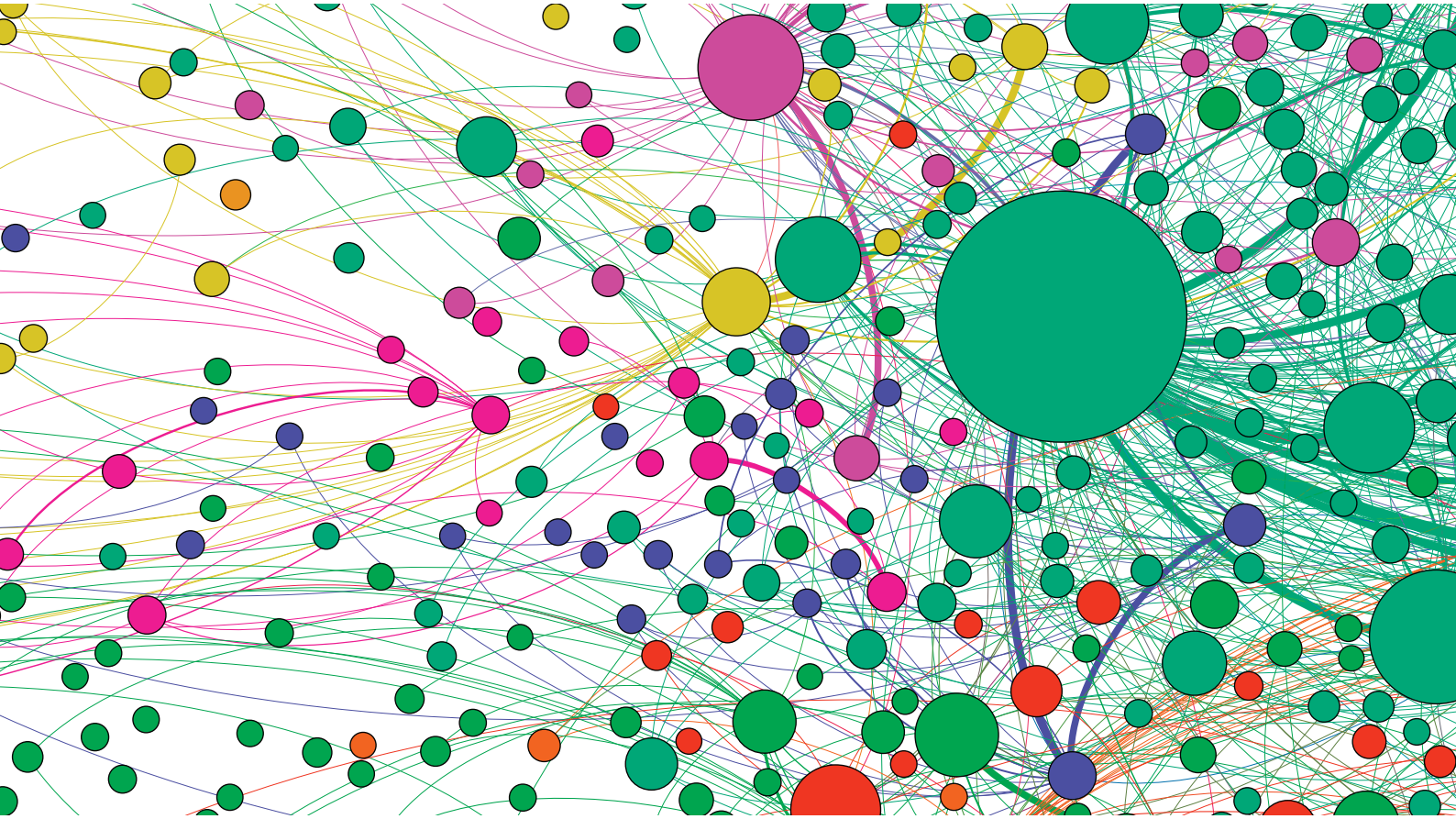
Project Ecosystem: Mapping the global mental health research funding system



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Preface

This study maps the global funding of mental health research between 2009 and 2014. It builds from the bottom up a picture of who the major funders are, what kinds of research they support and how their strategies relate to one another. It also looks to the future, considering some of the areas of focus, challenges and opportunities which may shape the field in the coming few years. We hope that developing a shared understanding of these facets will aid coordination and planning and assist research funders in targeting their scarce resources effectively.

This report and the accompanying documents produced as part of the study are available at www.randeurope.org/mental-health-ecosystem.

Acknowledgements:
We are grateful to the International Alliance of Mental Health Research Funders and in particular the members of the Alliance who kindly supported the study: the Graham Boeckh Foundation, Alberta Innovates – Health Solutions, the Canadian Institutes of Health Research, the UK National Institute for Health Research, the Wellcome Trust, MQ: Transforming Mental Health, and the Movember Foundation.

The bibliometric data for the study was provided by the Observatoire des sciences et des technologies (OST). Eddy Nason contributed to the Canadian fieldwork and the team at ÜberResearch contributed useful discussion and suggestions.

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Finally, we are very grateful to all of the organisations who agreed to participate in our deep dive reviews and the researchers who completed surveys as part of the study.

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Headline findings

1. The field of mental health research is large (and growing) and diverse – over 220,000 papers were published between 2009 and 2014, supported by over 1,900 funders.
2. Many of the funders identified using our approach would have been unlikely to appear in a top-down analysis of 'traditional' mental health research funders: we identified small or relatively new charities and foundations, as well as larger funders whose primary remit does not concern mental health.
3. The US dominates the mental health research field, being both the largest producer of research (36 per cent of publications) and accounting for 31 per cent of government and charity/foundation/non-profit funding organisations.
4. Charities, foundations and non-profits form the most numerous group of mental health research funders (39 per cent of the funders identified), but governments fund the most papers, accounting for over two-thirds of the papers with funding acknowledgements.
5. In the mental health field, papers acknowledging the support of charities, foundations and non-profits tend to have a higher citation impact than those acknowledging other sectors.
6. The highest concentrations of mental health research funders are located in North America, northern and western Europe and China. China is dominated by government funding agencies, while some European countries, in particular Finland and Sweden, have relatively higher numbers of charities and foundations.
7. The mental health papers which focus on a clinical condition cluster into eight groups, with the most common conditions being neurodegenerative and cognition disorders; depressive, anxiety and personality disorders; and substance use and addictive disorders.
8. Funder co-acknowledgement on papers tends to produce national rather than topic-specific clusters, suggesting that despite increasing international collaboration, national boundaries still remain important in mental health research funding.
9. The majority of mental health research funders we looked at in depth do not have an explicit definition for mental health.
10. Funders of mental health research anticipate future or continuing challenges relating to the diversity of the field, difficulty in maintaining funding levels, and the translation of research into practice.
11. Opportunities identified by mental health research funders include increasing collaboration, developing shared definitions, capitalising on government priorities, developing a key role for non-governmental funders and the advance of technology.

Chapter 1 Introduction and background

Mental illness has a substantial impact on individuals, healthcare systems and society. Recent estimates suggest that mental and substance use disorders comprise 7.4 per cent of the global burden of disease and represent the leading global cause of all non-fatal burden (Whiteford et al., 2013). This burden is increasing, primarily due to demographic change, which is also driving a dramatic increase in neurodegenerative conditions such as dementias and Parkinson's disease (Murray et al., 2012). When considering in isolation years lived with disability (YLD), mental health and substance abuse disorders represent 21.2 per cent of the global total, with major depression being the leading cause of YLDs in 56 countries (Vos et al., 2015). Aside from the impact of mental illness on individuals, it has been estimated that between 2011 and 2030, mental disorders could cost the global economy US$16 trillion in lost output (Bloom et al. 2011).

between 2011 and 2030, mental disorders could cost the global economy US$16 trillion in lost output

For many mental health conditions we have a poor understanding of the underlying mechanisms and there remains a lack of effective treatments (Insel & Gogtay 2014). Research is needed to address these challenges. The field of mental health research is broad and fragmented (e.g. Haro et al. 2013; Rutter 2002). It covers a diversity of health conditions, employs a wide array of different research approaches and is driven by a large and varied population of researchers and funding organisations (as we demonstrate in this report). In a context where important, complex questions remain unaddressed and resources are limited, these characteristics present a significant challenge for efficiently coordinating and conducting research.

While a number of national or subfield-specific research mapping exercises have taken place in the past, there has not yet been, to the best of our knowledge, a comprehensive review of the entire mental health research funding 'ecosystem' on a global scale. At a time when research is becoming increasingly collaborative and international (e.g. Gazni et al. 2012; Waltman et al. 2011), such an overview will allow funders to better understand the context in which they operate and the complementarity of their portfolios, and will enable researchers to identify opportunities in both their own fields and related areas.

This study aims to provide a snapshot of the mental health research funding ecosystem, building from the bottom up a picture of who the major funders are, what kinds of research they support and how their strategies relate to one another. We did this using the funding acknowledgements on journal papers as a starting point and looked at the global landscape, as well as specifically at Canada and the UK (which were of particular interest to the study's sponsors and are detailed in Annex 1 and Annex 2, respectively).

It is interesting to note that although 'funders' is a commonly used term, there is considerable diversity in mission and activities. Some funders primarily, or exclusively, award research grants whilst other funders also control institutes and centres; some have a single source of funds and others both raise and dispense money. We have taken a wide definition of funders – basing it on those organisations that appear in the funding acknowledgements

of journal articles – and the sample of funders we have examined in detail reflect that diversity.

Alongside our mapping of the global landscape of funders our study also includes a forward-looking component, highlighting for the major funders globally the areas in which they intend to focus their efforts in the coming years, as well as the opportunities and challenges they expect to shape the field.

We hope that by setting out the current landscape and considering the future evolution of the field, those working in mental health research will have a more complete picture of the scale and nature of efforts to address the many unanswered questions which remain. Developing a shared understanding of these facets will aid coordination and planning and assist research funders in targeting their scarce resources effectively.

1.1 Previous studies aiming to map research funding

While we believe this study to be the first to examine the global funding landscape for the entire mental health field, previous studies have looked at specific research areas and countries, in mental health as well as in other areas of health and biomedical research. Several of these studies use a 'top-down' approach, tracking the activities of key funders in the area of interest (CIHR 2014, Daniels 2012, MBCA 2014, Morgan Jones & Grant 2011, MQ 2015, Singh et al. 2009). Others apply a 'bottom-up' approach similar to that used in the present study, where funding acknowledgements from relevant papers are used to identify which funders are active in an area of interest and to characterise aspects of their support (Dawson 1998, Garau et al. 2011, NHS Executive 2001, Shah et al. 2014). These bottom-up studies have focused on mapping National Health Service research in England (NHS Executive 2001), exploring interactions among UK biomedical research funders (Garau et al. 2011 and Shah et al. 2014), and assessing national trends in biomedical research funding in the UK (Dawson 1998).

Of particular relevance for mental health research, UK charity MQ carried out an analysis of the research funding landscape for mental health in the UK over the period 2008-2013 (MQ 2015). It focused on the research portfolios of 11 UK funding bodies. Other studies have focused on autism research funding in the United States (Singh et al. 2009, Daniels 2012) and global funding for metastatic breast cancer (Metastatic Breast Cancer Alliance 2014). A framework for categorising Alzheimer's Disease research has been established, enabling global tracking of funding through the International Alzheimer's Disease Research Portfolio (IADRP) initiative (Liggins et al. 2014).

1.2 Our approach, its strengths and its limitations

Our approach builds on previous studies, taking advantage of increasing data availability and adopting a global perspective in mapping mental health research funding. Four key questions are central to achieving this:

- Who are the major mental health research funders?
- What do they fund?
- How do they relate to one another?
- What opportunities and challenges might the future hold?

