The role of international collaboration and mobility in research

Findings from a qualitative and quantitative study with Fellows and grant recipients of the Royal Society, British Academy, Royal Academy of Engineering and the Academy of Medical Sciences

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Executive Summary

This study, based on the experiences of 1286 Fellows and grant recipients from the National Academies, has found that international collaboration and mobility is integral to life as an active researcher across all disciplines and at all career stages. 95% of respondents have been involved in at least one international collaboration in the past five years and 89% said that international collaboration was important to their careers. International collaboration enables researchers to access additional, often specific, expertise, gain new perspectives on research and build relationships with others in the field, which for early stage researchers can be key to career development. The types of outputs which result from international collaborations parallel those which are produced in other ways, an indication that that collaboration[1] is a core part of the work of researchers. International mobility facilitates this collaboration but is also important in its own right: 91% of respondents reported that mobility was very important to their careers and 86% said that international travel was essential.

International collaboration takes many forms, involving bilateral and multilateral relationships and collaborations within and across disciplines. Researchers collaborate in and travel to all the world's continents, but most frequently to Europe and North America. Collaborations vary in length: 88% of respondents reported that their shortest international collaboration lasted less than a year, while 63% had been involved in collaborations lasting more than three years. For some researchers collaborations are very common, with 12% reporting that they had been involved in more than ten collaborations in the last five years, while a further 23% had contributed to between six and ten.

Networking and personal contacts facilitate both the creation and maintaining of international collaborations. Collaborations are most commonly created because of knowledge of the work of those involved (73%) or because individuals have previously worked together (65%), with meeting at conferences and events a factor in 62% of collaborations. This is consistent with the survey finding that developing networks is one of the main reasons for short-term international travel.

Short and long term international mobility is common in the careers of researchers, and is done for a variety of reasons. As well as attending conferences, researchers make short term international trips (of less than a year) to visit collaborators, either established or potential, and to carry out independent research. Short-term trips are considered to be becoming more frequent as part of the role of a researcher. More than half of respondents (58%) reported that at some point during their career they had spent a sustained period of a year or more working abroad. This was most commonly reported as something which participants had undertaken at post-doctoral stage (51%). It was something which many noted was valuable for career development (70%), particularly in terms of expanding professional networks and contacts, as well as enabling individuals to work with expert colleagues (51%) or on a particular research topics (51%), or to experience another culture (38%).

International collaboration and mobility have an integral place in the careers of Fellows and grant recipients and an environment which facilitates these is vital. The study has found that individuals are more likely to be involved in a higher number of international collaborations if they find it easy

[1] Readers should note that where this report refers to 'collaboration' we mean 'international collaboration'.

to access funding to support travel. Researchers use funding from a range of sources, including UK government, Research Councils, National Academies, charities and business, the European Research Council and other European sources, UK and overseas higher education institutions and other international sources. Different funding sources were seen to have complementary advantages, with some smaller sources useful on account of their flexibility while larger sources offered the opportunity to scale up programmes. The processes that are in place to support the working of the partnership (such as the relationship, common interests or communication) was the most commonly cited factor affecting the length of international collaboration (33%). The complexity of some funding application processes was seen as a disincentive by some respondents.

There is a correlation between international travel and collaboration, with those who travel more, or who saw travel as essential to their work being also more likely to be involved in multiple collaborations. Travel was seen to be important in building international collaborations by helping develop stronger relationships and a broader understanding of each other's strengths and interests. Defining clear roles and responsibilities was cited as an important element in initially formalising collaborations. It was found to be less important for longer-term partnerships. 36% cited personal commitments as a barrier to international mobility. A small number also cited teaching commitments in their home institution (26%) and knowledge of languages (23%) as barriers.

More than three-quarters (77%) of individuals who have been involved in research for more than 20 years felt that international collaboration was more common now than two decades ago. Most respondents (55%) across all levels of experience said that they anticipated the number of international collaborations that they are involved with to remain constant during the coming five years. Given that most of the respondents were late stage researchers this may reflect their career stage.

Objectives of this research

The UK National Academies – The Academy of Medical Sciences, the British Academy, The Royal Academy of Engineering and The Royal Society sought to obtain qualitative and quantitative evidence of the extent, value and nature of international collaboration and mobility by National Academies' Fellows and appropriate grant recipients.

The main objectives of this research were to:

- Understand the type of international collaborations that exist – for example long-term residency, academic visits, joint grants
- Understand the extent of international collaborations that exist – for example number of countries, duration
- Understand the perceived added value of international collaboration and any challenges involved
- Identify the funding sources that underpin international collaborations
- Understand the human and physical infrastructure that support collaborations forming
- Understand the extent and destination of travel undertaken for research purposes

This research took the form of a qualitative phase – 16 interviews with Fellows and grant recipients of the Academies – and a quantitative phase – an online survey of Fellows and grant recipients of the Academies. Further detail on the methodology, response rates and participant demographics are available in the appendix.

Further information about the researchers surveyed

We received responses from 1286 researchers, which included 762 Fellows and 524 grant recipients from the UK National Academies. This translates to a response rate of 26%. The specific nature of respondents should be noted when reading this report. Though we believe that there is a great deal which can be learnt from this, the nature of the sample should be borne in mind when generalising from any findings mentioned in this report.

Fellows of the Academies are elected for their distinction in research in science, engineering, medicine and the humanities and social sciences. They are not necessarily representative of the diversity of genders, ages and disciplines in the UK's research population as a whole.

The Academies award grant funding to enable talented academics to undertake excellent research. Surveying the Academies' grant recipients provides a valuable insight into the career paths of those who receive this funding and will help inform how funding programmes operate in future.

Throughout this report reference is made to REF panels. The Research Excellence Framework (REF) is an established, national system for assessing the quality of research in UK higher education institutions. The REF uses 36 subject-based units of assessment, grouped into four main panels[2]. This survey asked discipline specific questions using these units of assessment as discipline categories for ease of reference and comparability. The units of assessment do not necessarily capture the

[2] http://www.ref.ac.uk/panels/

diversity and complexity of the disciplinary make-up of UK research. The findings in this report are mainly grouped by the main panels which represent, broadly, medicine, health and life sciences (A), physical sciences, engineering and mathematics (B), social sciences (C) and arts and humanities (D).

Key Findings

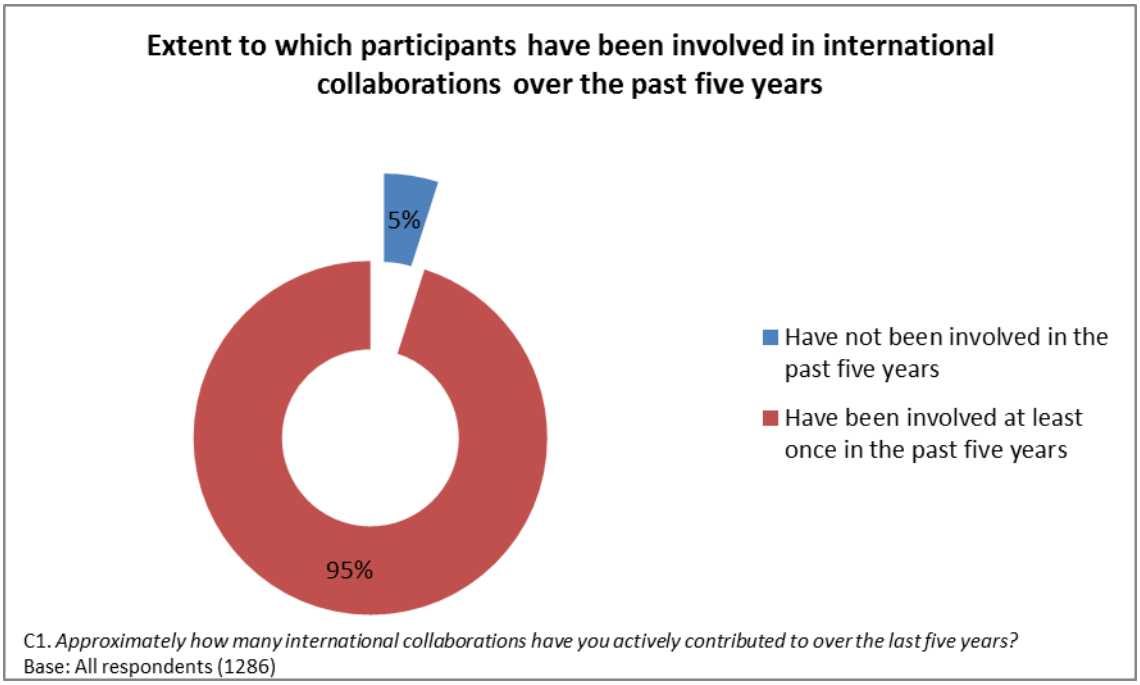
The extent of international collaboration

SUMMARY OF FINDINGS ABOUT THE EXTENT OF INTERNATIONAL COLLABORATION

- International collaboration was reported by almost all participants in this study – 95% of those surveyed had been involved in at least one collaboration during the past five years.
- Most participants reported having been part of between one and five collaborations during the previous five years. There were a small number of participants who reported very high levels of collaboration. These participants were commonly also those who undertook large amounts of short trips overseas.
- The collaborations that participants reported having contributed to vary greatly in length. Most reported that their shortest collaboration lasted less than 12 months. Most also reported though, that their longest collaboration lasted more than 3 years.
- Among participants who had been active in research for more than 20 years, it was commonly agreed that the amount of collaboration had risen during this time period. The majority of participants did not however expect that the amount that they personally collaborate would rise further over the next five years.

Almost all participants reported collaborating within the past five years

Throughout the course of this research it has been evident that collaboration is common within the work of the study participants. One of the core questions asked in this study was about the extent to which participants had been involved in collaborations during the past five years. The overwhelming majority of participants reported that they had been involved in at least one. This included the majority of respondents from all age groups, at all career stages and across all disciplines.

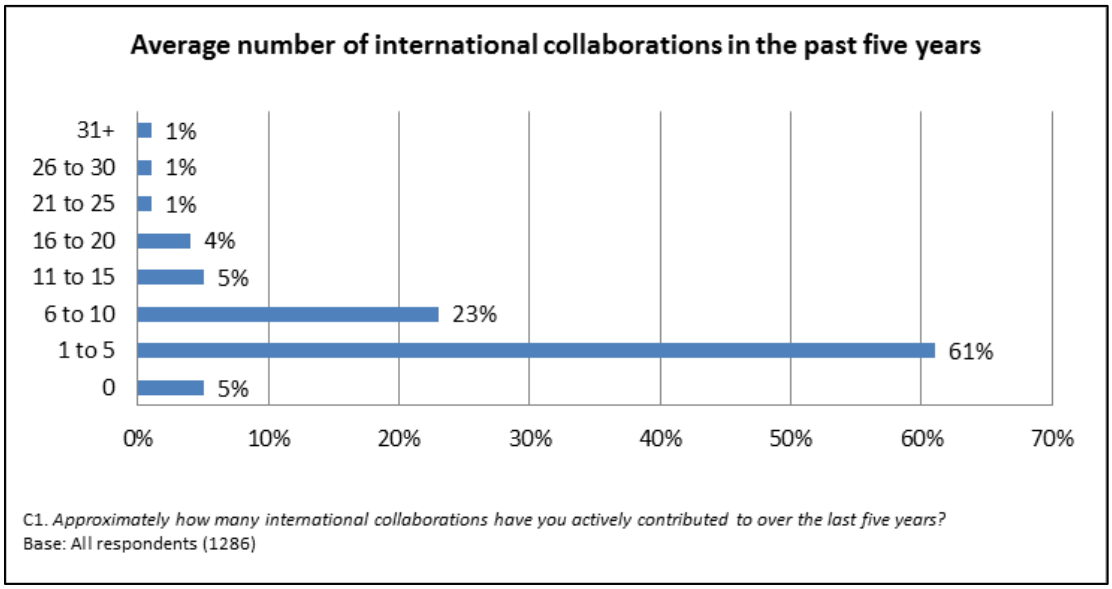


C1. *Approximately how many international collaborations have you actively contributed to over the last five years?*
Base: All respondents (1286)

Looking more closely at the minority who had not engaged in any collaborations, this was more common among older participants. Just over one in ten (12%) of those aged over 70 reported that they had not done so, compared with 5% of the sample overall. Respondents at post-doctoral level were also more likely to report that they had not collaborated, with 13% of respondents in this group reporting that this was the case. Lastly, participants from the arts and humanities were more likely than those from other REF main panels to report that they had not been involved in collaboration within the past five years. The proportion of participants who said this within each REF main panel was: 2% (medicine, biological sciences, physical sciences, engineering and mathematics), 3% (social sciences) and 18% (arts and humanities).

Most participants reported having been part of between one and five collaborations during the previous five years

The majority of participants (61%) reported that they had contributed to between one and five collaborations during the last five years. A further 23% reported that they had contributed to between six and ten collaborations in the same period.



C1. *Approximately how many international collaborations have you actively contributed to over the last five years?*
Base: All respondents (1286)

There is a correlation between number of collaborations and number of short visits

The frequent collaborators who have contributed to between 6-10 or 11-15 collaborations in the past five years are more likely to travel on more short visits – this is illustrated in the table below. The table also highlights a fewer number of short visits amongst those who took part in fewer collaborations and in turn no short visits at all for the non-collaborators. The table illustrates a correlation between the number of collaborations and the number of short visits overseas. The link between mobility and collaboration is discussed more, later in this report.

