputs identified were examined, and their references categorised and counted

- A total of 1,452 works from 484 authors were included in the analysis

Data were collected manually, and held in a series of Excel spreadsheets. The analysis was carried out using SPSS. The intention was that the method should be replicable for the outputs from any period, and as such it has been fully documented in the supporting paper to this report.

Focus groups

The qualitative aspect of the project comprised a series of 11 focus groups/interviews with research active academics from a cross section of institutions and disciplines. The focus groups were held in London, Manchester and Edinburgh. A purposive stratified sampling approach was employed to identify potential participants, with consideration given to: (1) research activity, (2) institution type and (3) stage of career.

The target number of participants for each focus group was originally set at 8 10, and the response rate was largely excellent. However, it was necessary to overbook focus groups to take into

account drop out. As a result, one focus group exceeded the expected ten (with 13 participants), but it was felt that in this case the numbers were still manageable.

Three disciplines (biomolecular chemistry, cancer studies and economics) did not attract sufficient participants to run a focus group and in these cases paired face to face interviews and/or telephone interviews were undertaken. Apart from biomolecular chemistry (which had fewer contacts, plus a problem with one university which meant that the invitations were not distributed to the appropriate members of staff), it was not obvious why these

disciplines did not attract more respondents. The strategy for inviting participation was undertaken consistently across all disciplines.

The focus groups lasted up to two hours, and interviews up to 45 minutes. Data were captured using a combination of sound recording and note taking. The recordings were transcribed in full, and ATLAS ti software was used to manage the data for analysis. The key issues described above provided the basis for top down coding. This was combined with open coding to capture aspects of behaviour and motivation which emerged from participants.

Table 10: Participants and disciplines

Whitley's Typology[1]	Fine Grain Subject Discipline	Course Grain Subject Discipline	Attended	Institution spread
High FD/High SD	Physics Bio-molecular chemistry	Physical sciences Medical sciences	10 2	4 2
High FD/Low SD	Nursing & midwifery Cancer Studies Computer science & informatics	Medical sciences Medical sciences Engineering	9 4 9	5 3 6
Low FD/Low SD	English literature Dance, drama, performing arts & music Politics	Humanities Arts Social sciences	10 13 10	8 7 6
Low FD/High SD	Philosophy Economics Psychology	Humanities Social sciences Social sciences	9 5 6	5 5 6
TOTAL	11 subject disciplines	6 broad disciplines	87	46

[1] Based on the degree of functional dependence (FD) and strategic dependence (SD)

For this part of the work we sampled not at the coarse grained level of broad disciplinary groupings - that is, Higher Education Statistical Agency (HESA) and RAE 2001 categories - but more specific subject areas based on Whitley's (2000) organisational theory of disciplines. We believe that Whitley's typology is particularly relevant for this study since it is based on disciplines as reputational systems of organising and controlling research: one of the particular features of reputational organisations is autonomy from the administrative hierarchy of employers and their control over how research is conducted and evaluated. Combining these two approaches ensured that the focus groups had breadth of subject coverage, both in terms of the distribution of UK higher education (HE) researchers overall, and in terms of the cultural characteristics of the disciplines in which they work.

Table 10 shows the disciplines included, and a profile of participation. Eighty seven scholars from 46 different institutions participated in either the focus group or interviews.

Researcher survey

A survey of UK academic researchers was conducted online over a period of 6 weeks to 6 May 2009. Invitations to complete it were sent to approximately 4,000 UK academics; in addition, publicity material was placed on the websites of CERLIM, LISU, and the RIN, included in a number of academic newsletters and publicised via the mailing list of the Association of Research Managers and Administrators. An incentive prize of a £100 Amazon voucher was offered, and one respondent picked at random from the completed returns received this prize.

A total of 944 responses were received by the closing date, including a small number from researchers based either outside the UK or not based in HE institutions, along with responses where only the first page had been completed. These were removed from the data file, leaving 857 responses for analysis. Nott all respondents completed every question and so some analyses are based on smaller numbers. The data were compiled into an Excel spreadsheet, and quantitative data analysed using SPSS. The qualitative responses to open ended questions were relatively short, and analysed manually.

Answers to each question were analysed across eight broad discipline groups: medical and biological sciences; physical sciences and mathematics; engineering and computing; social sciences, business and economics; humanities; arts; education and sport; and interdisciplinary. The response from researchers in the arts was low, with only 14 responses in total. It should be noted, however, that the response to the call for participation to the focus group from researchers in dance, drama, performing arts and music was overwhelming.

Figure 8 illustrates the main area of research of respondents to the survey. The largest number came from the medical and

Figure 8: Subject profile of survey respondents
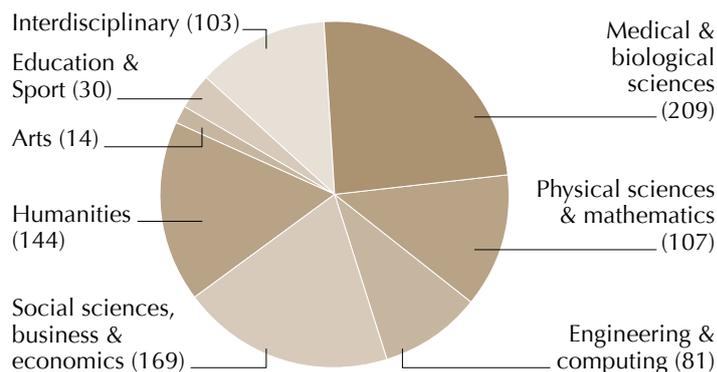
biological sciences (24%). If the interdisciplinary responses are omitted, the subject breakdown is broadly in line with the proportions of researchers in UK HE as shown in HESA data RAE submissions.

Analysis by discipline

For the bibliometric analysis and the focus groups, subjects were assigned by the research team. For the survey, a list of detailed subject areas, grouped into broad disciplines, was provided, and respondents asked to indicate their main area(s) of research. Where respondents ticked options in two, or more, broad discipline groups, they were allocated to the interdisciplinary category.

Table 11: Disciplinary groupings

Survey	Biometric analysis	Focus groups
Medical & biological sciences	Biomedicine	Medical sciences, *represented by* Biomolecular chemistry Nursing & midwifery Cancer studies
Physical sciences	Physical sciences	Physical sciences, *represented by* Computer science & informatics
Engineering & computing	Engineering	Engineering, *represented by* Computer science & informatics
Social science, business & economics	Social sciences	Social sciences, *represented by* Politics Economics Psychology
Humanities	Humanities	Humanities, *represented by* English literature Philosophy
Arts	Arts	Arts, *represented by* Drama, dance, perfprming arts Music
Education & sport	Education	*Not included*
Interdisciplinary	*Not applicable*	Included above

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About the Research Information Network

Who we are

The Research Information Network has been established by the higher education funding councils, the research councils, and the national libraries in the UK. We investigate how efficient and effective the information services provided for the UK research community are, how they are changing, and how they might be improved for the future. We help to ensure that researchers in the UK benefit from world-leading information services, so that they can sustain their position as among the most successful and productive researchers in the world.

What we work on

We provide policy, guidance and support, focusing on the current environment in information research and looking at future trends. Our work focuses on five key themes: **search and discovery, access and use of information services, scholarly communications, digital content and e-research, collaborative collection management and storage.**

How we communicate

As an independent voice, we can create debates that lead to real change. We use our reports and other publications, events and workshops, blogs, networks and the media to communicate our ideas. All our **publications** are available on our website at **www.rin.ac.uk**

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