This study aimed to answer these questions using primarily a bottom-up approach, in that we took individual journal papers – the outputs of the research process – as a starting point for defining the mental health field, identifying funders and constructing a data set for the subsequent analyses. However, as the systematic use of this kind of approach in examining the funders of research still remains relatively unexplored, we complement it with data from a number of other sources to validate assumptions and emerging findings. These data sources and how they relate to the study's key questions are shown in Figure 1-1. Our primary data source was the funding acknowledgements made by researchers on papers published between 2009 and 2014. A survey of researchers was used to explore acknowledgement behaviour and validate the list of funders obtained from the acknowledgement analysis. A telephone survey of the major funders identified in Canada, the UK and globally provided qualitative data on the level and nature of funding, current priorities and collaboration activities. Finally, a set of 32 'deep dive' profiles of funders was compiled, looking in depth at their current practices and future plans. Further detail on the methods for each of these data sources is provided in Appendix A.

Figure 1-1
Study aims and data sources (dark shading indicates primary data source; light shading indicates supporting data source)

	Data source				
	Funding acknowledgements	Researcher survey	Funder survey	Other bibliometric data[1]	Funder deep dives
Identifying major funders	■	■	■		
Examining what they fund	■		■	■	■
Exploring how they relate to one another	■		■	■	■
Considering future plans			■		■

Why use bibliometric data?

A number of prior studies have explored the research funding landscape using a top-down approach (as mentioned previously), identifying funders and then mapping the areas in which they operate. While this approach allows for reliable and detailed analysis of major funders, it also requires us to know who these funders are from the outset. In this study we chose a bottom-up approach, generating a list of research funders from bibliometric data, in the expectation that this would result in a more complete list of organisations supporting research in the mental health field and allowing the relationships between them and the profile of their funded research to emerge from the data.

Using bibliometric data as the initial basis for our analysis was made possible by the increasing availability of systematic information on the funding of papers indexed in the publications database Web of Science. This data on funding is compiled from the acknowledgements made by researchers on journal papers. Scientific publications have long included acknowledgements, whether to express gratitude for funding, expert advice, technical help or other support provided by individuals or organisations. More recently this practice has become more formal with an increasing number of research funders requiring support to be acknowledged in publications. In the past this information has not been analysable at an aggregate level, but in 2008 Thomson Reuters began systematically extracting acknowledgements of research funding, making this data available in a specific field in the Web of Science. This database field allows us to approximate the number of papers attributed to support from different research funders and thus sheds light on the global funding landscape of mental health research.

Using bibliometric funding acknowledgements as the initial data source for the study has several important advantages:

- It allows us to draw on a single data source for the vast majority of our data, helping ensure consistency.
- The Web of Science consistently covers the most visible and important journals across fields, affording a comprehensive overview of the entire mental health research field during our time period.
- Unlike in top-down approaches, we can identify funders who, despite having no explicit mission or intention to support mental health research, are nonetheless contributing to the research landscape.
- We can identify industry funders, a sector often not included in previous analyses.
- Crucially, the funding acknowledgements in the database are linked to a range of other key variables, including topic, country, co-authors and number of citations at the level of individual papers.

[1] Other bibliometric data includes information extracted from papers relating to topic, countries of authors, co-authors and number of citations.

While our approach has many advantages, we also recognise that funding acknowledgement data is a relatively new tool for addressing the kinds of questions that form the basis of this study and that our understanding of strengths and flaws in the data is still evolving (e.g. Costas & van Leeuwen 2012). As a result, there remain uncertainties about the extent to which it can provide a reliable basis for this kind of exploration. Therefore, we have taken an inquisitive and sceptical approach towards the data. The study's methods were selected to address these uncertainties and ensure the validity, accuracy and utility of our findings. The areas of concern (some of which we identified at the outset of the project and others which became apparent throughout), along with the actions taken to address them, are set out in the text box on the right.

1.3 Structure of this report

Three components make up the outputs of this study: this report, which provides a broad overview of the global research funding ecosystem; a set of 32 'deep dive' profiles of research funders in Canada, the UK and globally; and a set of six cards looking at particular cross-cutting themes which emerged from the funder profiles (all available at www.randeurope.org/mental-health-ecosystem).

The remainder of this report consists of a mapping of the overall mental health research funding ecosystem in Chapter 2 and a summary of funders' future plans emerging from the deep dives in Chapter 3, before concluding in Chapter 4 with a discussion of how this analysis might be built upon and developed in the coming years. The two annexes provide separate analyses for Canada and the UK, while the supporting appendices detail the methods, definitions of indicators and other additional data.

How robust is the data set?

What comprises 'mental health'? Have we selected the right papers?

As part of the study we conducted a telephone survey of the most frequently acknowledged funders globally (and separately for Canada and the UK). This revealed that there is no common definition of mental health in use by funders. In the absence of a universally agreed definition, we based our definition on that used in a previous study examining global mental health research outputs, based on journal and paper-level topic classification (see Appendix A and Larivière et al. 2013). The one difference made for the present study was to include substance-related disorders, which it was felt by the study's advisory committee were an important element of the mental health field.

A challenge for studies identifying research that is specific to a particular condition is how to deal with basic research that may, or may not, end up supporting developments in multiple clinical fields – for example, basic neuroscience research could support developments in stroke or neurological conditions as well as in mental health. The aim of this study was to identify research that is clinically relevant to mental health and for that reason we used clinical terms to define the scope of the data set. This means that while we still capture basic research which has been identified as clinically relevant when published (through MeSH terms or publication in a journal classified in psychiatry), we miss other basic research whose clinical relevance was not clear at the time of publication.

Are there funders missing from the bibliometric data?

To validate the list of research funders obtained from the funding acknowledgement data, we carried out a small-scale survey of researchers selected at random from our paper set (55 responses; for details see Appendix A). None of the survey participants reported receiving funding from organisations which were not already included in our data, and so while we cannot be certain that it includes every single funder, we believe the list to be fairly comprehensive.

Are funding acknowledgements found consistently on all papers?

As Thomson Reuters only began systematically recording funding acknowledgements part way through 2008, we do not include papers published before 2009 in our analysis. Just under half of the papers in our data set contained funding acknowledgements and, as might be expected for a newly introduced data field, this proportion has increased year on year. We have no reason to believe that the absence of funding acknowledgements on some papers would systematically bias our analysis. Figure A1-1 in Appendix A shows the number of papers with and without funding acknowledgements for each year.

Our data set also revealed that the number of acknowledgements per paper has increased over time (see Appendix A). However, a corresponding increase can be seen in the number of authors per paper over this period, with the result that the number of acknowledgements per author has remained constant. This seems a logical observation, given that additional collaborators may bring with them additional funding to a research team.

Do researchers acknowledge funding in the way we would expect?

A second small-scale survey of researchers carried out as part of this study explored the acknowledgement behaviour of researchers. This revealed that researchers tend to think about their funding as separate pots of money to support specific pieces of research, either exclusively or alongside a more general pool of funding (for example, a longer term fellowship award). In contrast, very few researchers reported pooling their funding and acknowledging all of their funding sources on all publications. This means that at the aggregate level, the funding acknowledgements reported on papers should broadly reflect the overall distribution of research funding. The survey did, however, reveal that we may not fully capture, for example, infrastructure contributions supporting research, as few researchers reported acknowledging facilities and equipment provided by their institution (see Appendix A for further details). For this reason, we remain cautious in drawing conclusions about academic institutions identified as funders in our analysis.

Are mentions of industry funders in the funding acknowledgement field qualitatively the same as for other funders?

As the funding acknowledgement field in Web of Science is populated by extracting funder names from the acknowledgement sections of papers, we were concerned that mentions of organisations in the pharmaceutical sector may not always reflect funding, but instead relate to declarations of potential conflicts of interest by the authors. To explore this issue further we manually examined a sample of 80 papers with industry funding acknowledgements. This revealed that, in general, papers mentioning more than two industry funders tended to relate to conflict of interest declarations. To account for this in the subsequent analyses, acknowledgements were excluded where the paper had more than two industry funders listed. This led to the removal of 962 papers from our core analysis (as these papers were left with no acknowledgements).

Do we capture different variants of the same funder's name?

While some funders ask researchers to acknowledge their support in a standard form, for others there are many variants that exist in the funding acknowledgement field in Web of Science (for example, due to the use of acronyms, inclusion of the funder's country in the name or simply spelling mistakes). To minimise the effect of this, all variants which were found in ten or more papers were manually examined and attributed to the correct organisation. Manual searches were also carried out across the whole data set to identify additional variants of the funders occurring most frequently. This means that while there is a long 'tail' of funder names, some of which may be variants of those in our core analysis set, none of these are acknowledged on more than nine papers and so their exclusion from the totals should not have a major impact on the analysis.

Chapter 2 Mapping the mental health research funding landscape

Key points

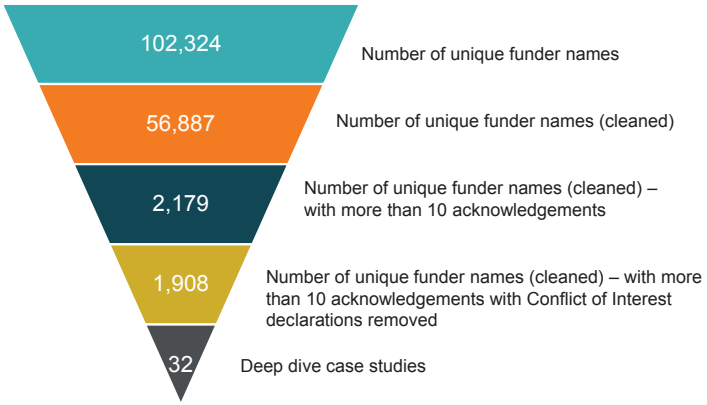
1. The field of mental health research is large (and growing) and diverse – over 220,000 papers were published between 2009 and 2014, supported by over 1,900 funders.
2. Many of the funders identified using our approach would have been unlikely to appear in a top-down analysis of 'traditional' mental health research funders: we identified small or relatively new charities and foundations, as well as larger funders whose primary remit does not concern mental health.
3. The United States dominates the mental health research field, being both the largest producer of research (36 per cent of publications) and accounting for 31 per cent of government and charity/foundation/non-profit funding organisations.
4. Charities, foundations and non-profits form the most numerous group of mental health research funders (39 per cent of the funders identified), but governments fund the most papers, accounting for over two-thirds of the papers with funding acknowledgements.
5. In the mental health field, papers acknowledging the support of charities, foundations and non-profits tend to have a higher citation impact than those acknowledging other sectors.
6. The highest concentrations of mental health research funders are located in North America, northern and western Europe and China. China is dominated by government funding agencies, while some European countries, in particular Finland and Sweden, have relatively higher numbers of charities and foundations.
7. The mental health papers which focus on a clinical condition cluster into eight groups, with the most common conditions being neurodegenerative and cognition disorders; depressive, anxiety and personality disorders; and substance use and addictive disorders.
8. Funder co-acknowledgement on papers tends to produce national rather than topic-specific clusters, suggesting that despite increasing international collaboration, national boundaries still remain important in mental health research funding.

2.1 How big is the field of mental health research?

In identifying the major funders of mental health research globally we first need to define the field we are considering. In this study we did this on the basis of journal publications, representing the knowledge output of funded research. While this does not allow us to assign a monetary value to the volume of research funded in the mental health field (something discussed further in Chapter 4), it does provide a picture of the volume of knowledge produced, the subfields in which research is taking place and the various actors involved in the mental health research funding ecosystem. As in a previous peer-reviewed study mapping mental health publications (Larivière et al. 2013), our selected paper set for this exercise was defined according to a combination of the Medical Subject Headings (MeSH terms)[2] assigned to individual papers and the categorisation of the journals in which they appear. A key difference in this study was that while the previous definition explicitly excluded substance-related disorders, a decision was taken

[2] MeSH terms are a controlled vocabulary of topic descriptors assigned by the US National Library of Medicine to journal papers.