Comparison of number of collaborations and number of short visits

Number of short visits

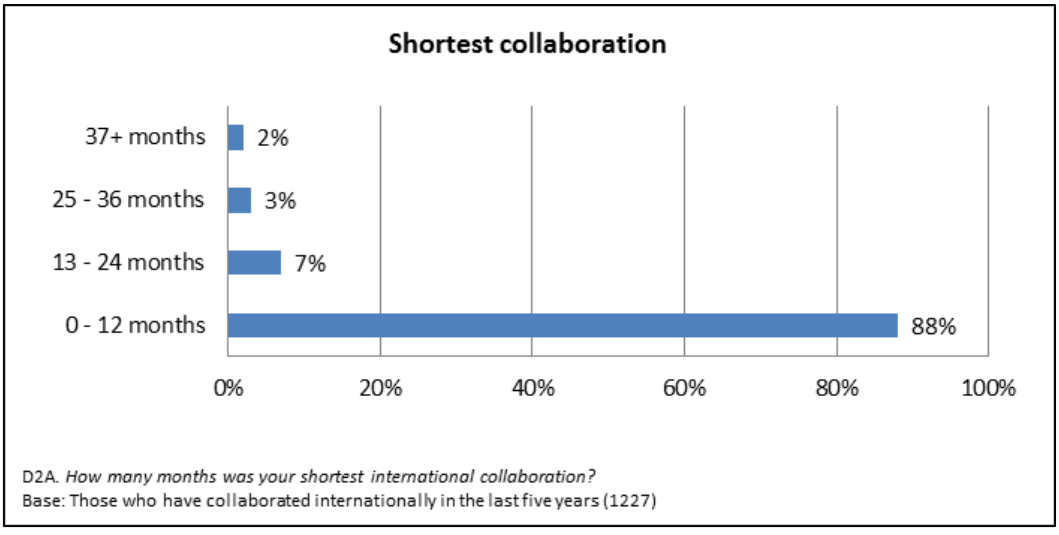
Number of international collaborations

	0	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31+
Never	31%	58%	0%	0%	8%	0%	4%	0%
Between 1 and 5 times	11%	72%	14%	2%	0%	0%	0%	0%
Between 6 and 10 times	4%	73%	19%	1%	3%	0%	0%	0%
Between 11 and 20 times	3%	63%	26%	5%	2%	1%	0%	1%
More than 20 times	1%	48%	29%	9%	7%	1%	2%	2%

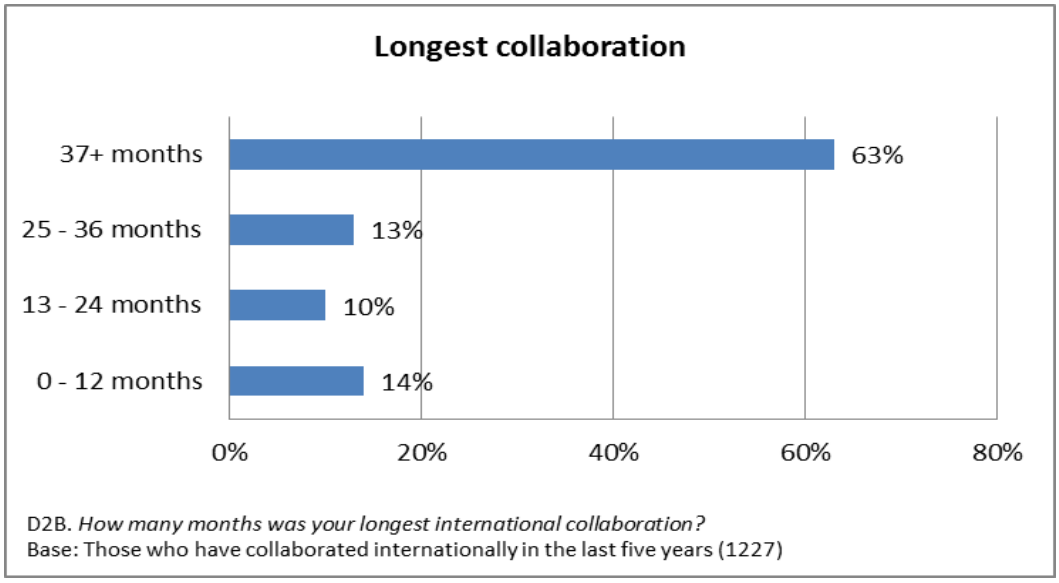
C1: *Approximately how many international collaborations have you actively contributed to over the last five years?*
Base: All respondents (1286)
B1: During the past five years, how many times have you travelled internationally on a short visit of less than a year for your research?
Base: All respondents (1286)

Collaborations vary greatly in length, and many individuals noted that they had experience of collaborations of various lengths

Participants reported that collaborations of various lengths were common. Almost nine in ten (88%) participants reported that their shortest collaboration lasted less than a year. Around two in three (63%) said that their longest collaboration lasted more than three years.



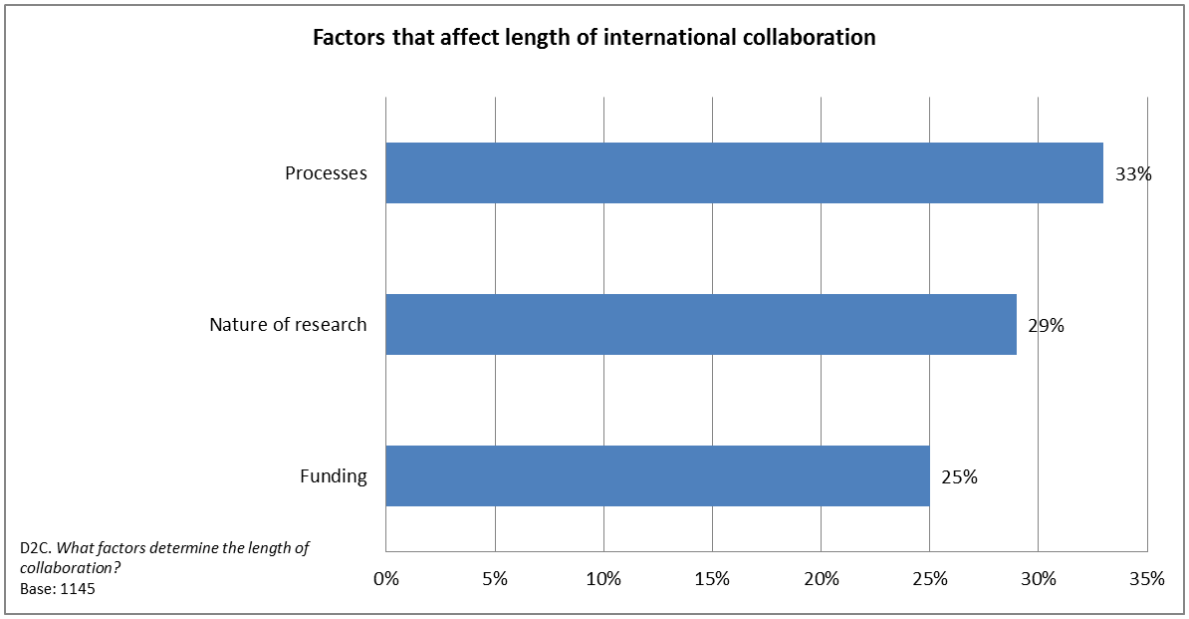
D2A. *How many months was your shortest international collaboration?*
Base: Those who have collaborated internationally in the last five years (1227)



D2B. *How many months was your longest international collaboration?*
Base: Those who have collaborated internationally in the last five years (1227)

Collaboration length increases with career level, with shorter collaborations occurring most often amongst postdoctoral level participants (67%). The longest collaborations reported were 37+ months (with 1% citing their longest collaboration lasting forty years). Participants at Professor/Chair level (28%) were most likely to report having collaborations lasting 37+ months. The qualitative phase of the research also revealed that collaborative involvement on an international level could last a number of years, or even a lifetime.

There are multiple factors which could affect the length of collaboration. From the quantitative survey, factors relating to the processes that are in place to support the working of the partnership (such as the relationship, common interests or communication) were mentioned by a third (33%) of participants. The nature of the research or problem under investigation (29%) and the funding that is available (25%) were also mentioned.



D2C. *What factors determine the length of collaboration?*
Base: 1145

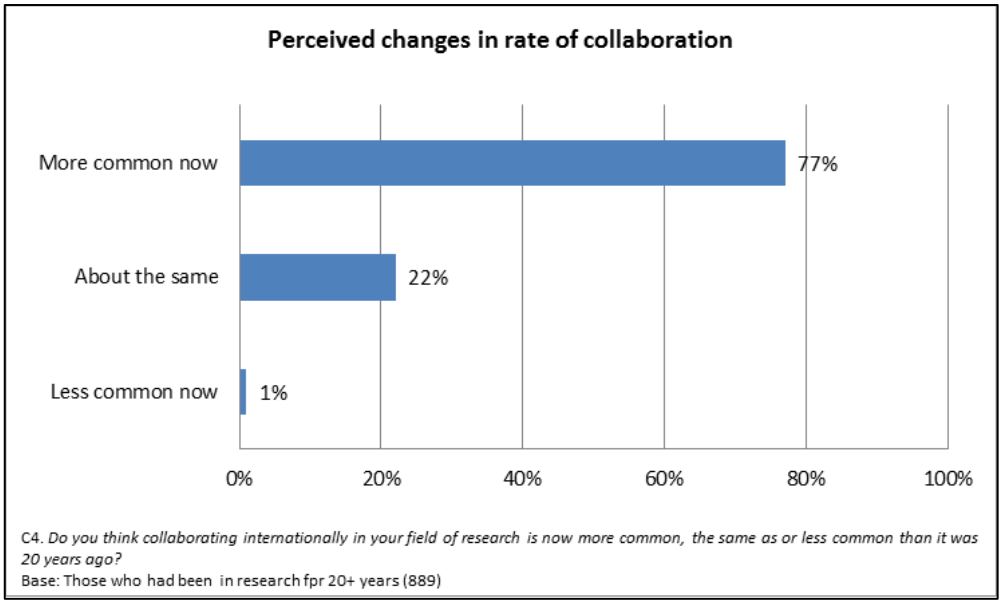
Face-to-face interaction is vital. The long collaborations have endured thanks to regular visits to meet each other, either at my home institution or theirs, or at other events. We arrange to go to the same events so we can work together. Collaboration takes work. Regular interaction to keep the project alive. But face-to-face ensures that goals are met, there is energy to progress and further collaboration discussed (British Academy, Grant recipient)

Grant timelines. Many of my collaborations are very long-standing and continuous though vary in intensity from year to year (Academy of Medical Sciences, Fellow)

It is very difficult to define "length of collaboration". Sometimes you know someone has a tool you need and you get help to access/use it and the whole thing is very brief, but essential. Sometimes you have a long-running collaboration based on complementary skills applied to an ongoing line of research. Sometimes it is a very specific project with a clear start and end point with agreed division of tasks etc. (Royal Society, Fellow)

Participants felt that collaboration was more common now than in the past

Those participants who had been research active for more than 20 years were asked whether they felt that rates of collaboration in their field had changed during the past two decades. Just over three quarters of these participants (77%) reported that collaborations were now more common.



C4. *Do you think collaborating internationally in your field of research is now more common, the same as or less common than it was 20 years ago?*
Base: Those who had been in research fpr 20+ years (889)

Participants in the qualitative work observed that there had been a great deal of technological advances and changes to mobility over the course of their careers which helped to make the logistical and practical aspects of collaboration more straightforward. The introduction of new forms of communication technology was reported to make working with people in other locations easier. An increase of population at a global level was noted to have demanded more scientific research over time, which has resulted in more and faster collaborations. Participants also discussed the importance of the EU in providing more funding and opportunities on an international scale, which has created more collaborations and greater ease of movement across countries. The quotes below illustrate some of these points.

[Collaboration] *is one of the big changes that's taken place over the 50 years I've been doing it. It's now much easier to do this and it's now much more common, but even when I started in the mid '60s, there was a tremendous amount of exchange going on, particularly with the United States and with Continental European countries* (British Academy, Fellow)

Still my feeling is that collaboration generally is greater than it used to be, I think. You know, all of us are more internationally linked and I think there's more opportunity and more funding available for collaborating internationally, certainly at the European level (Royal Academy of Engineering, Fellow)

The technology is there to make it straightforward to work with people even if they're in a different place (Royal Academy of Engineering, Grant Recipient)

[The EU] *raised the capacity to have exchange of researchers, which has grown ever since then. The EU has been absolutely crucial; I would say* (British Academy, Fellow)

The whole project itself was able to happen because we got a big computing allocation on the European network, that was 40 million hours just for this project (Royal Society, Grant Recipient)

Case study 1: A Fellow's experience of changing collaborations

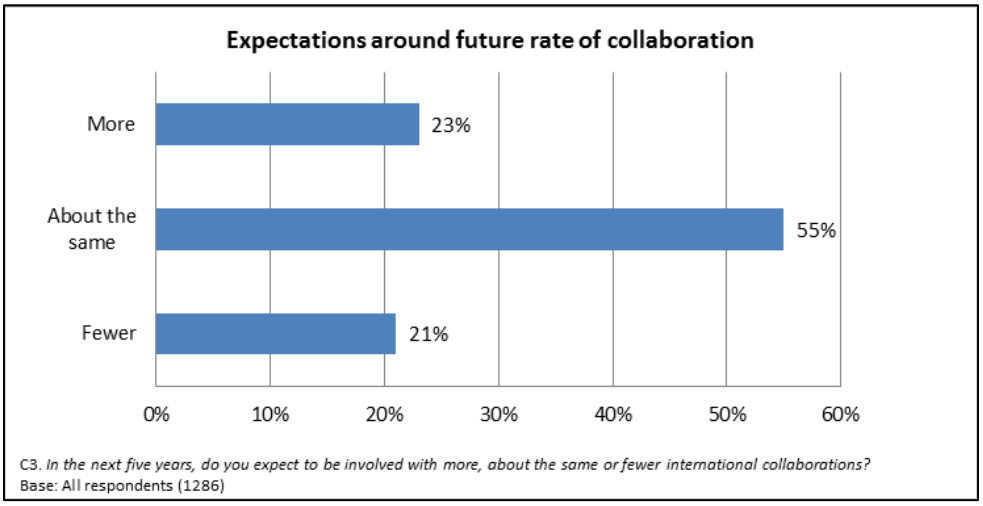
A Royal Society Fellow who has been researching for over sixty years and who is still collaborating now, shared his observations of an expanding collaborative environment which has occurred during his long experience of researching. This Fellow noted that he is currently involved with large numbers of different collaborations with people from all around the world simultaneously. Over the course of his career this Fellow has resided at several different universities in the UK and the USA and he has travelled to a number of different countries, including Germany, France and Mexico. His research activity is greater now than it ever was.