Figure 2-1
Cleaning process of funders



this time in consultation with the study's advisory group to include such papers, due to the complex interactions between substance use and mental health. The full criteria for the retrieval of papers are set out in Appendix A.

Our data set comprised 229,980 papers published during the period 2009-2014. The number of publications increased year on year, from 35,522 in 2009 to 44,348 in 2013,[3] continuing the general growth in the field observed in Larivière et al. (2013), albeit with the inclusion of substance-related disorders in the present study. The share of mental health publications in the total medical publication output increased very slightly during the period our data set covers, from 6.9 per cent to 7.1 per cent. The United States remains the largest producer of mental health research, with 36 per cent of papers having a corresponding author with a US address. The UK (8 per cent), Germany (6 per cent), Canada and Australia (both with 5 per cent) follow. The breakdown of the paper set by corresponding author location is provided in Appendix B.

2.2 How many mental health research funders are there?

Our analysis revealed 1,908 funders with ten or more acknowledgements in the data set. Some 85 per cent of the papers with funding acknowledgements in our sample mention one or more of these funders, representing 72 per cent of the total acknowledgements identified. These 1,908 organisations form the core set of funders used in the subsequent analyses.

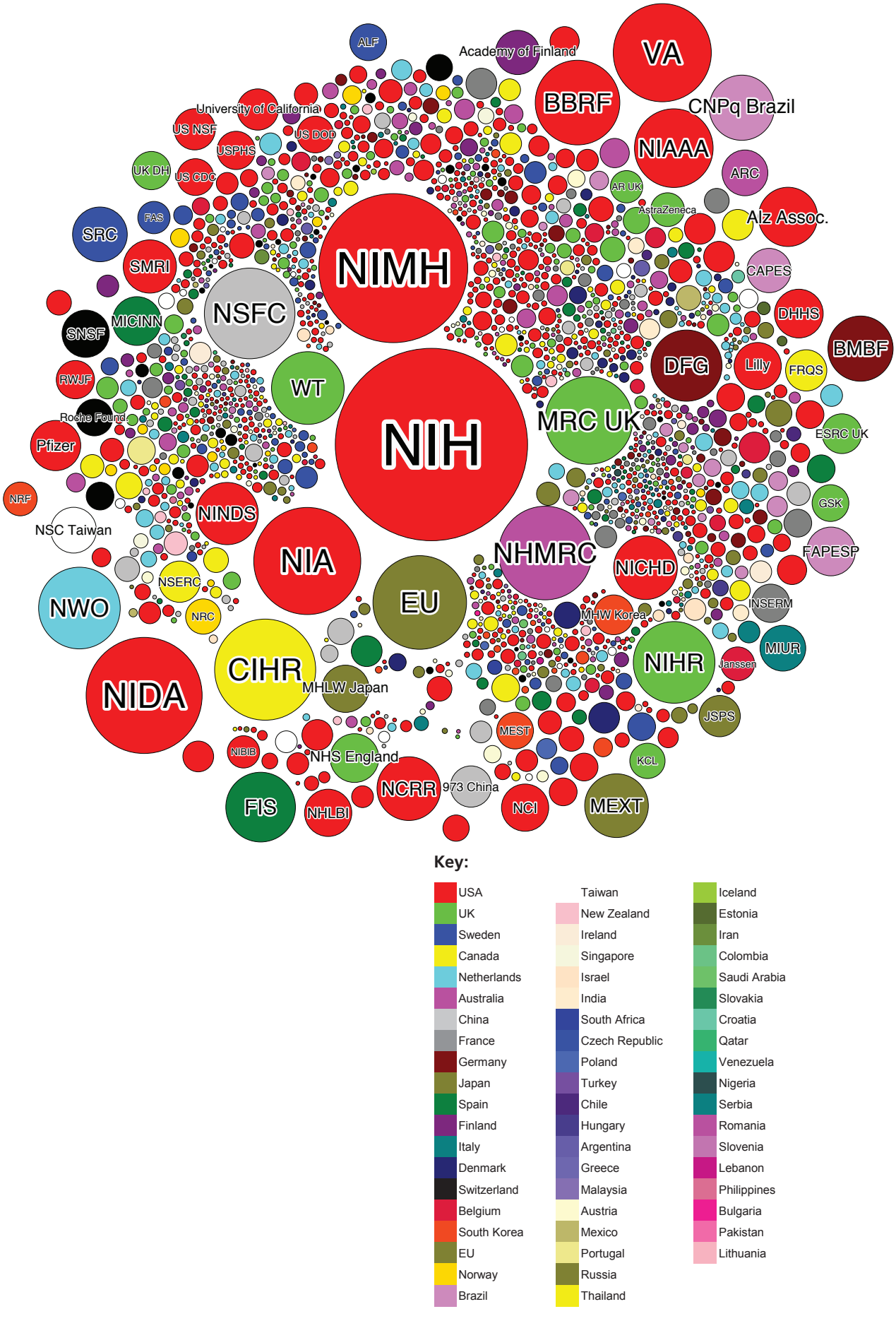
This total was reached through an extensive data cleaning process, summarised in Figure 2-1 above. As noted above, around half of the papers identified (49.5 per cent) contained funding acknowledgements (of course, this does not mean that the other papers did not receive funding; acknowledging support is rarely mandatory/enforceable). Since in some instances more than one funder was acknowledged, the total number of acknowledgements was 364,324, which corresponded to 102,324 different funder names. Given the expected inconsistencies in the form of funder names (for example, differing use of acronyms or inconsistencies in spelling), the data required substantial manual cleaning, which reduced the number of unique funder names to 56,887.[4] Further manual checking of those with acknowledgements in at least ten papers and the removal of conflict of interest declarations produced the final group of 1,908 funders used in our analysis. Selecting funders and then examining what they fund would have been very unlikely to have allowed the identification of this number of organisations.

> Our analysis revealed 1,908 funders with ten or more acknowledgements in the data set

[3] This is the most recent year for which complete data is available, since indexing of 2014 publications was only partially complete in spring 2015 when our final data set was extracted.

[4] It is also important to note that while some funding acknowledgements were specific to a particular department or initiative within a funding institution others would be very general. For example, one paper may reference a particular NHS hospital whereas another may just reference NHS England. In order to ensure accurate data analysis of the funders, names were aggregated to the highest level where possible.

Figure 2-2
Funders with ten or more acknowledgements (coloured by country)



Key:

USA	Taiwan	Iceland
UK	New Zealand	Estonia
Sweden	Ireland	Iran
Canada	Singapore	Colombia
Netherlands	Israel	Saudi Arabia
Australia	India	Slovakia
China	South Africa	Croatia
France	Czech Republic	Qatar
Germany	Poland	Venezuela
Japan	Turkey	Nigeria
Spain	Chile	Serbia
Finland	Hungary	Romania
Italy	Argentina	Slovenia
Denmark	Greece	Lebanon
Switzerland	Malaysia	Philippines
Belgium	Austria	Bulgaria
South Korea	Mexico	Pakistan
EU	Portugal	Lithuania
Norway	Russia	
Brazil	Thailand	

2.3 Who are they?

The 1,908 research funders found in our final data set are represented in Figure 2-2. The size of each bubble is proportional to the number of papers on which the funder was acknowledged (although those with fewer than 500 acknowledgements are very similar in size), while the colour indicates the country of the funder to provide an overview of their geographical distribution (position of each funder is not significant in this figure, but the relationships between them are addressed in Section 2.6). A list of funder acronyms can be found in Appendix C.

The top 30 most frequently acknowledged funders globally are listed in Table 2-1, while similar national lists for Canada and the UK are provided in Annexes 1 and 2. As expected, the group of top global funders is dominated by government agencies, particularly those in the United States. Charities, foundations and non-profits are represented in the list by the Brain and Behavior Research Foundation, the Alzheimer's Association and the Stanley Medical Research Institute, all of which are located in the United States, and the UK's Wellcome Trust, which is the third highest placed UK funder after the Medical Research Council and National Institute for Health Research. The highest placed non-Anglophone funder on the list is the European Commission, with government agencies of China, Japan, Brazil and a number of western European countries also appearing in the top 30. While a number of caveats are associated with our estimation of the scale of industry funding (for example, in relation to conflict of interest declarations on papers), one pharmaceutical company appears towards the lower end of the top 30, Pfizer.

Charities, foundations and non-profits form the most numerous group of funders, but governments fund the most papers

Charities, foundations, non-profits and government agencies make up the majority of our set of 1,908 funders. Charities, foundations and non-profits represent 39 per cent of the total and government bodies 33 per cent, but the latter account for 68 per cent of the funding acknowledgements in our data set (see Figure 2-3). Thus, perhaps unsurprisingly, the typical government funder supports more mental health research than the typical charity, foundation or non-profit. The average number of acknowledgements per government agency is 237, compared with an average of 58 for charities, foundations and non-profits. This is consistent with the dominance of government funders in the list of those most frequently acknowledged. Looking in more detail, however, we can see that the distribution of organisations in terms of the

Figure 2-3
Number of funders (and respective acknowledgements) by funder sector

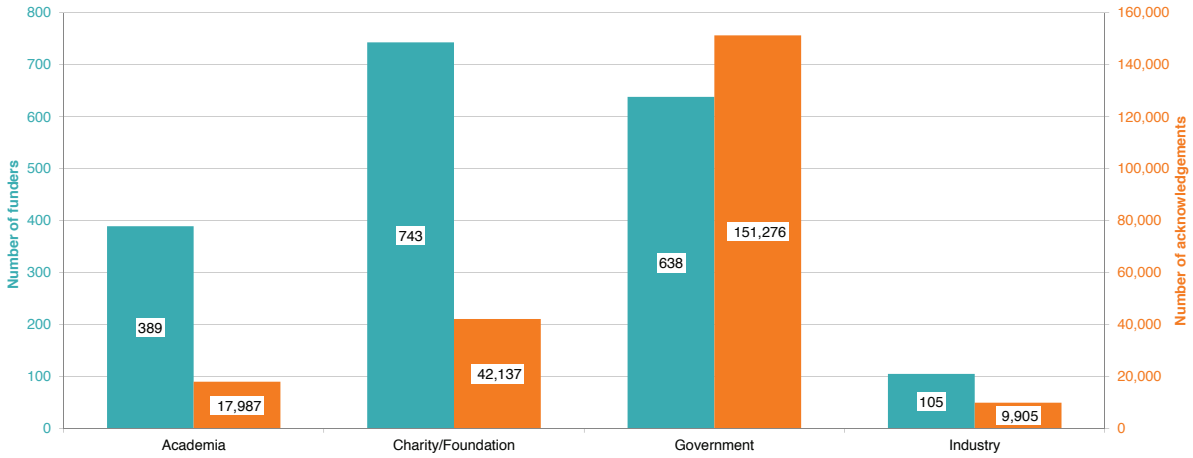
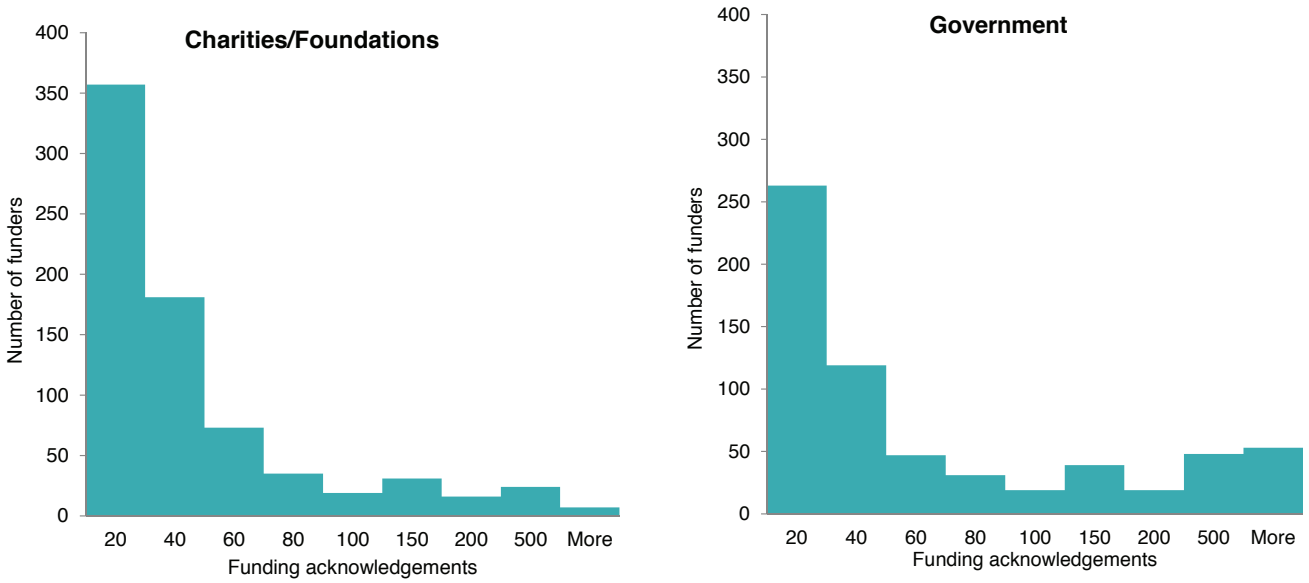