At a young age this Fellow began collaborating and these collaborations fed into even more collaborations. He was involved with student exchanges, and over time more and more students began to visit him in order to learn from him. This in itself resulted in a greater number of international collaborations.

> *Collaborations started young, carry on, then I got more collaborations in Germany, France, and every collaboration fed every other collaboration, and we had students. We exchanged students. I would send my young students to conferences.*

The type of research that this Fellow has been involved in has also dramatically changed over time. Beginning as a mathematician, he adopted new research interests over time, realising that subjects such as computer science were becoming increasingly important in modern society. Frequency of travel has also changed a lot for this Fellow; while at the early stages of his career travel was expensive and infrequent, over time he received more invitations as he became more recognised and travel became cheaper and easier.

> *Well, even at my age, travelling the world, I've been doing quite a lot, and all the collaborations, well, I continue, just by email and correspondence. I sit at my desk and I'm in touch with the rest of the world. My recent collaborations have been very, very extensive.*



C3. *In the next five years, do you expect to be involved with more, about the same or fewer international collaborations?*
Base: All respondents (1286)

The participants who said they expect to collaborate less in the next five years also tended to be participants who are at the later stages of their career and who are travelling less often over time. The group of participants who expect to collaborate less over time were also more likely to sit within the social sciences or arts and humanities.

Most participants (from all levels of experience) said the rate that they are collaborating will not increase any further in the next five years (55%). A factor to consider here is the typology of participants who took part in this research, many of whom are late career researchers.

The nature of international collaboration

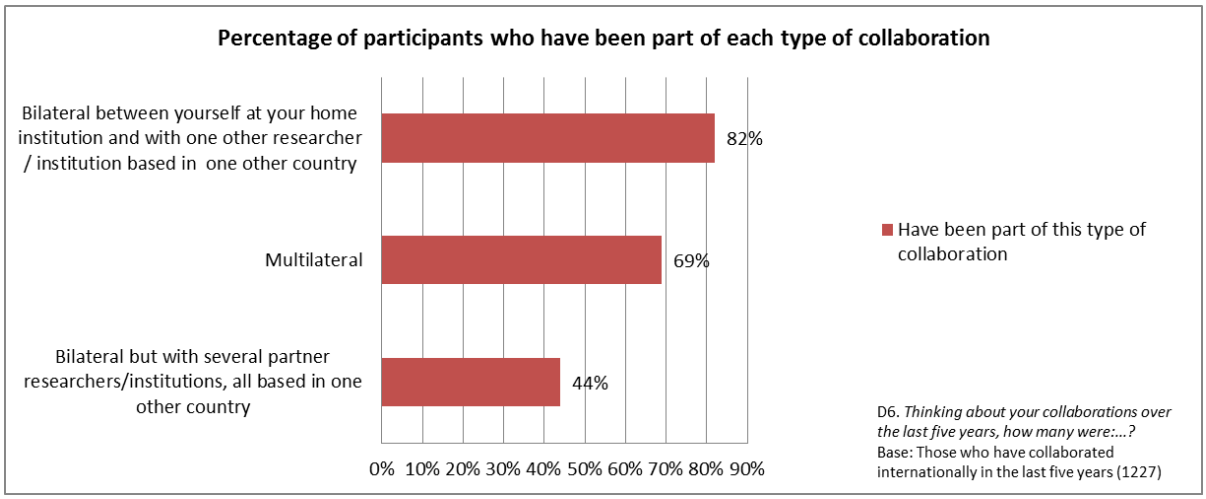
SUMMARY OF FINDINGS ABOUT THE NATURE OF INTERNATIONAL COLLABORATION

- The nature of the collaborations which participants had taken part in was varied. Bilateral and multilateral collaborations were both common. Participants reported engaging in multiple types of collaboration. There were also high levels reported of both intra-disciplinary and inter-disciplinary collaborations within REF main panels.
- Participants highlighted the importance of networking and personal contacts in the formation of collaborations. It was commonly reported that collaborations had initially been formed through personal relationships, or by a researcher contacting a potential collaborator whose body of work they were familiar with.
- A range of funding sources are used to support international collaboration. In most cases researchers from this study report that they had used a mix of UK-based and international-based funding sources to support these during the past five years.

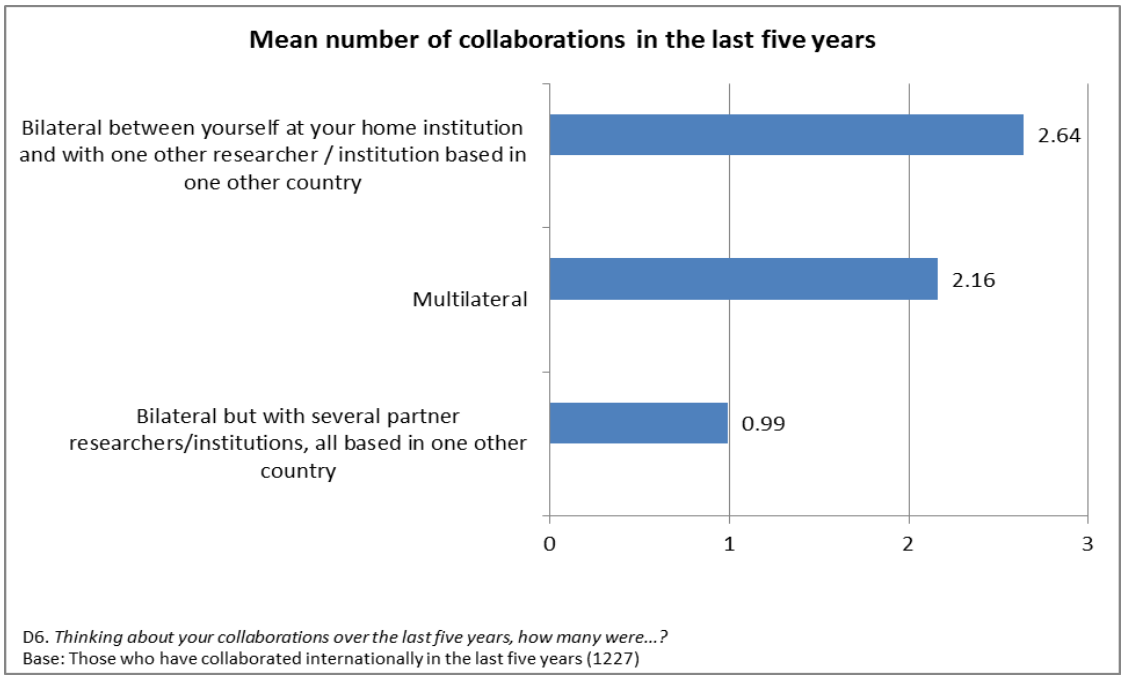
Bilateral and multilateral collaborations were both common

A range of different types of collaboration were in evidence amongst participants who have collaborated in the past five years. Bilateral (between two institutions and based in no more than two countries) collaborations were the most common, with 82% of collaborators reporting that within the past five years they had been involved in such a project.

Multilateral collaborations were also reported as being common, with 69% of collaborators reporting that they had been involved in a multilateral collaboration across more than two countries. Fewer participants reported that they had been involved in a bilateral collaboration with several partners in one other country, with 44% reporting this. Participants commonly reported being involved with one or two different types of collaborations in the past five years – with 54% reporting that they had been involved in one type and 43% reporting that they had been involved in two types.



The chart below highlights the mean number of bilateral and multilateral collaborations across participants who have collaborated in the past five years. The mean number of bilateral collaborations with one other partner and between two countries in the past five years was 2.64. The mean number of multilateral collaborations between more than two countries which participants had been involved with was 2.16. Bilateral collaborations with several partners in one other country were less frequent, with the mean amount reported by participants at 0.99.



D6. *Thinking about your collaborations over the last five years, how many were…?*
Base: Those who have collaborated internationally in the last five years (1227)

There were high levels of collaboration within the same discipline and with other disciplines from the same REF main panel.

Participants were asked about the disciplines of the people they had worked with on an international collaboration during the previous five years. Responses indicated that there was a high degree of collaboration with others from the same discipline (based on units of assessment), with 93% of collaborators reporting this. Collaboration was reported with colleagues from other disciplines (66% of collaborators mentioned this); though this was only with other researchers from the same REF main panel.[3]

[3] The following table illustrates the proportion of participants from each REF main panel that have taken part in intra-disciplinary collaboration (within the same discipline based on units of assessment), inter-disciplinary collaboration (within the same REF main panel but from a different discipline) and inter-disciplinary collaboration (outside the REF main panel).

Intra-disciplinary and inter-disciplinary collaboration for all participants in medicine, health and life sciences

Intra-disciplinary collaboration was reported by **96%** of participants
Inter-disciplinary collaboration within the same REF main panel was reported by **68%** of participants
Inter-disciplinary collaboration outside the REF main panel was reported by **less than 1%** of participants

Intra-disciplinary and inter-disciplinary collaboration for all participants in physical sciences, engineering and mathematics

Intra-disciplinary collaboration was reported by **93%** of participants
Inter-disciplinary collaboration within the same REF main panel was reported by **60%** of participants
Inter-disciplinary collaboration outside the REF main panel was reported by **2%**

Intra-disciplinary and inter-disciplinary collaboration for all participants in social sciences

Intra-disciplinary collaboration was reported by **88%** of participants
Inter-disciplinary collaboration within the same REF main panel was reported by **67%** of participants
Inter-disciplinary collaboration outside the REF main panel was reported by **7%** of participants

Intra-disciplinary and inter-disciplinary collaboration for all participants in arts and humanities

Intra-disciplinary collaboration was reported by **89%** of participants
Inter-disciplinary collaboration within the same REF main panel was reported by **64%** of participants
Inter-disciplinary collaboration outside the REF main panel was reported by **4%** of participants

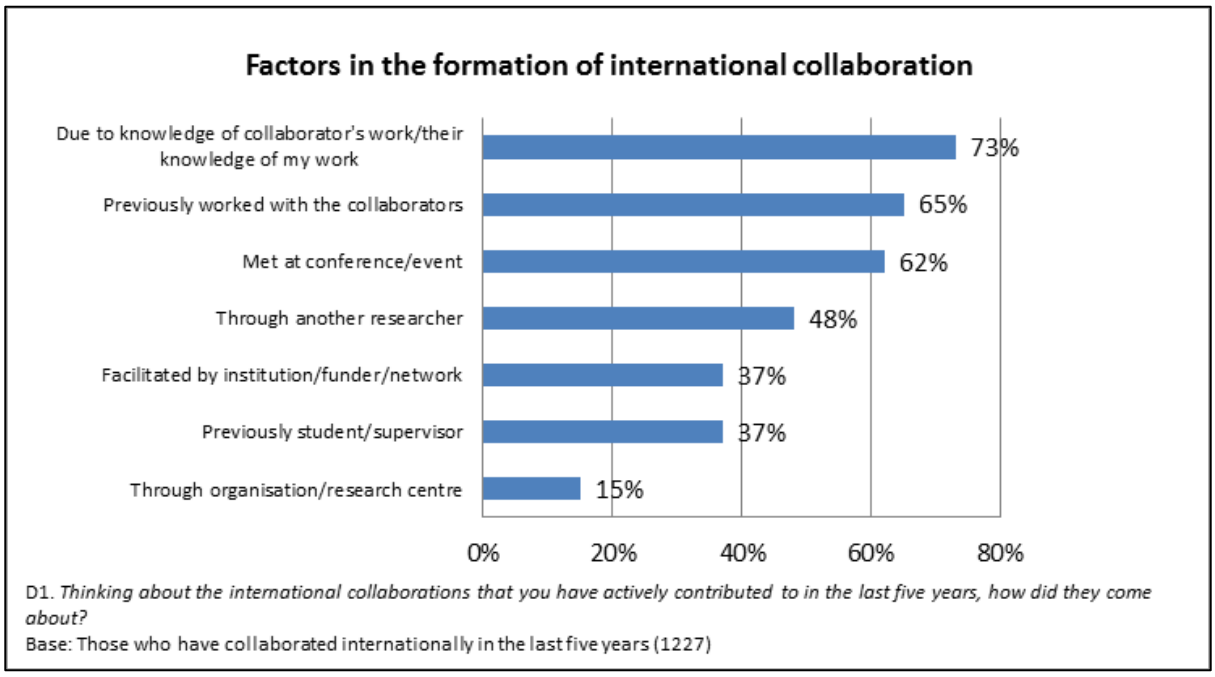
A3B. *Which of the following best describes your [main] discipline?* Base: All respondents who were involved in a collaboration and who gave a response that was not 'other' when asked for their primary discipline (1192)

Similar to the quantitative findings, qualitative participants reported being involved in both intra-disciplinary and inter-disciplinary collaborations. In relation to inter-disciplinary collaborations in particular, participants highlighted a range of positive benefits. They have been able to learn things such as new approaches to research, different skills and techniques and how to use specific pieces of equipment. Drawing from more than one discipline in a collaboration was seen to facilitate a broader understanding of the research project, which positively impacted the outcome of the research. It was also reported that for larger collaborations that involve multiple partners and countries, it can be expected that multiple disciplines are also involved.

I'm a psychologist and I'm quite quantitative, I've also ended up having contact with anthropology and qualitative methods. I probably didn't have much time for them before, but I've really learned to see the advantages and the strengths of those methodologies. So it has changed me as a researcher (Academy of Medical Sciences, Fellow)

Personal networks and knowledge of others in the field play key roles in the formation of collaborations

The importance of networking and reputation was highlighted by participants. The most commonly cited reasons given for why their collaborations had come about were either approaching or being approached by a potential collaborator due to knowledge of each other's work (73%), through personal networks (65%) or meeting at a conference or event (62%). A smaller, though still noteworthy proportion (37%) highlighted past student or supervisor relationships as being a route through which collaborations developed. This route was most commonly cited by those contributing to large numbers of collaborations. 66% of those who had contributed to between sixteen to twenty collaborations in the past five years mentioned it. This was also most commonly cited by participants at professor/chair level, with 42% reporting this route. The role of institutions, funders and networks was also raised by around two in five respondents (37%).



D1. *Thinking about the international collaborations that you have actively contributed to in the last five years, how did they come about?*
Base: Those who have collaborated internationally in the last five years (1227)

Qualitative insights supported the quantitative findings mentioned above. In addition to these quantitative findings, participants from the qualitative work also highlighted a range of potential methods of initiating collaborations, including approaching personal contacts, meeting other researchers at conferences, reading and identifying the experts in the subject area and approaching them. Participants said that usually one or two people might have an interest in the topic and they will then approach those who they would like to work with. The quotes below demonstrate a selection of these views.

Ideas propagate and you talk to people, and you talk to other students, and it has spread, and through that way, you get collaboration. You can go to a meeting and it can be a very productive meeting, you come away with a few other new ideas and a few contacts. You can talk to somebody for five minutes on the bus and suddenly you've got a new idea. There are no rules (Royal Society, Fellow)

It's not a matter of usually phoning somebody up out of the blue, it maybe that you approach somebody who you don't know personally but one of your collaborators said, 'Well, these people are really quite good and you should have a talk with them,' and that's how it tends to build up (Academy of Medical Sciences, Fellow)

I simply phoned up my colleague in Talles, and said, 'Look, you know, we've got an opportunity, let's start putting the thing together (...) we had a very, very good consortium where we knew each other pretty well, and worked very well together (Royal Academy of Engineering, Fellow)

Case study 2: A Fellow's view on the importance of personal networks to collaboration

A Royal Society Fellow remembers how moving to the USA for his PhD – and for the first time being part of a big network of people within his field – became a "complete revelation" and is what led him to seriously consider a career in academia.

It was around this time that he attended his first Gordon conference. There, he met a lot of people, a few of whom were from abroad. In particular he had a heated discussion with a Japanese researcher, in which he questioned the latter's research project. As a result of this, he was invited to the lab in Japan to come and see things for himself. This led to a collaboration that lasted several months. After a first paper was published, many other scientists expressed their interest in a follow-up project and the Fellow went back to Japan. There, he worked with other scientists, amongst which were researchers from Germany and the USA, with whom he ended up co-authoring further papers.

In particular, this Fellow stresses that spontaneous collaborations, such as the one described above, are the best. He explains that they are much more natural – and as a result much more productive – than those collaborations that are formed for financial purposes and where scientists, who have never previously met, are expected to represent their respective countries at an international level. The Fellow highlights the lack of trust that sometimes appears in such "artificial" environments. Instead, he much prefers collaborations that result from personal connections and unexpected encounters.

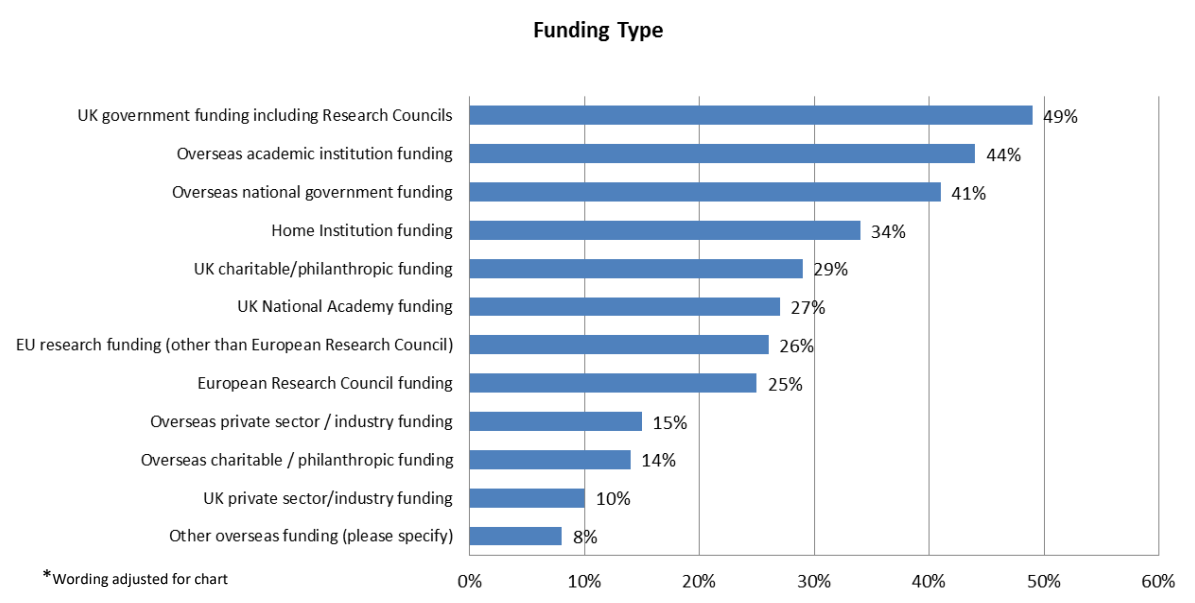
The really great collaborations that occur are those that happen more or less spontaneously. […] a lot of that, in the past, has occurred through postdocs coming and working in my group, and them doing well and then going back to their own countries or going elsewhere, and then setting up their own groups, and then sending their students to us.

Two weeks ago, a German professor came and stayed at my flat for a week. He was visiting Cambridge and Brighton, but he was also visiting us, giving a talk... I met him and I interviewed him for an EMBO fellowship in probably about 2008…and he went to the States. While he was in the States, he kept in contact and then came and worked with me. We had a paper out earlier this year and we're working on another one.

Participants reported using a range of funding sources to support international collaboration, with most using both UK-based and overseas-based funders

All types of funding sources were cited as playing an important role in supporting collaboration, however private sector funding from both the UK and overseas were used in a small percentage of cases (see chart below for details).

Most participants (83%) reported that their collaborations during the past five years have been supported by a UK-based funder. A large proportion (70%) also noted that they had used funding from an overseas-based source to support international collaborations. The proportion of participants who only use UK funding to support their international collaborations was 13%; and 17% of participants only use overseas funding for their collaborations. The proportion that reported receiving funding from both the UK and overseas for their collaborations was 70%. Participants commonly use multiple sources to fund collaboration. Just over a fifth (22%) of participants reported receiving funding from two different sources and a quarter of participants (26%) mentioned receiving funding from three sources. A smaller proportion (17%) reported they have received funding from four sources.



D3. *Which of the following funders continue to support and / or have supported your international collaborations in the past five years?*
Base: Those who have collaborated internationally in the last five years (1227)

Participants from the qualitative phase of this research highlighted what they felt were the benefits of different funding sources. Independent funders such as UK universities and the UK National Academies were described as occasionally smaller in scale and flexible. These attributes enable greater focus on the expertise of individuals or institutions, which was said to be important for ensuring the collaborators involved are the right fit. Larger independent funders, such as the Gates Foundation, were said to be highly effective at both funding and encouraging large-scale collaborations.

EU research funding programmes, such as Horizon 2020, were noted to be important in expanding and formalising collaborations in ways that smaller, local funders cannot. They were also noted to provide wider-reaching opportunities, with a greater number of people who can bring other types of

funding with them from overseas. The wider-reaching nature of such large-scale research funding programmes means that applications can be more complicated and time demanding.

The European Union has made quite a big difference to the amount of formal relationships, but much of that was in fact formalising what was already happening to some degree. It's just allowed it obviously to expand considerably and it's particularly, I think, made a big difference to people who are starting out in their careers (British Academy, Fellow)

Case study 3: The range of funding sources that one AMS Fellow has received

A Fellow from the Academy of Medical Sciences shared some examples of the various types of funding he has received for different collaborative needs. With a medical background, this Fellow reports that it is rare to find a transnational funder that "encourages and supports" collaboration in medical research. The Gates Foundation had been the ideal funder for one of this Fellow's projects, as they were willing and able to support him and did so to the full extent requested.

This Fellow discussed his experience with EU grant funding, which has involved receiving funding from FP5, FP7 and Horizon 2020. In this Fellow's opinion applying for funding from the EU funding programmes could be more complex. There were advantages and disadvantages to this funding, as it encouraged an international outlook, which was viewed positively but the criteria on which the applications were assessed sometimes meant it restricted the potential.

One of this Fellow's collaborations which was initiated and funded by two universities was a particularly positive experience. Regarded as an 'independent' funding source, which is more localised in nature than the EU grant example, this type of funding was seen to be far easier to manage.

[Local funding] was easier to manage because the investigators themselves could identify the most appropriate contributory centres, and had people who were all making a particular intellectual contribution, which doesn't always happen in the EU grant structure.

It was noted in the qualitative aspect of this research that participants occasionally rely on self-funding to supplement the travel or logistical costs that arise during collaborations. Examples of when this might occur included using self-funding to continue research past the funded period. Additional costs outside the remit of grants are also self-funded, particularly when sample or materials must be shipped from another country. It was also noted that student/mentor collaborations have gone ahead without any external funding.

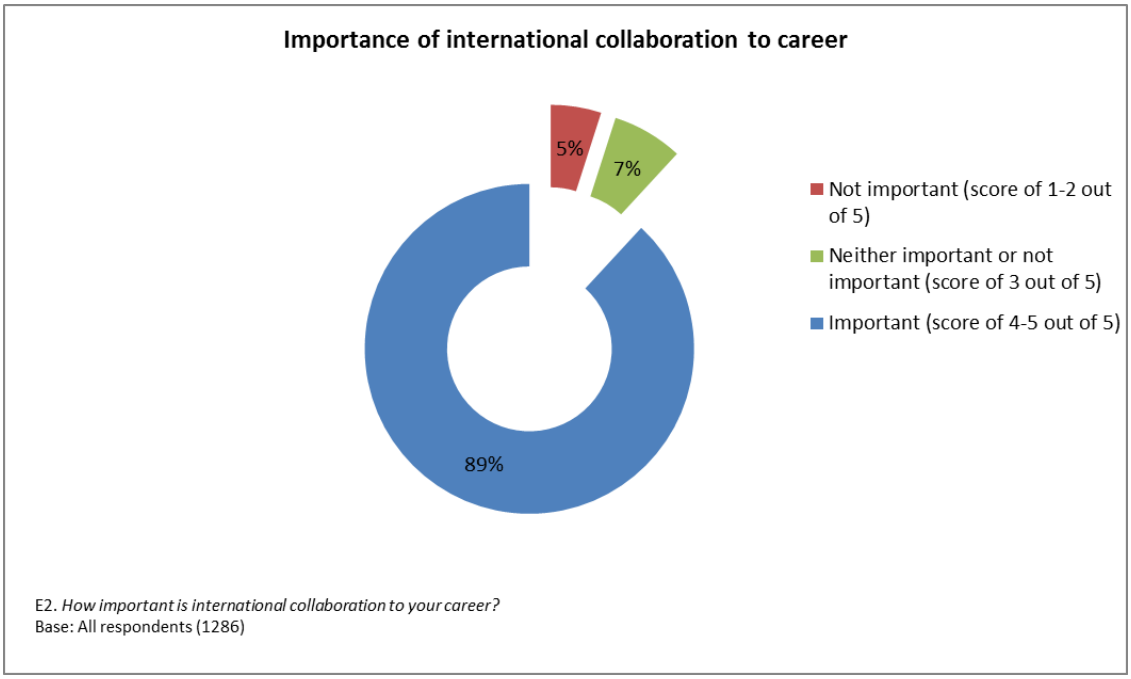
The perceived added value of international collaboration

SUMMARY OF FINDINGS ABOUT THE PERCEIVED ADDED VALUE OF INTERNATIONAL COLLABORATION

- Collaboration was highlighted by almost all participants as being important to their careers.
- There were a number of different reasons highlighted as to why participants collaborate, including to build relationships with others in the field or to access specific expertise and new perspectives. In some cases it was also noted that funding requirements drove some elements of collaborations. For younger participants in particular, it was also seen as valuable for their career development.
- The types of research outputs which participants reported arising from collaborations were similar to those which emerged from other research work.

Collaboration was seen to be important to participants' careers in almost all cases

Participants were asked to rate how important collaboration was to their careers, on a scale of 1 to 5. Nine out of ten participants (89%) reported that collaboration was important to them (a score of 4 or 5), while only 5% said that it was not important at all.