Table 2-1
Top 30 most frequently acknowledged funders globally

	Funder	No. of papers	Location	Sector	Proportion of papers
1	US National Institutes of Health (NIH)	16716	USA	Government	15%
2	National Institute of Mental Health (NIMH)	10081	USA	Government	9%
3	National Institute on Drug Abuse (NIDA)	6231	USA	Government	6%
4	National Institute on Aging (NIA)	5266	USA	Government	5%
5	Canadian Institutes of Health Research (CIHR)	4701	Canada	Government	4%
6	Department of Veterans Affairs (VA)	4387	USA	Government	4%
7	National Health and Medical Research Council of Australia (NHMRC)	4033	Australia	Government	4%
8	European Commission	4021	EU	Government	4%
9	National Natural Science Foundation of China (NSFC)	3836	China	Government	3%
10	UK Medical Research Council (MRC UK)	3503	UK	Government	3%
11	Brain and Behavior Research Foundation (NARSAD)	3281	USA	Charity/ Foundation/ Non-profit	3%
12	Netherlands Organization of Scientific Research (NWO)	3112	Netherlands	Government	3%
13	National Institute for Health Research (NIHR)	3062	UK	Government	3%
14	National Institute on Alcohol Abuse and Alcoholism (NIAAA)	2887	USA	Government	3%
15	Wellcome Trust	2434	UK	Charity/ Foundation/ Non-profit	2%
16	German Research Foundation/Deutsche Forschungsgemeinschaft (DFG)	2360	Germany	Government	2%
17	National Institute of Health Carlos III (FIS)	2225	Spain	Government	2%
18	CNPq Brazil	1994	Brazil	Government	2%
19	Federal Ministry of Education and Research (BMBF)	1939	Germany	Government	2%
20	National Center for Research Resources (NCRR)	1917	USA	Government	2%
21	Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD)	1909	USA	Government	2%
22	Ministry of Education, Culture, Sports, Science and Technology in Japan (MEXT)	1852	Japan	Government	2%
23	National Institute of Neurological Disorders and Stroke (NINDS)	1847	USA	Government	2%
24	Alzheimer's Association	1636	USA	Charity/ Foundation/ Non-profit	1%
25	Swedish Research Council	1409	Sweden	Government	1%
26	Stanley Medical Research Institute (SMRI)	1317	USA	Charity/ Foundation/ Non-profit	1%
27	Pfizer	1197	USA	Industry	1%
28	Spanish Ministry of Science and Innovation (MICINN)	1151	Spain	Government	1%
29	Fundacao de Amparo a Pesquisa do Estado de Sao Paulo (FAPESP)	1132	Brazil	Government	1%
30	Department of Health and Human Services (DHHS)	1128	USA	Government	1%

Figure 2-4
Distribution of funders in the government and charity/foundation/non-profit sectors, by numbers of papers on which they are acknowledged



volume of research supported is heavily skewed in both sectors (Figure 2-4). While in both government and charity sectors there are large numbers of funders supporting small amounts of mental health research, the government sector has a notably higher number of very large funders. Our data indicates that there are few such large funders in the charity, foundation and non-profit sector. What we cannot judge from this data, however, are the absolute amounts of money involved, something discussed further in Chapter 4.

The remaining organisations in our analysis were classified as industry funders or academic institutions.[5] While uncertainties around industry funding have been discussed previously, the extent to which academic institutions are providing independent funding for research is also unclear. In many cases, these acknowledgements may represent, for example, the provision of laboratory space, infrastructure or support services by a researcher's host institution. That is not to suggest that these forms of support are not important, but highlights that they are more difficult to capture in this kind of analysis due to inconsistencies in the way that researchers acknowledge support which may be non-monetary or less-formally attributed to a particular project.[6]

The share of funding acknowledgements accounted for by each sector has remained fairly constant over the six year time period covered by our data (see Figure B-3 in Appendix B.).

Papers acknowledging charity, foundation or non-profit support have the highest citation impact

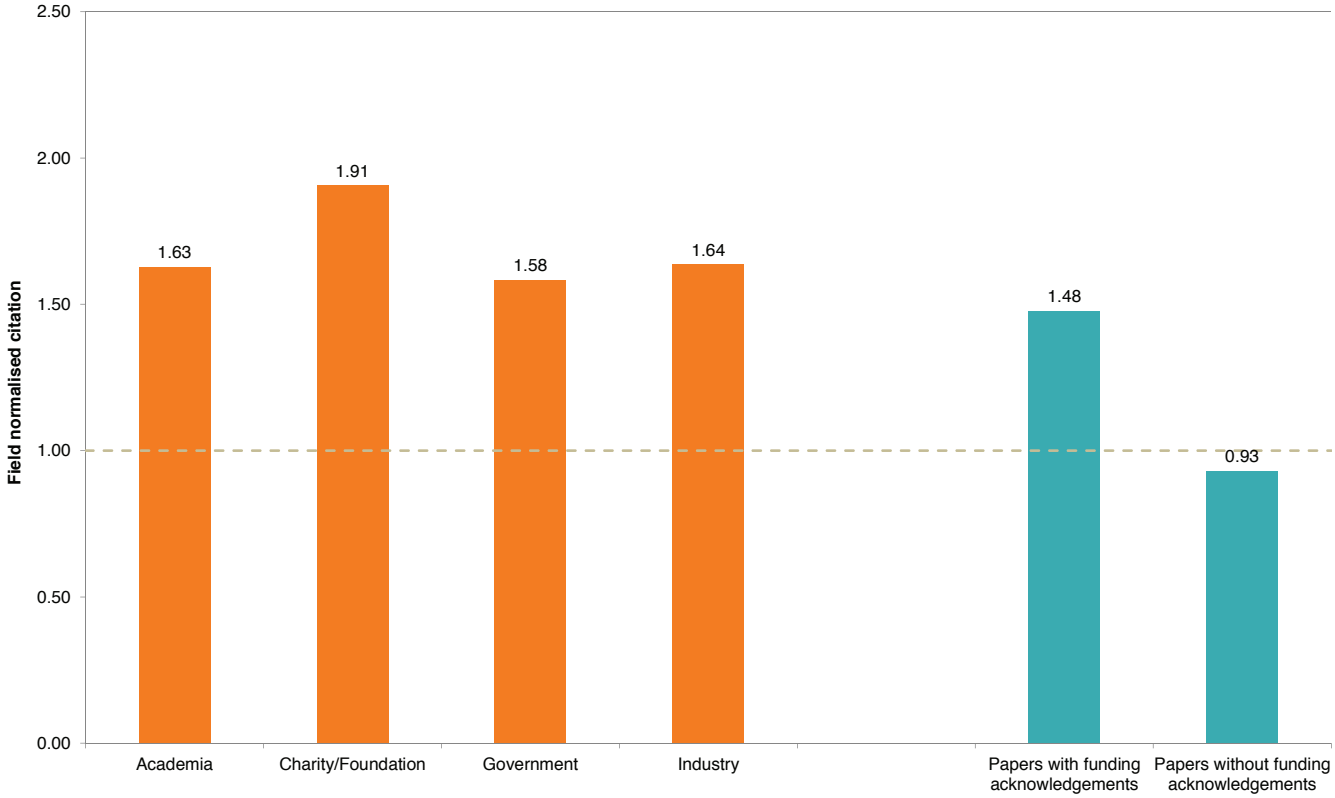
Measures of citation can be used as an indicator of the scientific impact a particular piece of research has in the academic world. As publication and citation practices vary substantially by discipline (e.g. Moed et al. 1985), we use the indicator 'average of relative citations' (ARC), which normalises the number of citations a paper receives according to its age (since older papers have had more time to accumulate citations) and the field in which it is published (see Appendix A for further details).

In our data set, the ARC of papers containing funding acknowledgements was substantially

[5] In addition to these groups there were a small number of funders that either did not fit into these categories (such as publishers) or were unable to be classified due to a lack of available information.

[6] Our survey of researchers revealed that only 20 per cent usually acknowledged access to equipment and facilities in journal papers, and only 4 per cent acknowledged estate costs.

Figure 2-5
Average of relative citations by funder sector (world average = 1.0)[7]



above the global average (of 1.00) for all sectors (see Figure 2-5), a finding consistent with previous studies demonstrating that papers acknowledging funding tend to be more highly cited than those without such acknowledgements (e.g. Costas & van Leeuwen 2012). In addition to this, however, papers acknowledging support from a charity, foundation or non-profit had a higher citation impact on average than those acknowledging other sectors. This was also true within individual countries (see Annexes 1 and 2 for data on Canada and the UK), suggesting that the higher average citation of papers supported by charities, foundations and non-profits is not due solely to the geographical distribution of funding organisations.

There are examples of new funders emerging in the field of mental health

One of the primary reasons for using a bottom-up approach in this analysis, in contrast to the top-down approach of many previous studies, was to enable us to explore the field of mental health research beyond the large and well-known funders. Through the funding acknowledgement data extracted from journal papers we have been able to do this, highlighting some funders who have begun supporting mental health research only recently.

We looked at the number of acknowledgements of each funder in each year of the data set and identified those with the greatest differences in frequency between the first part (2009-2012) and second part (2013-2014) of the time period. Some of the funders highlighted by this analysis were organisations which had changed name or restructured during or shortly before the first year of our data set – for example, the Spanish Ministry of the Economy and Competiveness, created in 2011 from the merger of two prior ministries.

However, there were also examples of newly established funders. The US National Center for Advancing Translational Sciences (established under the auspices of NIH in 2012) is a notable example here. It was established with the aim of speeding up the delivery of new drugs, diagnostics and medical devices to patients (a challenge highlighted by a number of funders in our deep dive interviews).

[7] Funder sectors were only assigned to funders with 10 or more acknowledgements

the United States is home to 31 per cent of all government, charity, foundation and non-profit mental health research funders in our data set

We also identified a range of smaller organisations, primarily in the charity, foundation and non-profit sector, which were either recently established or began new funding programmes related to mental health in the years just prior to our data set. The clearest examples of this were the Swiss Anorexia Nervosa Foundation, which was established in 2007 and appears in our data from 2012, and the William K. Wallace Foundation (US) and Champalimaud Foundation (Portugal), which launched mental health and neuroscience programmes, respectively, in 2007.

Being able to identify the emergence of new funders or funding programmes in the data both highlights the value of mapping mental health research funding using a bottom-up approach, and also serves as a useful validation of the sensitivity of our methodology to changes in the ecosystem.

2.4 Where are they?

Government, charity, foundation and non-profit funders are clustered in the countries which produce the most mental health research

To explore the geographical distribution of mental health research funding agencies we identified the location of each of the funders in our set of 1,908. In instances where funders are international (such as multilateral organisations) the location of the funder's headquarters is considered to be its home country (with the exception of European Union institution funding, which is not attributed to any one country). For this analysis we use only organisations in the government and charity/foundation/non-profit sectors. Industry funders tend to operate in many countries, making it difficult to accurately attribute funding to any one country, while (as discussed previously) the acknowledgement of support from academic institutions in providing non-monetary or less-formal support appears inconsistent.

As shown in Figure 2-6 below, the United States is home to 31 per cent of all government, charity, foundation and non-profit mental health research funders in our data set. The UK, Canada, Sweden, China and the Netherlands each have more than 60 funders.

In total, government, charity, foundation and non-profit mental health research funders were identified in 55 countries,[8] with the majority located in North America, northern and western Europe and China. Perhaps unsurprisingly, the highest concentrations of funding agencies tend to be located in the countries producing the most mental health research. Of the ten countries with the highest volume of mental health publications in our data set, only one (Italy) was not also in the top ten in terms of number of funders.

Figure 2-7 and Figure 2-8 show this same data split by sector. They highlight that the predominant funder type varies somewhat by country. While the United States is home to the largest number of funders in both sectors examined here, China is dominated by government funding agencies, while the UK, the United States, Australia, Denmark, Germany and, in particular, Sweden and Finland, have greater numbers of charitable funders.

Figure 2-9 shows the average citation impact of funders in each country – that is, the average level of citation of papers acknowledging funders from a given country, when normalized for field and year of publication. Funders in Ireland, EU institutions, the UK, Switzerland, and New Zealand average the highest citation impact, followed by papers funded by institutions in Germany, France, the United States and the Netherlands. Of the countries receiving large numbers of funding acknowledgements, South Korea, Taiwan, Brazil, China and Japan score notably lower than other major research funding and producing countries.

[8] 58 countries were identified if we include academia

Figure 2-6
Number of government, charity, foundation and non-profit mental health research funders by country