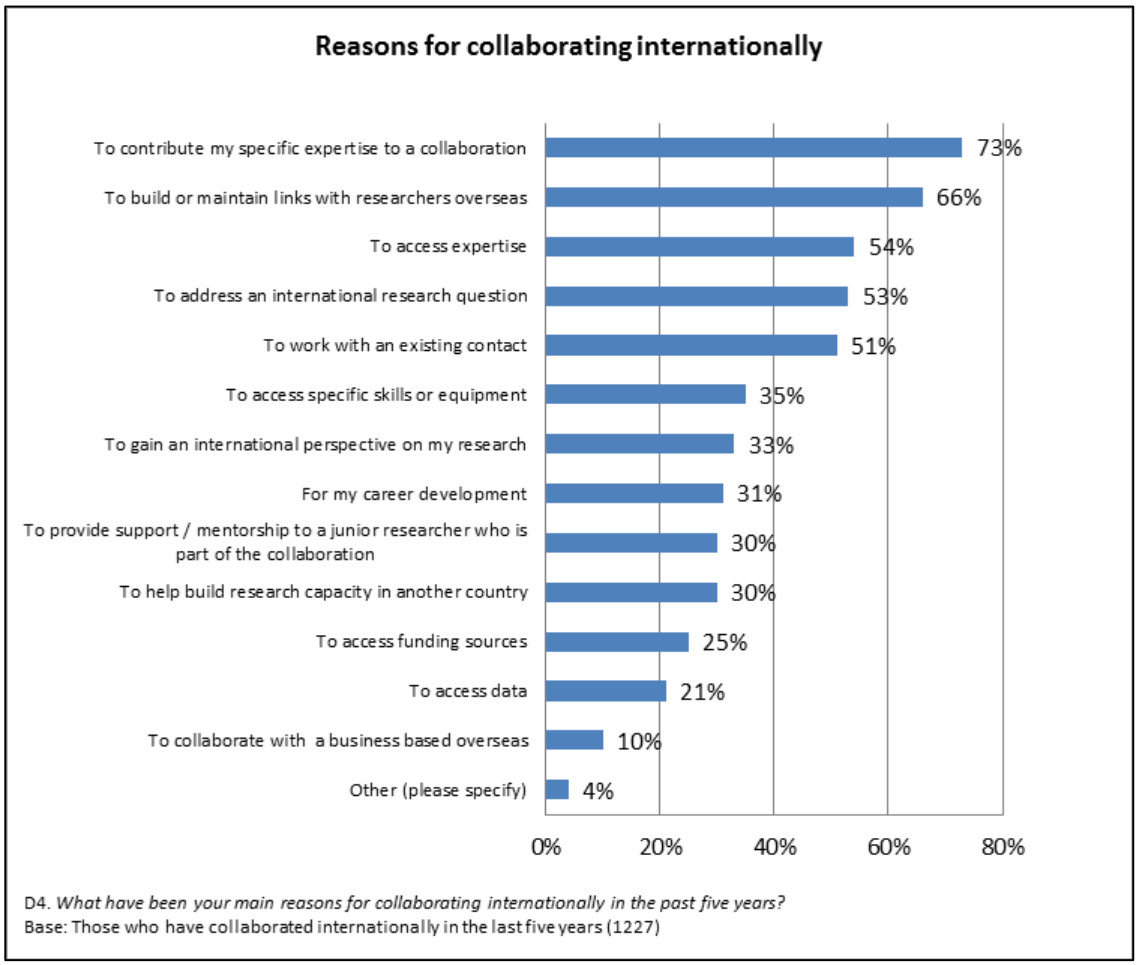
E2. *How important is international collaboration to your career?*
Base: All respondents (1286)

A large amount (95%) of respondents who said collaboration is important also said mobility is important. Collaboration was reported to be particularly important by participants who are also frequent travellers. Amongst those who said collaboration is important, 91% said they have spent a sustained period working overseas and 95% noted they have travelled on a large amount of short visits in the past five years (over twenty visits). Of those who said collaboration is important, 93% reported the amount they travel is increasing over time.

The small proportion (5%) of participants who saw little importance in collaborating were more commonly participants nearing the end of their careers. This group tended to be older researchers who were over seventy years old (11%) and who have had a research career of over fifty years (12%). This is a similar age profile to the proportion of participants who earlier reported that they had not been involved in collaborations during the previous five years. Perhaps unsurprisingly, those who saw little importance in collaborating, were also less likely to have collaborated in the past five years - with 34% of those who rated collaboration as not important also saying that they had not taken part in one during the preceding five years.

There were a number of different reasons highlighted as to why participants collaborate, including building relationships, accessing expertise and career development

A range of different motivations were given by participants when asked why they had collaborated within the past five years. The most commonly cited motivations were to contribute expertise (73%), a desire to build or maintain links with researchers based overseas (66%) and to access expertise (54%). This is consistent with the finding that personal networks and knowledge of others in the field play key roles in the formation of collaborations. Practical reasons, such as sourcing funding (25%) or accessing data (21%) were also reported as being important for some. For many younger participants, aged between 31 and 39, collaboration was seen to have an important role in career development (70%).



D4. *What have been your main reasons for collaborating internationally in the past five years?*
Base: Those who have collaborated internationally in the last five years (1227)

Participants from the qualitative work also highlighted a range of key motivations for taking part in collaborations. For some, this included accessing the expertise and new perspectives that collaborators would bring. Others highlighted that it could help their access to funding. In terms of career development it was also noted that senior researchers will seek to work with junior researchers who have been involved with collaborations.

"You just want to work with the best (…).You want to work with the best minds, who've got the best ideas, who are going to work really well (Academy of Medical Sciences, Grant Recipient)

The original remit is to obtain funding in order to carry out the research, and one of the vehicles happened to be the European funding (Royal Academy of Engineering, Fellow)

You get a difference in perspective, which I think is hugely enriching actually (…) the US practice of medicine is different to the UK practice of medicine, the priorities that that person set and the way of thinking about the problem was just refreshingly different (Academy of Medical Sciences, Grant Recipient)

Case study 4: A Fellow from the Royal Academy of Engineering discusses his reasons for collaborating internationally

As a Water Engineer who has collaborated in various international locations, this Fellow has a lot of collaborative experiences to refer to. Drawing on his experience, including currently managing a large group of researchers, he outlines why he thinks collaboration is important.

The Fellow – who works for a global association – explains that he often has to run working groups, and organise workshops and conferences. Over the years, he has set up quite a few international conferences, where he brings together collaborators from different countries. He also mentions Horizon 2020 projects, which are "*inevitably and fundamentally internationally collaborative*".

In particular, he highlighted an example of a collaboration he has with a university in East Asia. The university is based in a country that suffers from typhoons, and as a result they have a lot of forecasting technology that this Fellow does not have at his home university. In this regard, the exchange is extremely useful, as it allows both institutions to benefit from one another's field of expertise.

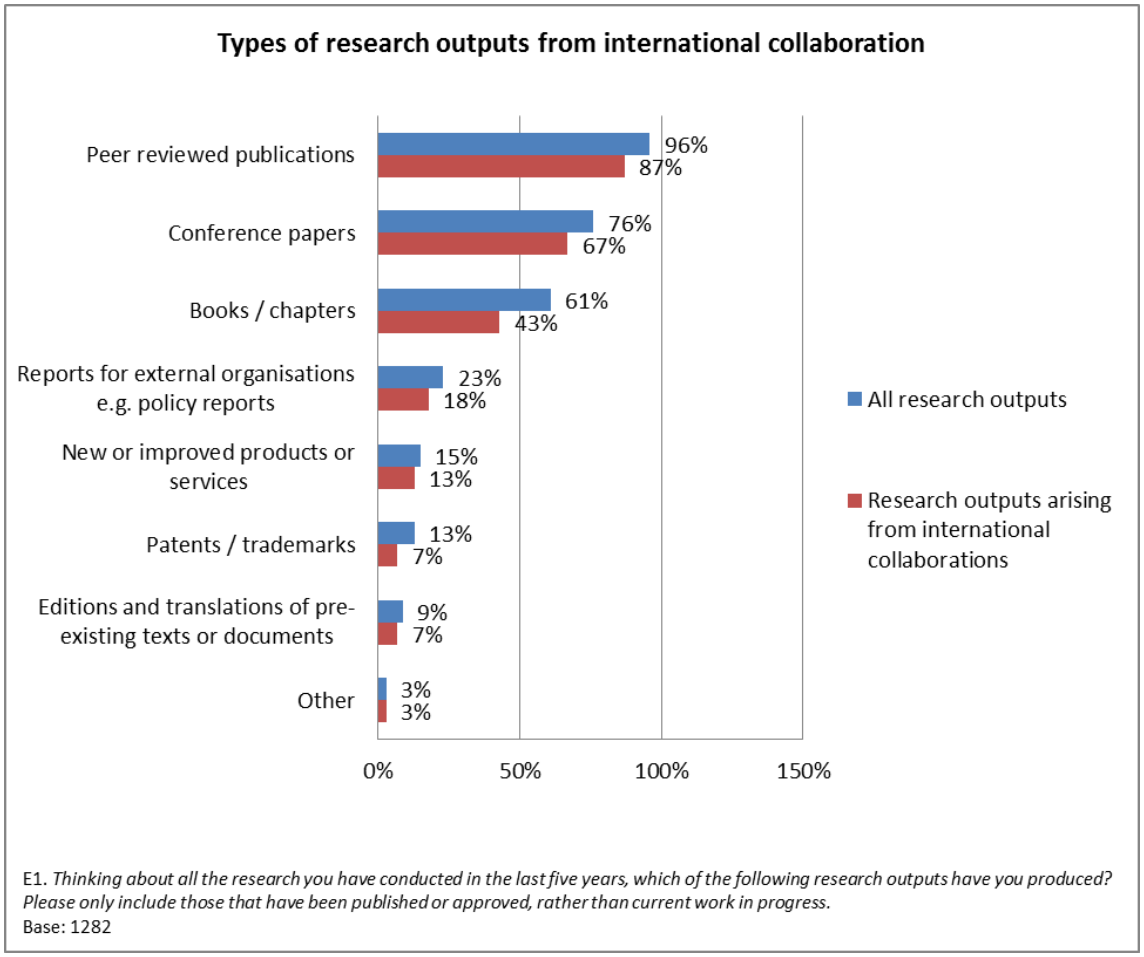
General engineering principles are the same everywhere, but engineering practice is quite different. So it's very important and interesting to see how principles are expressed in practice. […] It's done differently in China perhaps, or in the US and so on.

This potential for knowledge-exchange is a key benefit of collaboration according to this Fellow. He encourages the people who work for him to collaborate as much as possible; this is one of the reasons why his group is so internationally facing. And, more specifically, this is very useful when they publish something, because they need to be aware of who is going to read their paper and make sure that all of it will make sense to everybody, wherever they are on the globe.

Part of it is to do with exposure of your research internationally, so you're increasing your profile. Part of it is to do with learning from other groups and how they do their work. Certainly, if you send people over there you are developing their skills. If you get people over here, okay you are helping them develop skills, but you learn from them as well.

The types of outputs from collaborations are similar to those from other research work

Participants were asked about the types of research outputs which they had produced or contributed to as part of the collaborations that they had worked on. There was little difference in the type of outputs which participants reported producing from collaborations when compared with the outputs they produce from their work more generally. This highlights the extent to which collaborations are embedded across all types of participants' research work.



E1. *Thinking about all the research you have conducted in the last five years, which of the following research outputs have you produced? Please only include those that have been published or approved, rather than current work in progress.*
Base: 1282

Enablers and barriers of international collaboration

SUMMARY OF FINDINGS ABOUT THE ENABLERS AND BARRIERS OF INTERNATIONAL COLLABORATION

- Participants typically highlighted that they prioritised collaborating with others who have subject expertise, but also who they enjoy working with. This supports the earlier findings which highlight the importance of personal networks in the formation of collaborations.
- It was also highlighted by participants that defining clear roles and responsibilities were an important element of setting up successful collaborations. This was a factor which was less commonly highlighted among those who had been collaborating for long periods of time – potentially indicating that while this is an important factor in initial success, its importance diminishes over long-term collaborations.
- A number of barriers to collaboration were also highlighted. One potential barrier was the complexity and time-intensive nature of some funding applications.

Access to funding and international travel enables more collaboration

Participants were asked to rate different factors which were made up of attitudes and experiences relating to their research careers. A key driver analysis was carried out to highlight the factors which are the most and least influential on collaboration. The key driver analysis supports the findings already mentioned earlier in this report. Looking at the areas identified as enablers of collaboration, those who agreed with the statement 'international travel is essential to work' were more likely to contribute to more collaborations. International travel is a key supporter of international collaboration and it was also considered by 86% of participants as essential to research as a whole.

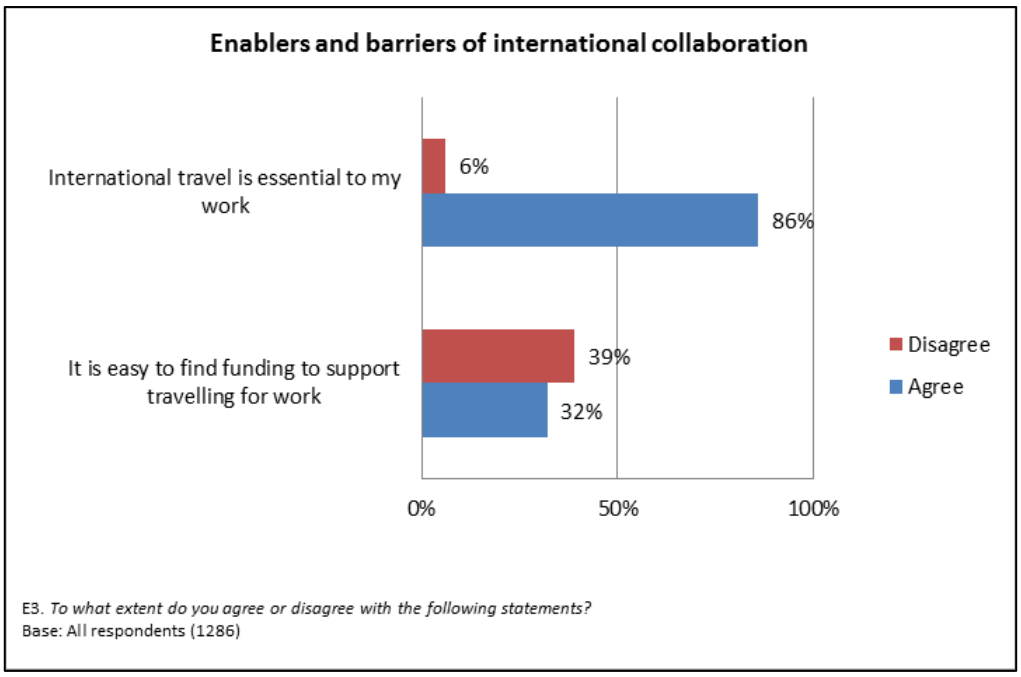
Participants from the qualitative work highlighted the benefits of international travel to their collaborations. Travel was said to enable more face to face interactions, which contributes to more efficient working and relaxed conversation. Seeing the workplace of their collaborators helped participants to get to know them better and these visits were said to enable longer lasting collaborations. The quote below captures both the value of travel to collaborations and the value of having longer-term collaborations.