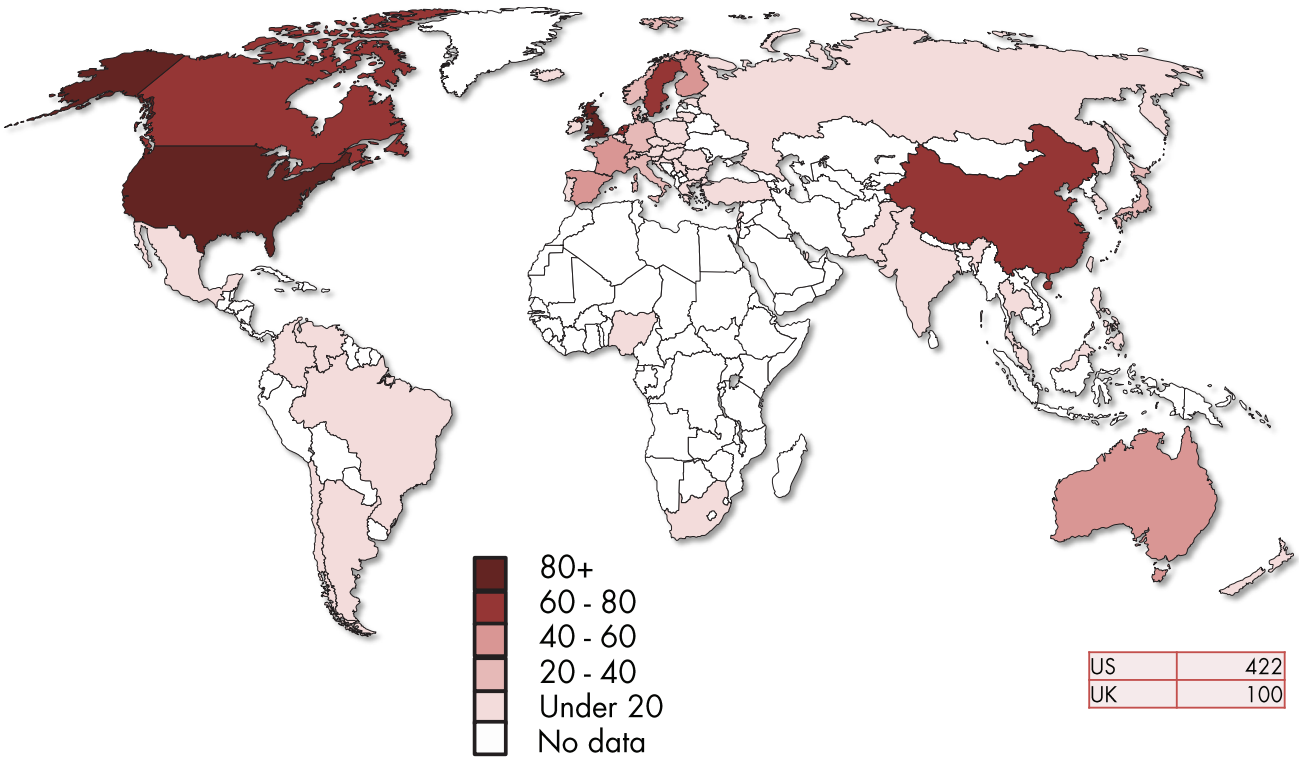


Figure 2-7
Government funders by country

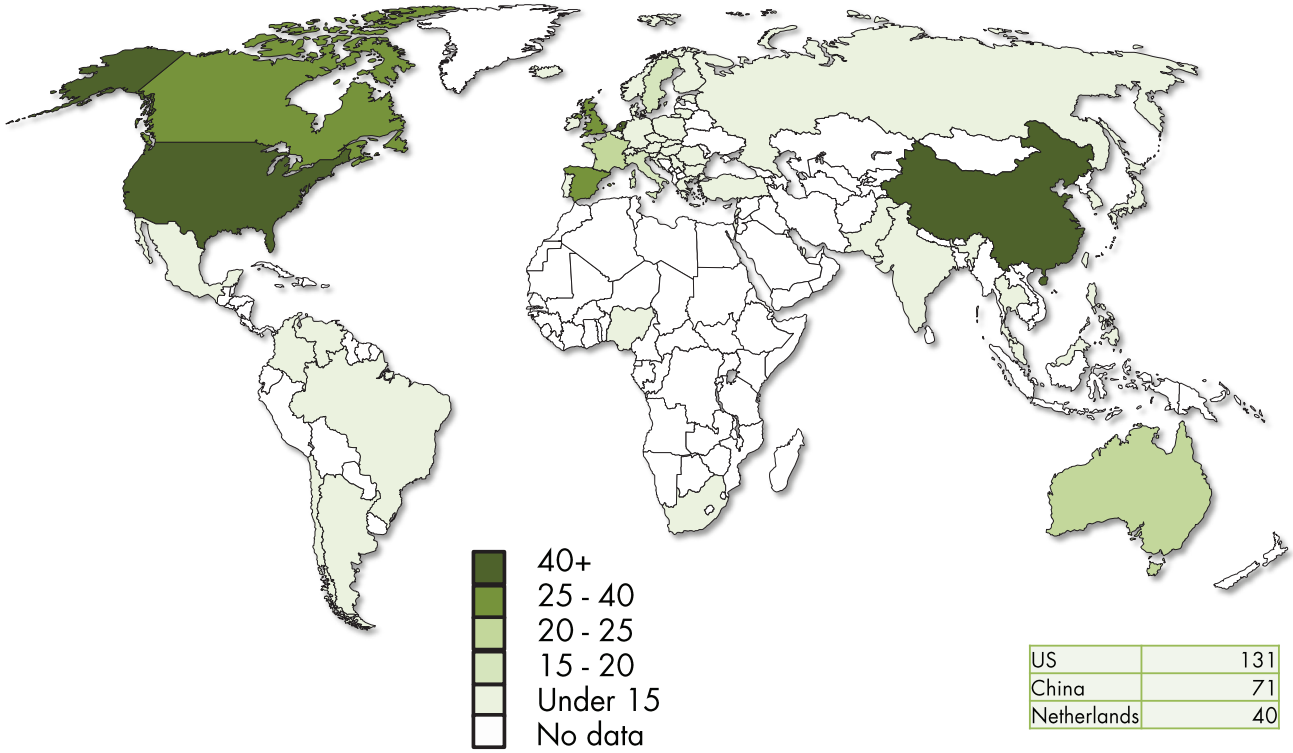


Figure 2-8
Charity, foundation and non-profit funders by country

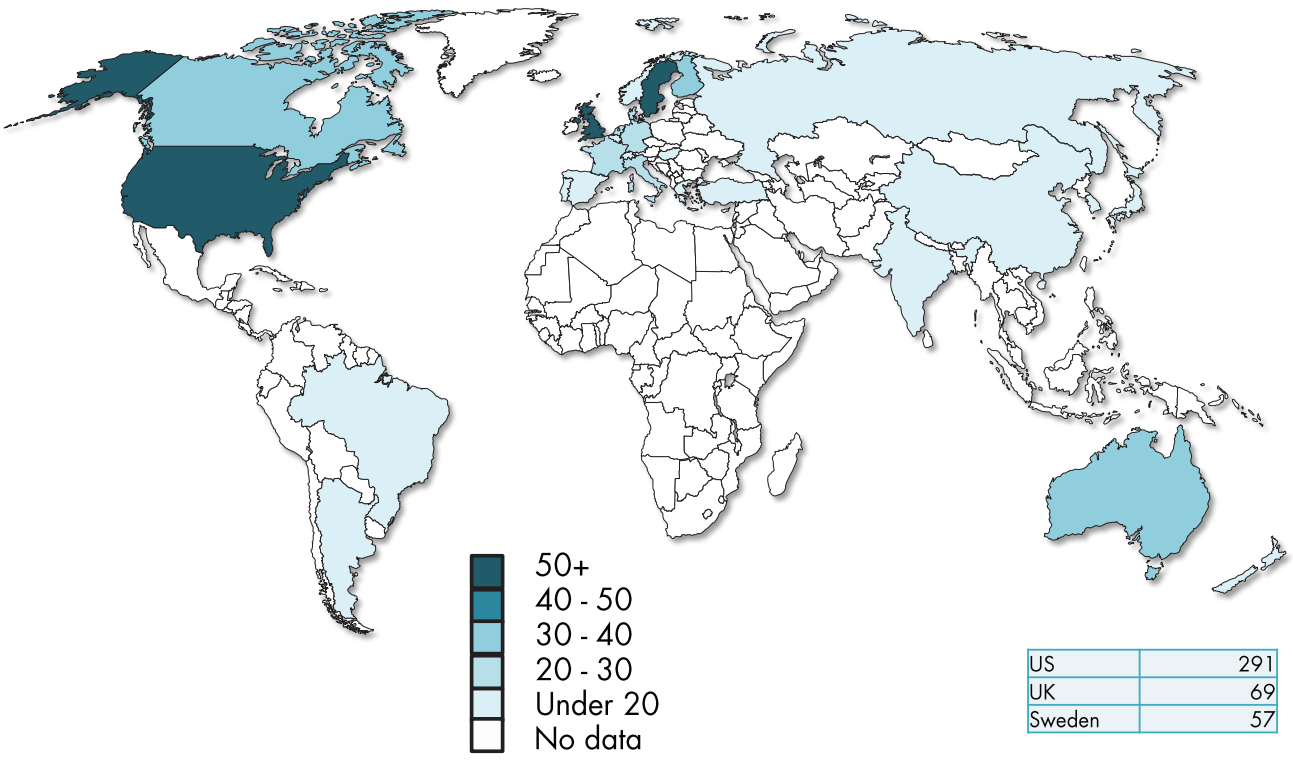
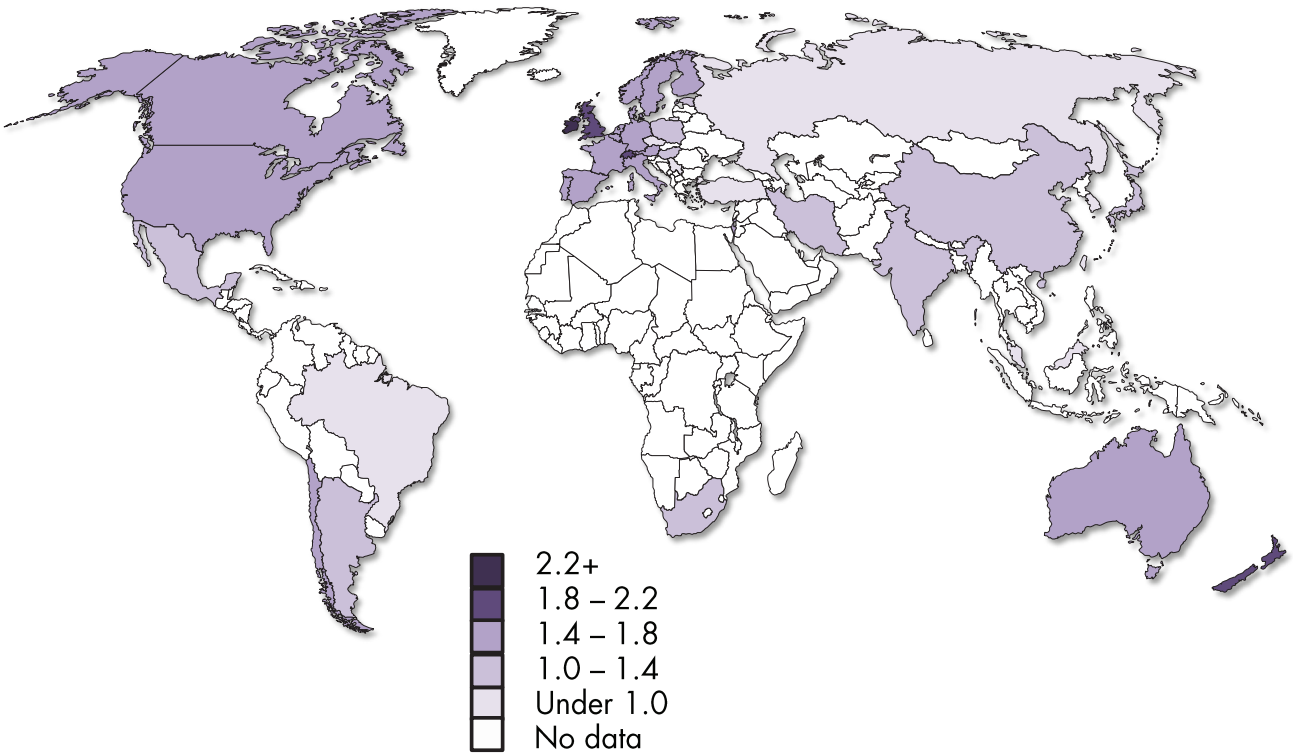


Figure 2-9
Average relative citations by country of funder[9]

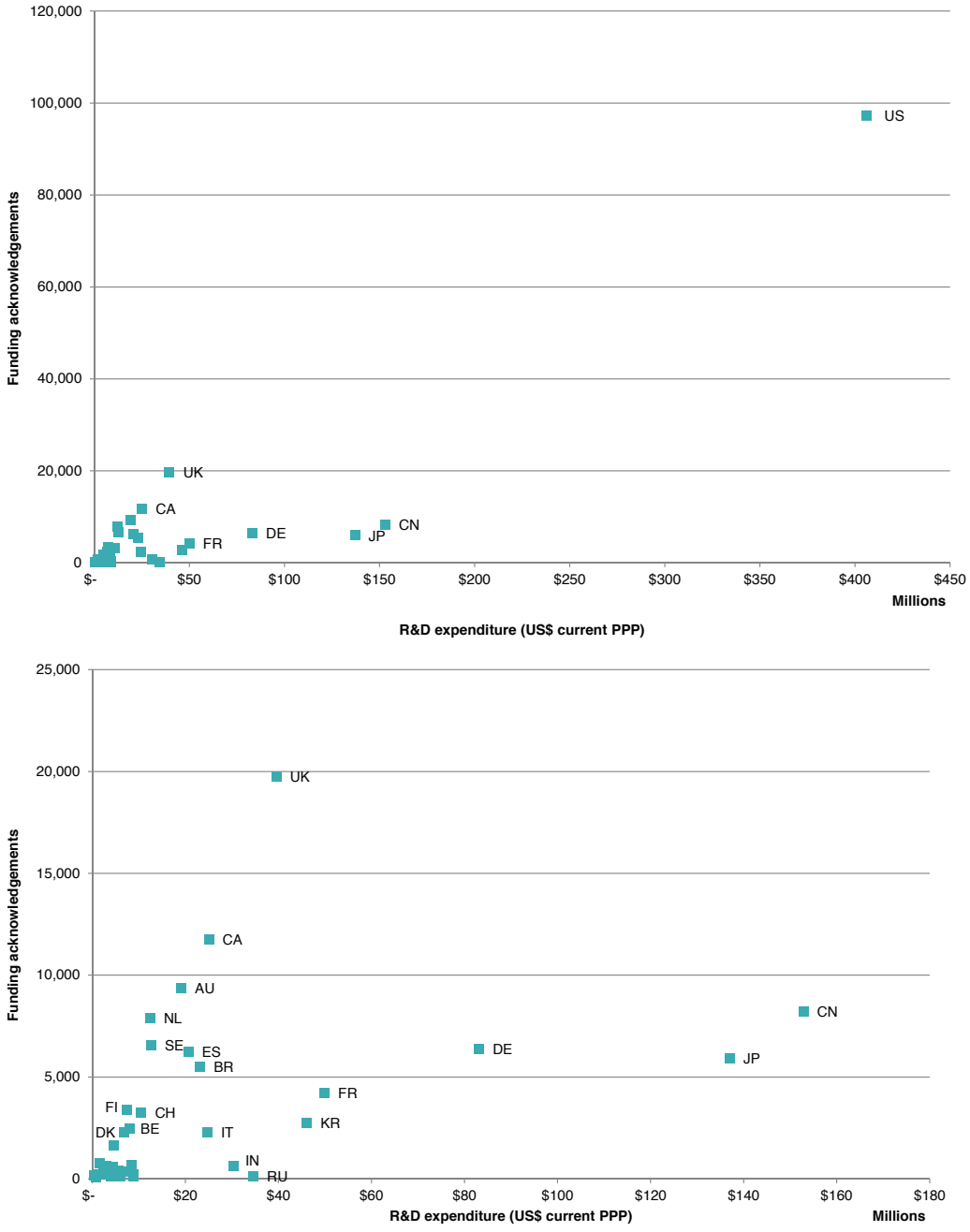


[9] For government, charity, foundation and non-profit mental health research funders in countries with over 100 papers

We also compared the number of acknowledgements per country (of funding organisation) with an indicator of overall spend on research and development. As mentioned previously, we cannot assume a direct link between funding acknowledgements and amounts of funding, but this does provide an indication of which countries may be supporting relatively more or less research in the mental health field compared with other research areas. The R&D expenditure data used is from 2009 or the nearest available year prior to that, given that the time between funding being awarded and a research paper being published has been shown to be around three years on average (e.g. Boyack & Jordan 2011).

Figure 2-10 reveals a number of countries with relatively large numbers of acknowledgements in mental health, including the UK, Canada,

Figure 2-10
Acknowledgements per funder country by R&D expenditure: (i) all countries. (ii) excluding the United States (Source: UNESCO, 2009 or nearest available prior year)



Australia and the Netherlands. A second group, including China, Japan, India and Russia has relatively few acknowledgements given the size of their annual R&D expenditure, suggesting that they focus their research resources in other areas.

2.5 What are they funding?

Funded topics cluster into eight groups of mental health conditions

Medical Subject Headings (MeSH terms) are a defined set of terms applied to journal papers to indicate the type of content. They can be used to understand the topics of the papers in our data set and how these topics relate to one another. We looked at terms within the MeSH subset 'Mental Disorders' to explore the various mental health conditions that the research in our data set focuses on. Terms within this subset occur on 69 per cent of all papers (76 per cent of papers with acknowledgments). Since each paper can be assigned a number of terms within the Mental Disorders subset, we could build a network of the co-occurrence of terms. This network showed that within our dataset conditions clustered into eight broad groups, representing terms which tend to occur together on papers. The groups have been labelled with a descriptor that covers the majority of terms in that class (see Appendix D for a full list of terms in each group).

Using the entire data set, Figure 2-11 shows the number of papers falling within each of the eight groups. The most common conditions occurring in our data set, together comprising 61 per cent of all papers, are neurodegenerative and cognition disorders; depressive, anxiety and personality disorders; and substance use and addictive disorders. Papers may fall into more than one class if they contain terms from multiple classes.

Figure 2-12 takes the same data, but adds an extra dimension by showing the proportion of papers in each group which also include a funding acknowledgement. This varies by the area of mental health the paper relates to, with, for example, 66 per cent of papers on neurodegenerative and cognition disorders acknowledging at least one funding source, in comparison with only 48 per cent of those relating to sleep disorders. Further analysis of the funders acknowledged in each of these groups is set out in Section 2.6, where we look at networks of the funders co-acknowledged on papers within each.

Figure 2-11
Papers in complete data set with 'Mental Disorder' MeSH terms

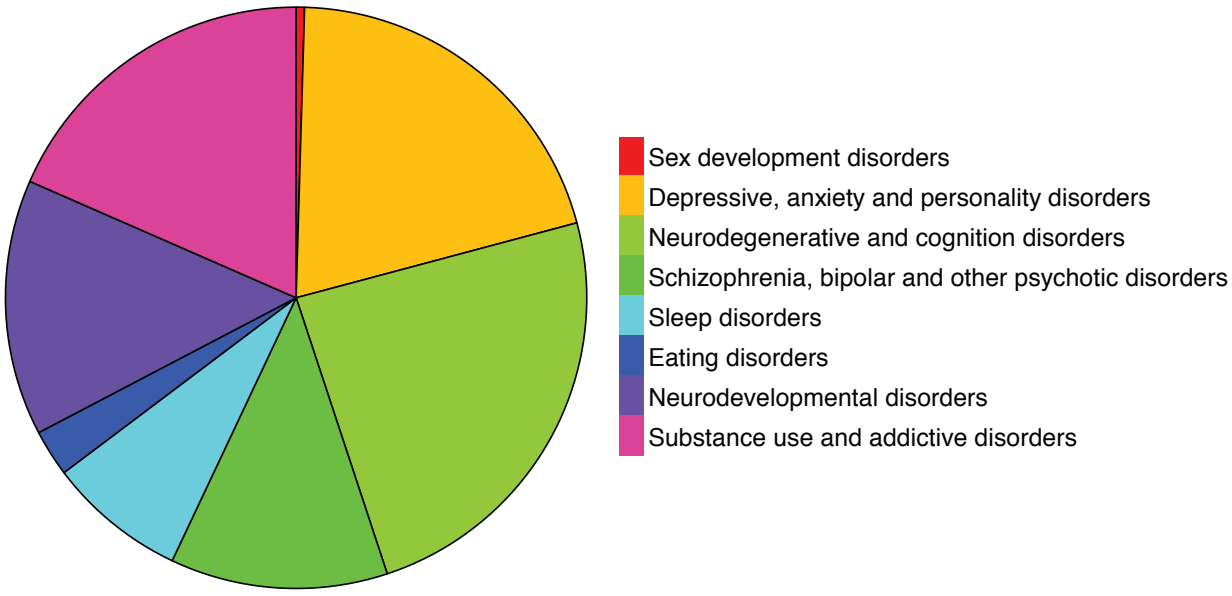


Figure 2-12
Coxcomb plot of papers with acknowledgement data and Mental Disorder MeSH terms

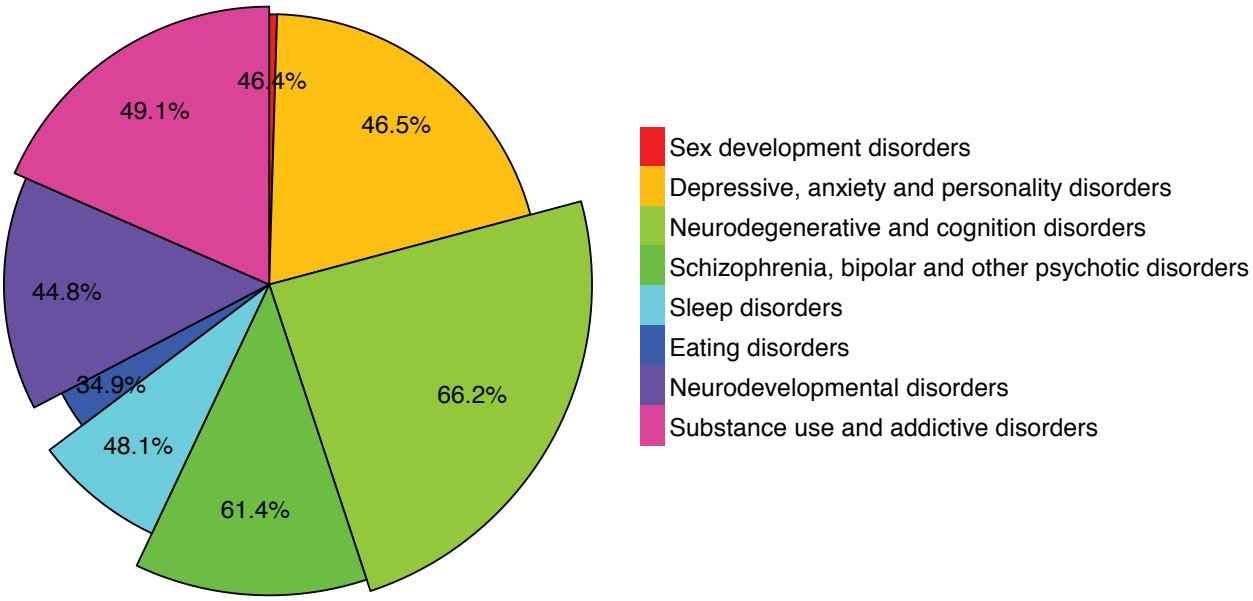
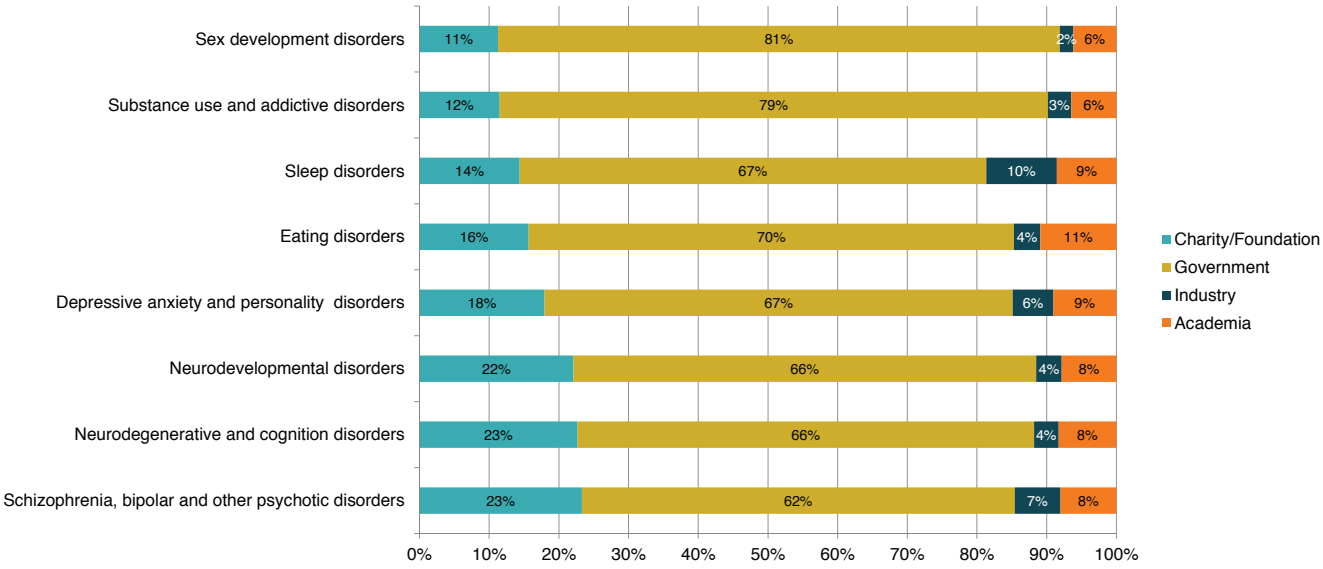


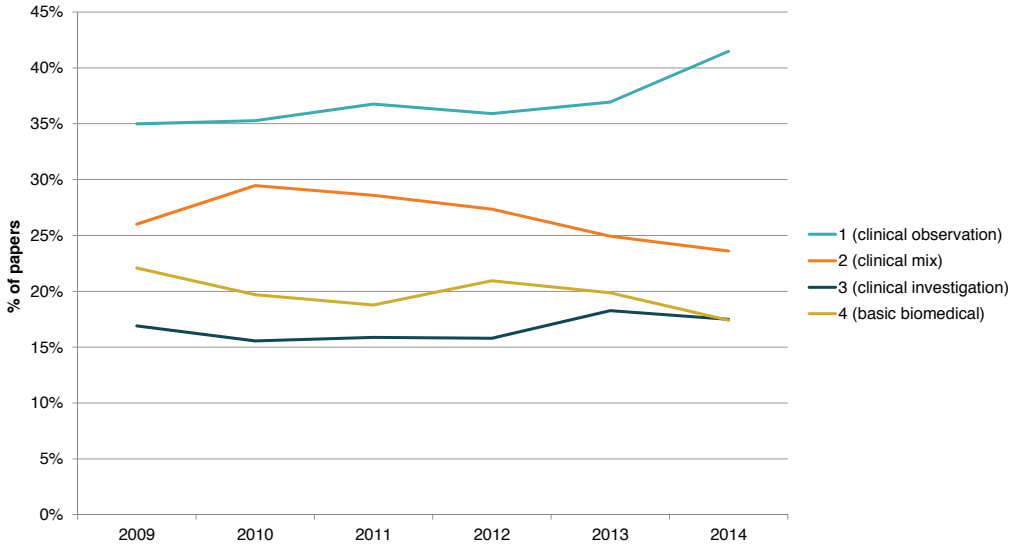
Figure 2-13
Funding acknowledgements by sector for each group of MeSH terms



Government funders support the most research in every subfield of mental health, but the involvement of charities and industry varies by area

Figure 2-13 shows how the involvement of funders in different sectors varies in each of the eight topic groups. It shows the proportion of funding acknowledgements attributable to each sector in each of the eight groups formed from 'Mental Disorder' MeSH terms in our data set. In all eight areas the majority of funding acknowledgements relate to government funders, but in schizophrenia, bipolar and other psychotic disorders, as well as both neurodegenerative and neurodevelopmental conditions, charities, foundations and non-profits account for more than 20 per cent of the total acknowledgements. Industry funders appear to invest more in sleep disorders and schizophrenia, bipolar and other psychotic disorders than in other areas of mental health.

Figure 2-14
Research level of papers by year



Industry funders tend to support more applied research

The 'research level' assigned to a journal provides an indication of the type of research it publishes.[10] There are four levels, which form a scale from applied to basic research: (1) clinical observation (e.g. *Schizophrenia Bulletin*); (2) clinical mix (e.g. *Journal of Psychiatric Research*); (3) clinical investigation (e.g. *Neuropsychopharmacology*); and (4) basic biomedical (e.g. *Neuroscience*). It should be noted that research level is a fairly crude measure, since it is applied at the journal level, rather than to individual papers and not all journals have been classified. However, it is the best approximation available and when used at the aggregate level can provide an overview of how basic or applied a body of research is. In a previous study (Wooding et al. 2013) we noted that over a 20-year time period clinical research has had a larger impact than basic research on patient care in the mental health field. This observation raises questions about how research funders can best balance their portfolios to achieve their intended impacts within appropriate timeframes and highlights the value of exploring the distribution of research types within the field.

Figure 2-14 shows that the representation of journals at each research level in our data set has not changed dramatically over time, although the proportion of the most clinically-focused research appears to increase in 2014. While this could be a short term fluctuation or the start of a longer term trend, it is important to bear in mind that the indexing of 2014 papers was incomplete when we extracted our data (and so this variation may be an artefact of differential indexing of journals at each research level). In contrast, we do see a difference in the distribution of research levels according to the sector of the funder acknowledged (Figure 2-15). Industry funding is associated with a greater proportion of the most applied research (level 1) and is acknowledged on a much smaller proportion of papers in basic biomedical (level 4) journals than is the case for funders from other sectors.

The US and the UK are consistently the top two funder countries across all subfields of mental health research

In all eight areas of mental health research, US funding organisations were most frequently acknowledged in our data set, followed by funders in the UK (Table 2-2). Below these two countries there was more variation, although Canada was third or fourth in each of the six largest areas and Australia was also prominent. Chinese funders were acknowledged proportionally more in neurodegenerative and cognition disorders. Swedish organisations also featured prominently in this area, as well as (along with Spanish funders) on papers relating to eating disorders.