You develop long-lasting relationships, you're writing papers together. We're still writing papers with folk that we worked with fifteen, twenty years ago. Those initial collaborations turn into real long-term [collaborations] (Royal Academy of Engineering, Fellow)

A second factor identified by the key driver analysis, was that perceived ease of access to funding for travel also has a big impact on the amount that participants collaborate. Agreement with the statement 'It is easy to find funding to support travelling for work' was associated with taking part in a greater number of collaborations. From the qualitative phase too, access to funding was seen to be a barrier at times.

Looking at the key driver analysis findings by discipline, participants who were associated with medicine, health and life sciences had a similar outcome to the overall level key driver findings. The ability to travel internationally and having access to funding are the two main factors affecting the

amount participants from medicine, health and life sciences collaborate. For participants who allocated themselves to either the physical sciences, engineering and mathematics or arts and humanities, there was less emphasis on having access to funding to initiate collaborations; however the ability to travel internationally was still found to impact the amount these participants collaborate. No significant findings arose from the key driver analysis for participants who were from the social sciences, which is due to low numbers of participants within this category.



Expertise and good relationships were both cited as being factors that participants wanted from co-collaborators

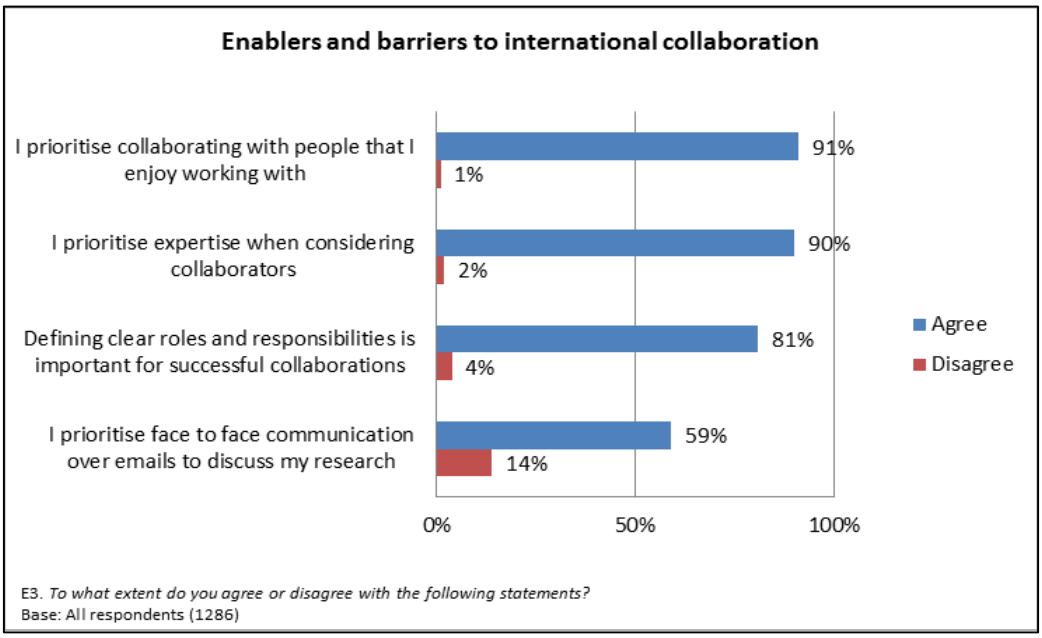
Amongst the areas which participants considered important in sustaining collaborations, good relationships (91%) and expertise (90%) were the factors most commonly highlighted. The ability to meet like-minded researchers in casual, as well as in formal, settings was highlighted by participants in the qualitative work as being a crucial part of collaborating. The spontaneous meetings and casual conversations that often occur outside the working space were described as being part of the experience of collaborating and where a great deal of good ideas can come from. Below are example quotes that illustrate these points.

It's about common, overlapping interests. It's also about just the very basic curiosity of other scientific approaches, and the questions that emerge from, 'What happens if we do this and what happens if we do that? Will that make detection of malicious threats on a network easier, or better, or efficient?' Its things like that that drives that, for example. So it's driven by basic curiosity, really (Royal Academy of Engineering, Grant Recipient)

You basically work with people you can get on with and if you get on with them, it's usually then much more productive (British Academy, Fellow)

Another factor considered by 81% of participants as a way of sustaining collaboration is to define clear roles and responsibilities. A high proportion (96%) of participants who agreed with this statement were at postdoctoral level. A large amount of participants whose collaborations are

facilitated by their institution, funder or network (89%) were also more likely to want clearly defined roles and responsibilities. This factor varied across participants but also according to the length of collaboration. A finding from the key driver analysis highlighted that defining clear roles and responsibilities is an important factor in initially formalising partnerships but becomes less critical in longer-term partnerships.



Case study 5: How travelling enables collaboration from a Grant Recipient's perspective

A British Academy Grant Recipient, at the early stage of her academic career, talks about the importance of travel in fostering collaboration. She has previously worked on a three-year project involving fifteen different countries as well as other projects across the UK and the US. She often travels for conferences and for projects meetings and has a few trips planned for the near future, especially in America.

In her experience, travelling for work has led to the formation of more collaboration, not only for herself as a result of the three-year international project mentioned above, but also for her colleagues. In particular, she mentions how her bosses also continue to work with members of teams from different countries with whom they shared similar perspectives.

We've all stayed in contact after the project, the European project. […] Some of them-, we're writing publications with them. One of the partners in Greece - they were applying for another project, an Erasmus project – […] asked me if I could be an evaluator on it, knowing that that was my role in the previous project. It's nice, the continual inclusion.

Travelling allowed this Grant Recipient to be included in departments and lab groups abroad, which in turn enabled her to meet many more people and be connected to a vaster network much quicker.

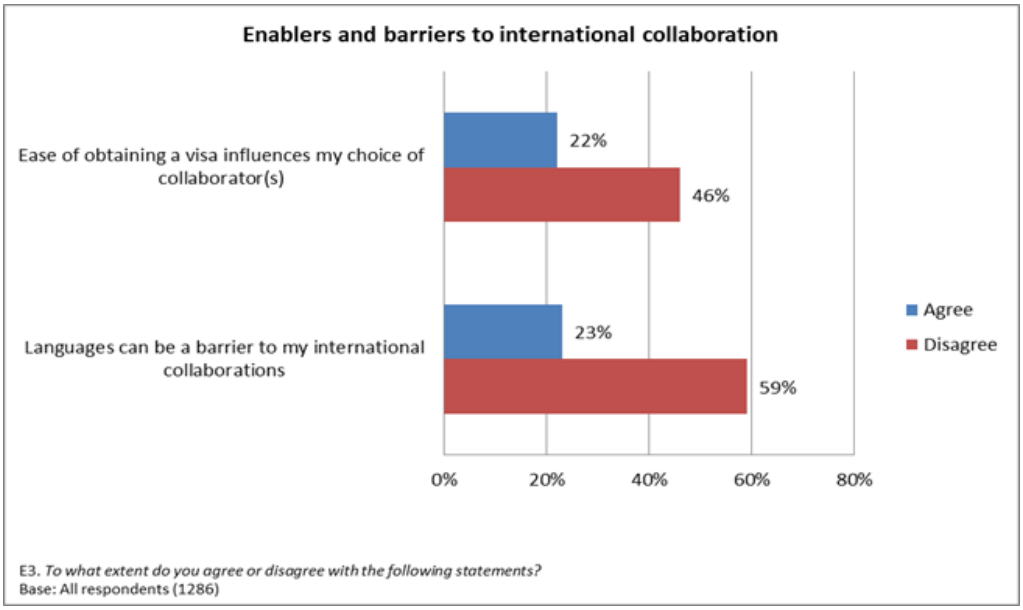
Travelling has also been a way of getting around the problems that arise from international collaboration. Examples of this include issues with time difference or getting everyone to focus on a specific part of the project with a tight deadline. She describes having had to organise a Skype call once, with six or seven people from different countries, as a "real nightmare".

Finally, this participant also stresses how travelling can really benefit international collaboration. In particular meeting with someone face-to-face was said to make things much easier for the project; she got a much better feel for where the other collaborators are coming from and she could tell a lot more about someone's perspective, willingness or enthusiasm for something.

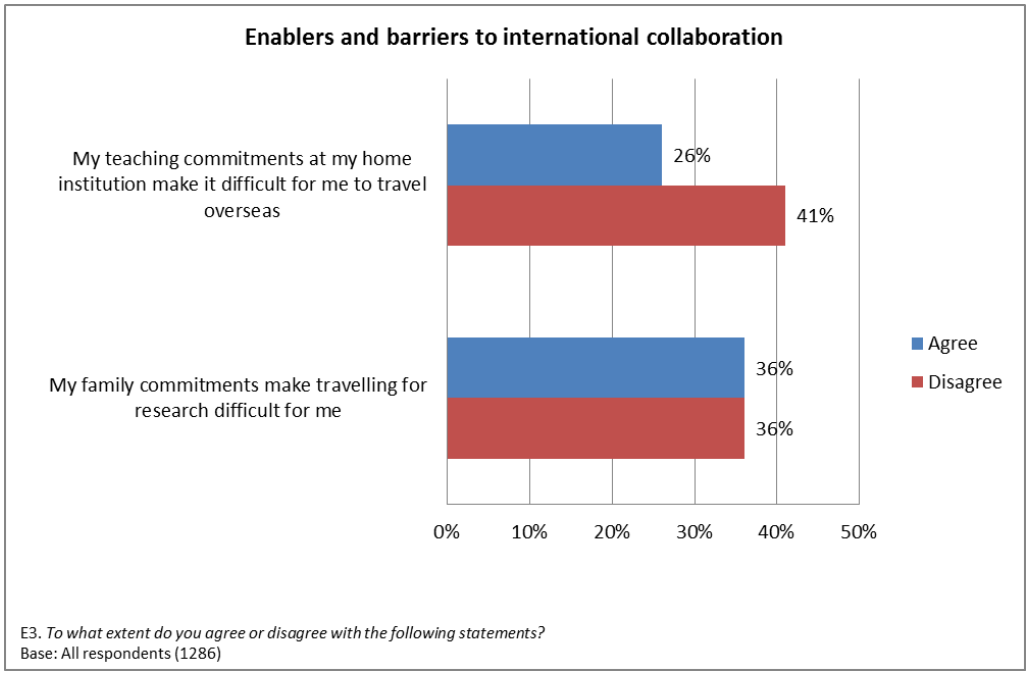
You don't necessarily communicate on a regular basis but when something comes up and you think, "This would be perfect, they would be great to work with", then they come back in the picture again. It might be putting things on the backburner, and then when you really need something, you've got that person on the network as such.

A number of barriers to research and collaboration were highlighted

When asked to rate the extent different factors act as barriers to collaboration, 23% reported languages as a barrier and 22% noted that the ease of obtaining a visa influences their choice of collaborator.



Participants also noted that their ability to travel could be restricted by other commitments. Just over one third of participants (36%) noted that family commitments could make it difficult for them to travel for research. Agreement with this statement was more likely amongst 41% of participants who reported that they have never spent a sustained period working outside the UK, compared to 33% who reported they have. Teaching commitments at home were also cited by 26% of participants as a barrier to travel.



In the qualitative work, participants also highlighted various barriers which were related to the time constraints of having work or home commitments or even other collaborative projects which take priority over the initiation of new collaborations.

Case Study 6: Barriers to international collaboration for a British Academy grant recipient

A British Academy grant recipient discussed her experience of working at a UK university as a post-doctoral researcher.

This grant recipient's PhD was in social psychology and following this she became involved with an FP7 funded collaboration between various organisations and fifteen different countries. The main challenge that she faced during this project was the FP7 funding application, which required organising the various partners around the world to write their allocated sections. The lead partner at her institution who was responsible for organising this was also the most willing partner, who was most invested in the project. Due to a lack of time and motivation on the side of some of the partners, this individual took on most of the writing in order to reach the deadline. It was noted that an imbalance of individual motivation is common, as usually someone initiates the idea and naturally becomes more invested. This grant recipient noted this type of issue such as being something that would prevent her from going ahead with the application at all if there was any doubt that the application will be successful or if the time spent did not seem worth the research outcome.

> Trying to organise the different partners, in terms of who's going to write what sections. That was quite a big barrier and the main person that was working on it from [university] ended up writing most of it.

The benefits of travelling to meet collaborators were also discussed by this participant. By doing this she could understand more about the collaborator's perspectives and willingness to co-operate which enabled more efficient working and broke down a lot of unknowns.

> It's these things that you might see the value of it, or really want to work with someone, but it's then having to justify that to a funder. It's a bit harder, I think, so that might be a barrier to even thinking about it in the first place.

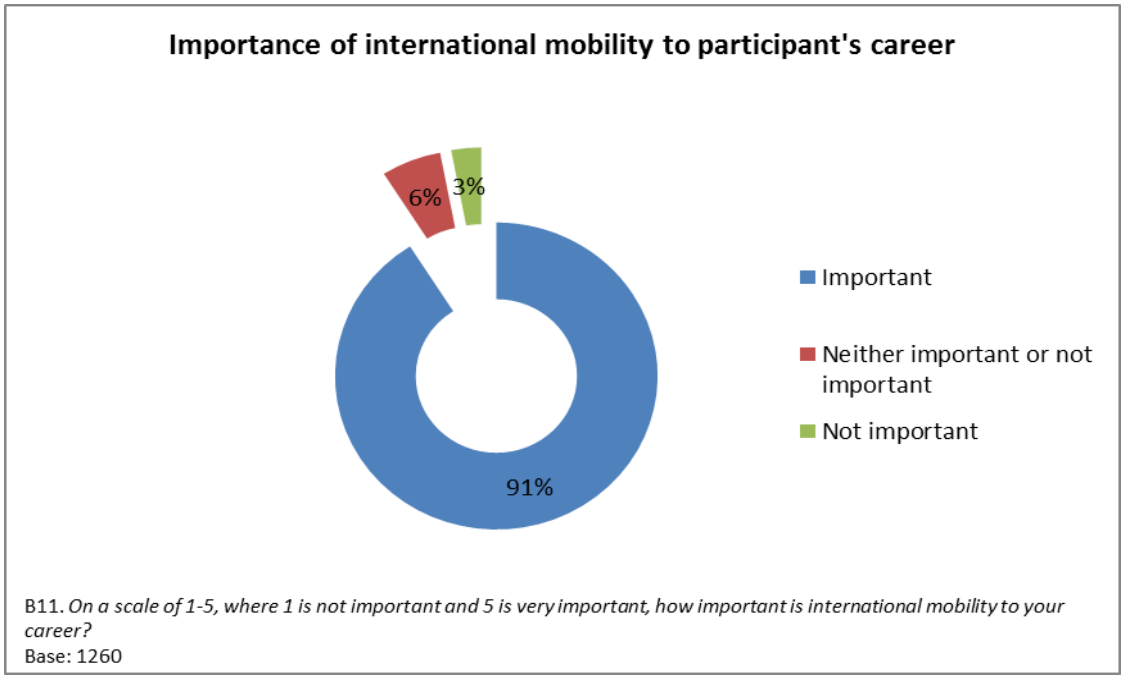
Mobility amongst researchers

SUMMARY OF FINDINGS ABOUT MOBILITY AMONG RESEARCHERS

- In addition to playing an important role in facilitating collaboration, international mobility was also seen to have an important role in research more broadly. More than nine in ten participants agreed that international mobility was important to their careers.
- Participants reported both short-term and long-term international mobility was common. Participants commonly reported that they took short-term trips overseas (of less than one year) as part of their role.
- More than half of participants also reported that at some point during their career they had spent a sustained period of a year or more working abroad.
- Participants reported that the reasons for short-term travel commonly included travelling to meet collaborators, but also to develop networks – for instance by attending conferences and events. The areas in which participants have recently travelled and in which they collaborate internationally are correlated. It is not necessarily the case however that the areas in which participants have spent sustained periods overseas are the same as those in which they have recently collaborated internationally.
- Currently, there are few reported instances of issues where visa or immigration policies had dissuaded participants from international travel. Where this was reported, the most commonly mentioned affected countries were Russia, the USA, China and India.

In addition to playing an important role in facilitating collaboration, international mobility was also seen to have an important role in its own right

More than nine in ten (91%) of participants said that international mobility is important to their career.

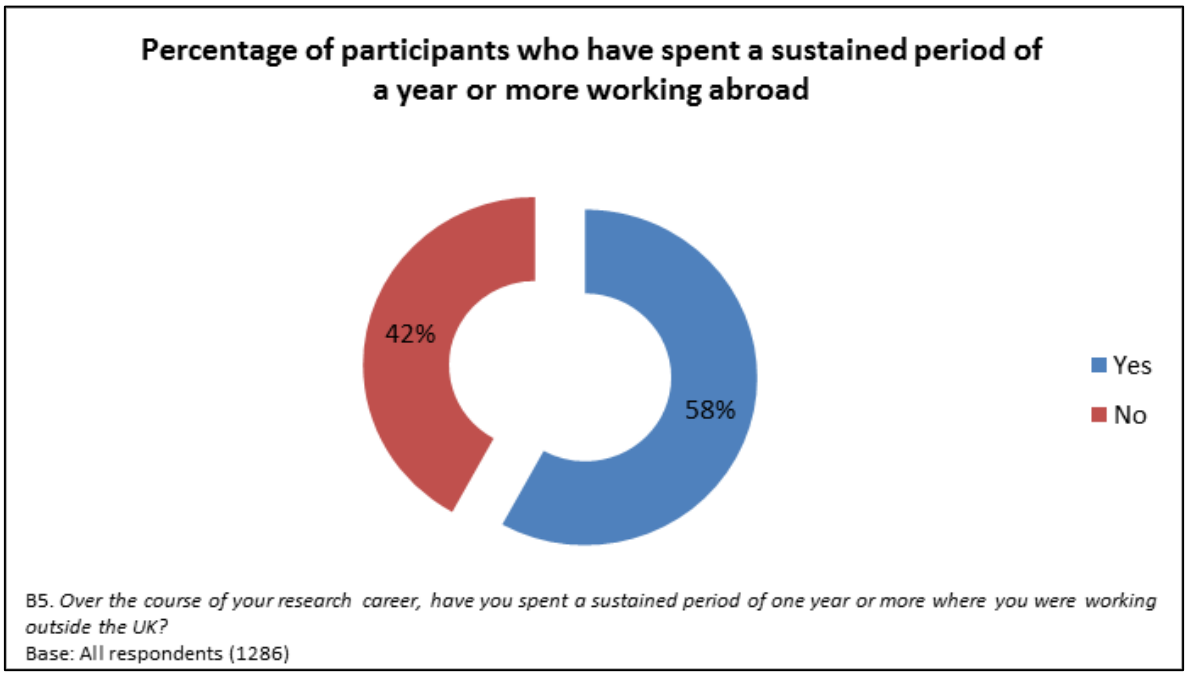


B11. *On a scale of 1-5, where 1 is not important and 5 is very important, how important is international mobility to your career?*
Base: 1260

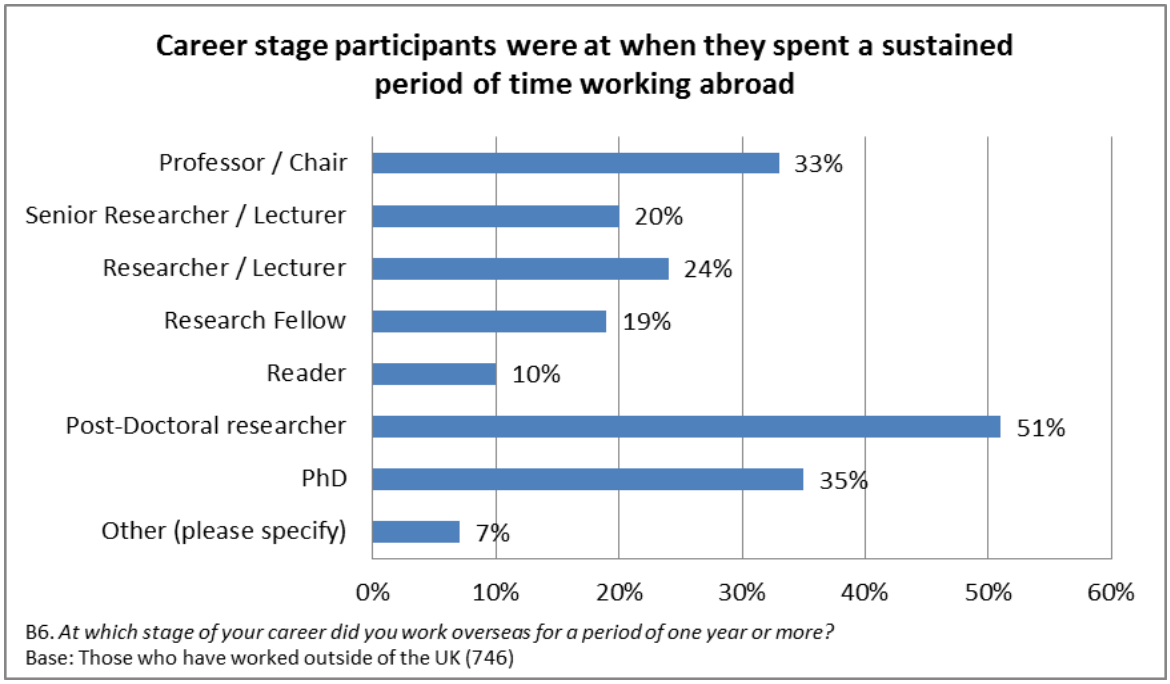
This study looked at mobility both in terms of short visits overseas (of less than one year) and a more sustained period of working overseas (for more than one year). Participants commonly reported that they took short-term trips overseas (of less than one year) as part of their role. Almost two fifths (38%) reported taking more than twenty short visits in the past five years. Around half (47%) of participants who have been researching for over twenty years said travelling on short visits (of less than a year) are becoming more frequent over time.

More than half of participants reported that at some point during their career they had spent a sustained period of a year or more working abroad

Of those who had spent a year or more working abroad, this was most commonly noted by participants who were at post-doctoral stage when they were overseas (51%). It was also noted by over two thirds (70%) of those who had worked abroad for over a year as being valuable for career development.



B5. *Over the course of your research career, have you spent a sustained period of one year or more where you were working outside the UK?*
Base: All respondents (1286)

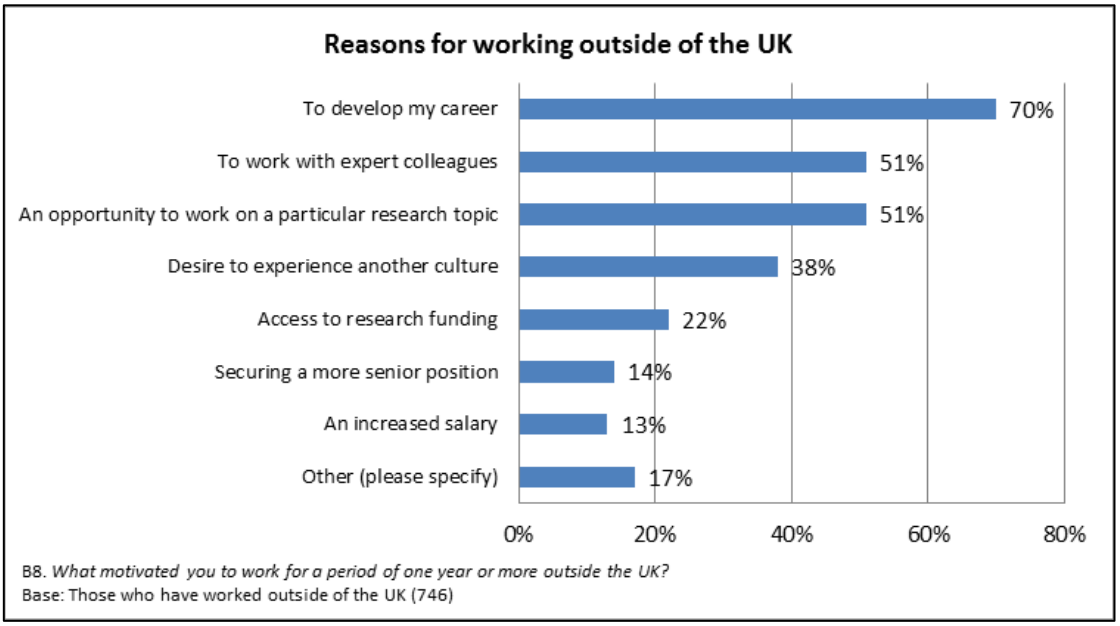


B6. *At which stage of your career did you work overseas for a period of one year or more?*
Base: Those who have worked outside of the UK (746)

Working abroad for an extended period was considered by qualitative participants to be useful for becoming better connected. This could include developing connections with both direct working partners and through wider networks they were exposed to. Through gaining connections early career researchers are able to progress and establish themselves. A quote below by a Fellow describes how working abroad can help with career development.

It goes in phases of your career. When you're at an early stage of your career you're haring around like absolute crazy because you need to make the collaborations, you need to establish yourself and so forth, and I don't need to do that anymore (Royal Academy of Engineering, Fellow)

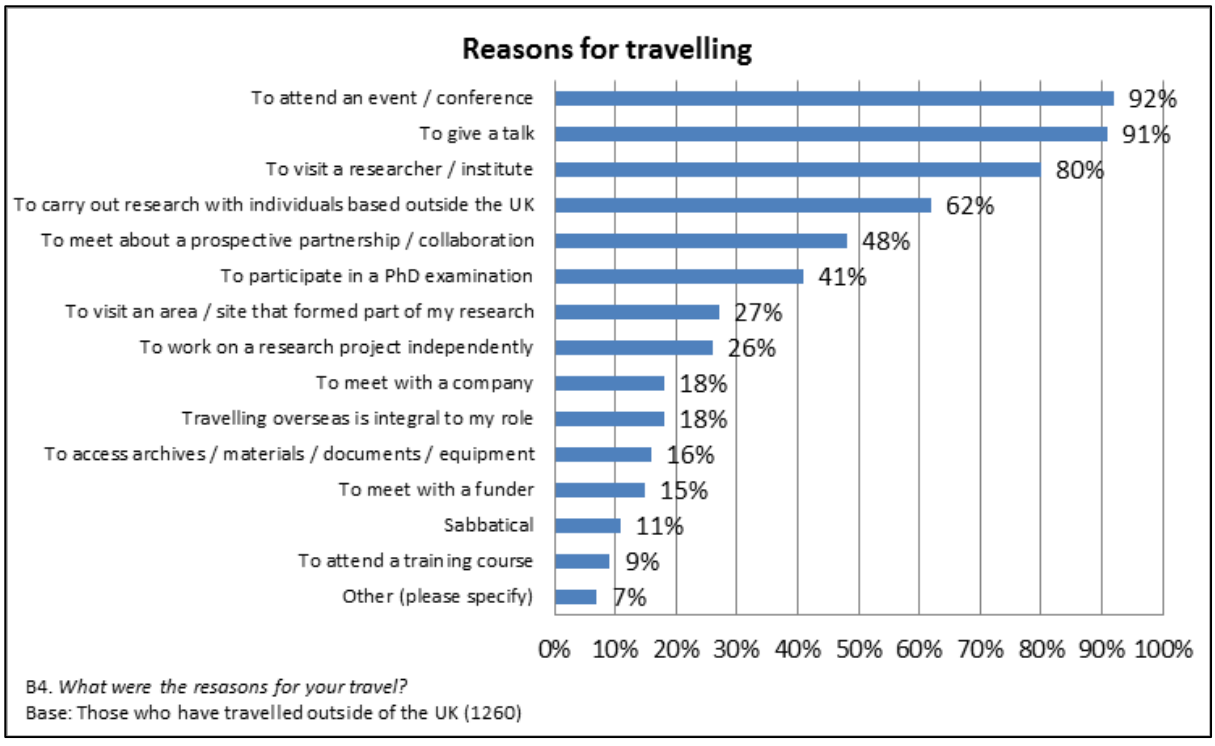
Participants also reported that working abroad for a sustained period provides opportunities to work with specific experts (51%) and topics (51%) that they may not otherwise have access to in their own country. Fewer participants reported working abroad to increase their salary (13%) or to secure a more senior position (14%). Whilst career development is the main reason for participants to work abroad, this does not appear to be for financial reasons or status, but to become better connected and more knowledgeable.



B8. *What motivated you to work for a period of one year or more outside the UK?*
Base: Those who have worked outside of the UK (746)

Participants mostly travel to speak at a conference or to collaborate

When participants were asked why they travel, common answers were related to either attending or speaking at a conference (97%) or meeting with collaborators or potential collaborators (90%), the majority of participants who gave these reasons were also far more likely to have spent time working abroad during their career (91%). Participants reported that they are much less likely to travel for training (9%), a sabbatical (11%) or to meet with a funder (15%). Collaboration and mobility are both reported to be essential for supporting the types of activities required by the work of participants.



B4. *What were the resasons for your travel?*
Base: Those who have travelled outside of the UK (1260)

Participants from the qualitative work noted mobility as being part of the day-to-day conduct of collaboration but also described mobility as serving to initiate collaborations. Participants even described how the day to day conduct of travelling and meeting collaborators can give rise to further collaborations. The intangible aspects involved in this process were illustrated by participants and can be understood further by reading the following quotes.

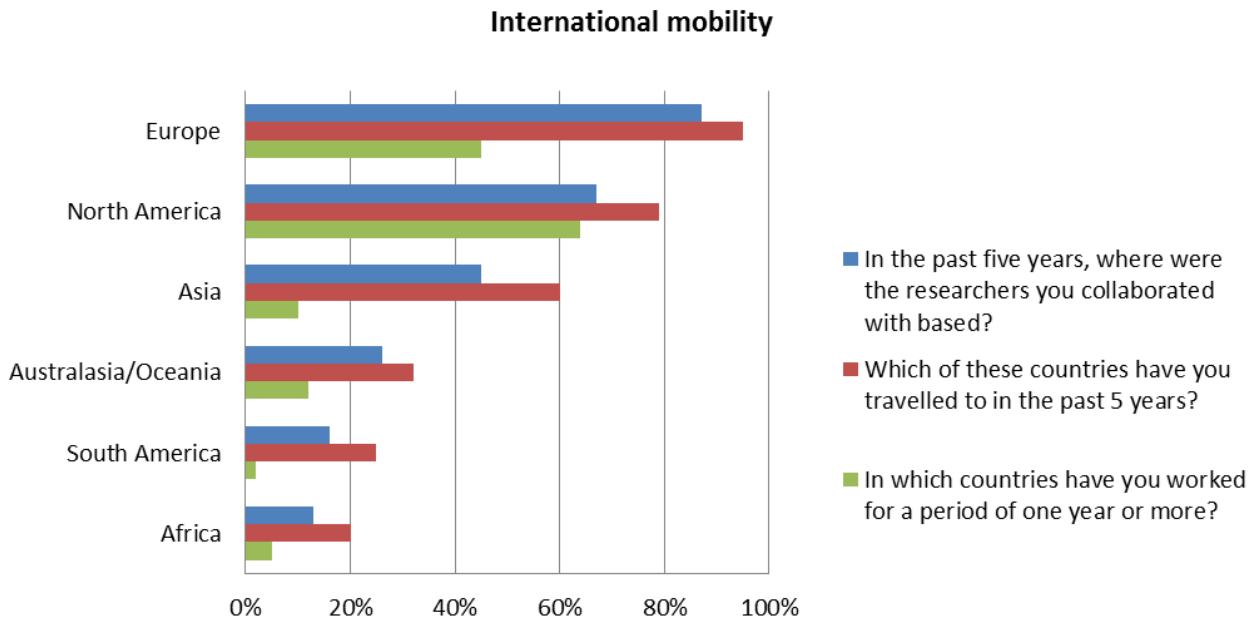
We find generally you need at least one visit both ways. You can do Skype and all the rest of it, but there's something about meeting, having a meal together, a drink (Royal Academy of Engineering, Fellow)

I think international collaboration is woven into the fabric of what we do (…) the very nature of the field is that we travel to international conferences and we collaborate with people around the world (Royal Society, Grant Recipient)

The areas in which participants travel and in which they collaborate are correlated, however the areas in which participants work abroad for an extended period are different

Europe was reported to be the most likely continent in which participants both travel (95%) and collaborate (87%); this was followed by North America (both for travel, 79% and collaborating, 67%). Amongst participants who have worked abroad for at least a year however, North America (64%) was the most common area in which they did this.

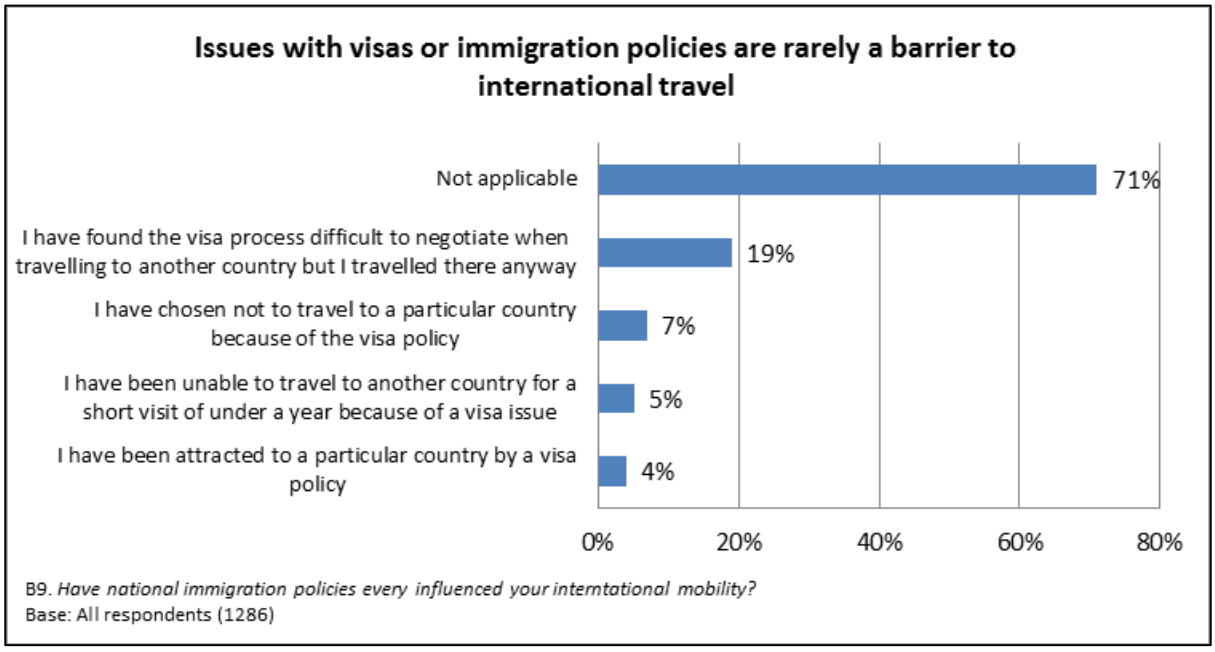
Professor/Chair level participants were more likely than the other career stages to travel to (68%) and collaborate in Asia (50%). The group of participants that tended to work for a year or more in Europe however were those who have been researching for less than ten years (62%) and likely to be at the early to mid-stages of their career.



C2. *In the past five years, where were the researchers you collaborated with based?* B3. *And which of these countries have you travelled to in the past five years?* B7. *In which countries have you worked for a period of one year or more?*
Bases: C2. Those who collaborated internationally in the last five years (1227) B3. Those who have travelled outside the UK (1260) B7. Those who have worked outside the UK (746)

Currently, there are few reported instances of issues where visa or immigration policies had dissuaded participants from international travel

In those cases where this had been seen, the most commonly cited locations were Russia (31%), USA (24%), China (13%) and India (12%). There were very few instances of any issues within the EU (1%), which is likely due to the high number of EEA citizens surveyed for this research.



Participants in the qualitative phase shared experiences of denied visas for themselves or for students on scholarships and the complexity of the process when travelling overseas more generally; however at present these issues are not dissuading participants from travelling.

Mostly it's within the European comfort zone, where I have no problem whatever, and I know I can get by with some language or other (British Academy, Fellow)

Appendix

Further details on the Methodology

Qualitative phase

The 16 participants interviewed during the qualitative phase were randomly selected from a list of Fellows and grant recipients of each of the Academies. To ensure we were speaking to an equal spread from each Academy, we recruited four participants from each Academy (Royal Society, Academy of Medical Sciences, British Academy and Royal Academy of Engineering) and two Fellows and two grant recipients within each of those.

The criteria by which Fellows and grant recipients were recruited for the qualitative interviews required them to currently be research active and to have been involved in an international collaboration in the past 6 months. For the Royal Society and British Academy, only Fellows and grant recipients who were not Presidents or Officers were recruited and for the Royal Academy of Engineering a combination of industrial and non-industrial collaborators were approached.

The qualitative depth interviews were exploratory in nature, enabling a more detailed understanding of a broad topic. The interviews contributed to a deeper understanding of recurring views or opinions, the range of collaborative experiences and the ideal conditions needed to encourage collaboration.

Quantitative phase

The key findings from the qualitative work were fed into the design of the question set used for the quantitative stage, which took the form of an online survey. The key themes were incorporated into the questionnaire in a way that would measure the extent, nature, value and drivers or barriers of international collaboration amongst a larger audience than that of the 16 participants we interviewed. To collect data on the field of the respondents and their collaborators, a list of disciplines was drawn from the REF 36 units of assessment; these disciplines were then categorised into the four panels (Panel A: medicine, health and life sciences, B: physical sciences, engineering and mathematics, C: social sciences and D: arts and humanities) for analysis purposes. The online survey length was between 15-20 minutes.

Fieldwork took place from the 9th to the 20th January 2017. During that time the number of responses was monitored with the aim of achieving a spread of respondents across Academies and between Fellows and grant recipients. Although the sample comprised largely of senior Fellows at Professor/Chair level, a mix of other career levels was achieved. The total number of respondents was 1286, which included 762 Fellows and 524 grant recipients. All respondents reported that they were research active at the time of the survey. The sample should be borne in mind when generalising from any findings mentioned in this report.

In total 1,286 responses were received to the online survey. All participants were Fellows and/or Grant Recipients across the academies and career levels. Other subgroups also include age, gender, REF panel. The tables below show the demographic breakdown of the weighted sample.

	Total	%		Total	%
Age[4]					
Under 30	18	1	**50-59**	213	17
31-39	257	20	**60-69**	323	25
40-49	175	14	**70+**	300	23
Gender[5]					
Male	987	77	**Prefer not to say**	13	1
Female	286	22			
Career Level[6]					
PhD	6	0.5	**Senior Researcher / Lecturer**	106	8
Post-Doctoral Researcher	52	4	**Reader**	36	3
Research Fellow	75	6	**Professor / Chair**	819	64
Researcher / Lecturer	83	6	**Other**	109	8
REF Panel[7]					
Panel A	440	34	**Panel C**	116	9
Panel B	508	40	**Panel D**	184	14
Academy[8]					
Academy of Medical Sciences	210	16	**Royal Academy of Engineering**	116	9
British Academy	300	23	**Royal Society**	660	51

[4] F1 What was your age at your last birthday? (Base: All respondents, 1,286)
[5] F2 Are you…? (Base: All respondents, 1,286)
[6] F3 Which of the following best describes your career level? (Base: All respondents, 1,286)
[7] A3B Which of the following best describes your discipline? (MAIN)? (Base: All respondents, 1,286)
[8] To show AMS vs Other Academies (Base: All respondents, 1,286)

Combined Analysis

The quantitative analysis looked at key patterns in the data to develop an overall narrative on international collaboration. To identify important differences between sub-groups, two-tailed significance tests were carried out using a combination of z-tests and t-tests. Any references to 'significant differences' in this report are statistically proven using this method.

A statistical technique called 'Key Driver Analysis' was carried out to highlight the factors which affect international collaboration amongst Fellows and grant recipients. The factors could be attitudes, experience or stage of career. The questions were carefully designed to allow for this analysis, using a set of statements which explored a range of underlying barriers or enablers to international collaboration and then derived the importance of different enablers and barriers. The statements were measured using a 5-point scale which asked respondents to state how far they agree with each of them. The key driver analysis measured the areas that are most and least influential on international collaboration.

The key driver analysis used linear regression modelling to measure the relationship between number of collaborations (dependent variable) and a range of different factors (independent variables). A forced enter approach was used to build regression models and models tested for significance, at 95% confidence level. Where there were multiple solutions the selection of model was based on the highest r squared value.

During the analysis stage, quantitative and qualitative findings were brought together to allow for combined analysis on a thematic basis. Six case studies were also selected from the sixteen qualitative interviews to help illustrate and bring to life core findings.