[10] As defined by the Patent Board (formerly CHI Research): Hamilton, K. (2003) Subfield and Level Classification of Journals (CHI Report No. 2012-R). Cherry Hill, NJ: CHI Research

Figure 2-15
Research level of papers by funder sector

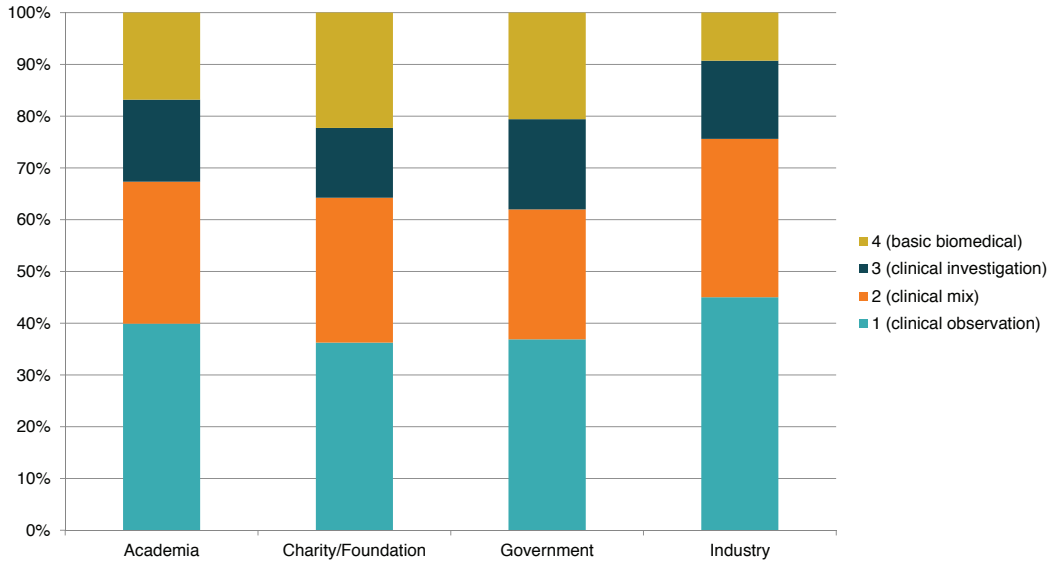


Table 2-2
Top ten most frequently acknowledged funding countries for each group of MeSH terms

	Neuro-degener-ative and cognition disorders	Depressive anxiety and personality disorders	Substance use and addictive disorders	Neuro-develop-mental disorders	Schizophrenia, bipolar and other psychotic disorders	Sleep disorders	Eating disorders	Sex develop-ment disorders
1	USA	USA	USA	USA	USA	USA	USA	USA
2	UK	UK	UK	UK	UK	UK	UK	UK
3	China	Netherlands	Canada	Canada	Australia	Brazil	Spain	Japan
4	Canada	Canada	Australia	Australia	Canada	Canada	Sweden	Brazil
5	Sweden	Australia	Netherlands	Germany	Spain	China	Germany	China
6	Australia	Germany	Spain	Netherlands	China	Japan	Australia	EU
7	Spain	China	China	EU	Japan	Australia	Canada	Australia
8	Japan	Brazil	Sweden	France	Netherlands	Germany	EU	Canada
9	EU	Spain	Germany	Japan	Brazil	Finland	Brazil	Germany
10	Germany	Sweden	Finland	China	Germany	Sweden	France	Switzerland

2.6 How do funders relate to one another?

One of the aims of this study was to identify the connections between mental health research funders, whether these arise through formal funding collaborations or due to researchers using funding from two (or more) different organisations to support the same work. To explore these connections, we used papers with multiple funding acknowledgements to link funders. For example, a paper supported by CIHR and the Wellcome Trust would produce a link between these organisations. While we are not aware of previous studies using funding acknowledgement data in this way, network analysis is increasingly being used to evaluate collaborative research and explore the relationships between actors in a network and

information flows between them – numerically or graphically (e.g. Wagner et al. 2005).

Networks constructed using funding acknowledgement data indicate simply where two funders are acknowledged on the same paper. As such, this analysis cannot (on its own) differentiate qualitatively between cases of 'active' collaboration between funders and instances in which researchers combine funding from two (or more) organisations to support the same work. It can, however, cast light on the extent to which funders' portfolios overlap or complement one another, highlight where they (knowingly or unknowingly) co-fund research and reveal whether any clusters of funders emerge. To complement this, the profiles of individual funding organisations completed as part of the study detail current collaborative and cooperative activities that each funder actively engages in.

In the mental health research field as a whole…

A network analysis was conducted to examine the extent of collaboration and co-acknowledgement across our core set of 1,908 funders (Figure 2-16; see Appendix A for methodological details). A larger-scale version of the network is included in the pack which accompanies this overview report. The network analysis aimed to highlight the relationships between funders linked through funding acknowledgements on each paper. Using a 'network approach' in exploring this provides a systemic perspective on linkages between funders as it takes into account the dynamics of the system as a whole, as well as the relative position of individual funders in collaborative networks and thus affords greater analytical detail.

In the network, each node represents a funder and the connecting lines indicate these funders' co-acknowledgement on papers (a heavier line indicating a greater number of co-acknowledgements). The size of a node is proportional to the number of acknowledgements that the funder has in the data set. Funders are coloured by modularity class – clusters which emerge from the data and provide an indication of how closely related nodes are in terms of co-acknowledgement. The organisations within each cluster are densely connected to others within the same class and are more sparsely connected to those outside it (see Appendix A for further details).

The overall network illustrates the complexity of the research funding ecosystem in mental health. The dominance of US funders is clear, in particular of NIH and its associated institutes. Major government funders in Canada, the UK, China, Australia and the EU can also be seen, surrounded by a large number of smaller government agencies and other funders. Generally, the clusters emerging from the data are geographical, representing either countries or regions. This suggests that despite increasing international collaboration in research (e.g. Gazni et al. 2012; Waltman et al. 2011), national boundaries are still important in funding distribution. Similar networks specifically for Canada and the UK can be found in Annexes 1 and 2.

In subfields of mental health…

We also developed individual networks for funders acknowledged on papers in each of the topic groups identified in Figure 2-11. These networks give an overview of the funders active in each area and the relationships between them. The five largest topic areas are shown in Figures 2-17 to 2-21. Funders are again coloured according to modularity class. Further details on the construction of the network maps are set out in Appendix A.

In neurodegenerative and cognition disorders (Figure 2-17), funders whose portfolios focus on aging and dementia are clearly visible, in particular NIA and a number of charities and foundations focusing on Alzheimer's and Parkinson's research. The noticeable presence of some relatively large charity funders is consistent with our earlier observation that this is one of the areas of mental health research in which charities, foundations and non-profits appear to be most active. While US government agencies are still the most prominent funders in this field, there is a wide representation of European funders towards the right of the network, including a notable cluster of UK funders (shown in red) and a similar group of Swedish organisations (in brown). Most other European funders form one cluster (in a lighter green than the United States).

For depressive, anxiety and personality disorders (Figure 2-18), the funding landscape divides broadly into two large clusters, one dominated by the United States, but also including some industry funders, and the other consisting mainly of European and Australian funders (again with a

few pharmaceutical companies). The other organisations acknowledged on significant numbers of papers in this subfield form four national clusters for Canada, Brazil, China and Japan.

As one might expect, the funding landscape for substance use and addictive disorders (Figure 2-19) is dominated by NIDA and NIAAA, along with NIH. Most of the major funders in the network are government agencies, an observation consistent with the relatively low involvement of charities, foundations and non-profits seen in Section 2.5. Notable exceptions include the Wellcome Trust and Robert Wood Johnson Foundation.

In neurodevelopmental disorders (Figure 2-20) we see a large and closely linked network of US funders. Compared with other research areas (and as expected) NICHD is much more prominent, as are the charitable funders Autism Speaks and the Simons Foundation Autism Research Initiative. EU institutions also appear prominent, a finding consistent with our earlier observation that this is a research area in which they are more heavily involved (see Table 2-2). There are fewer industry funders than found in some other areas (as also illustrated previously) exceptions being Shire and Eli Lilly.

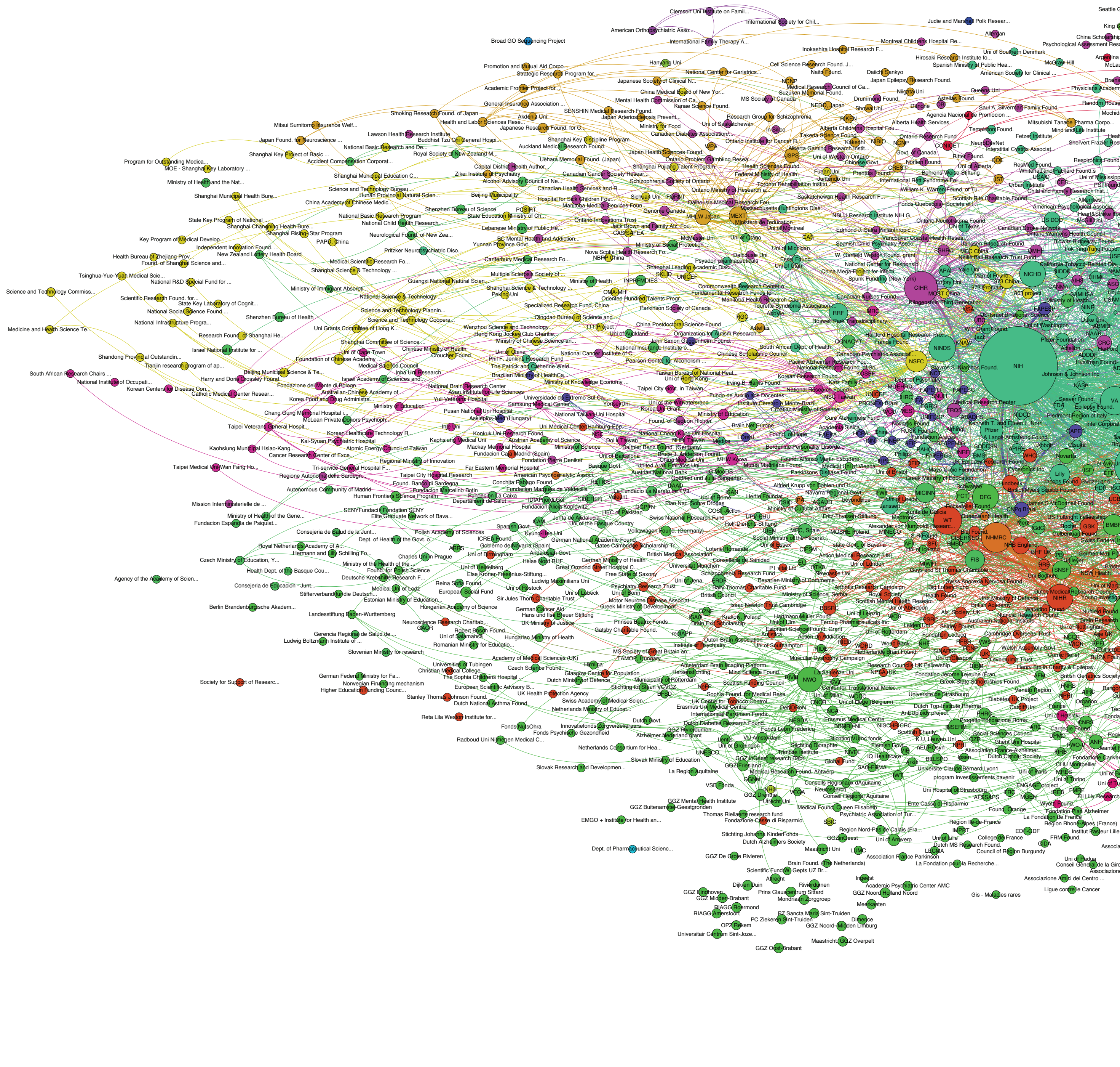
The landscape for schizophrenia, bipolar and other psychotic disorders (Figure 2-21) is dominated by a few large US funders – NIMH, NIH, the Brain and Behavior Research Foundation and the Stanley Medical Research Institute. Other major funders tend to be pharmaceutical companies and government agencies in the countries most frequently acknowledged in our data set.

Finally, networks were constructed for two population groups of different ages. Figure 2-22 shows funders acknowledged on papers concerned with young people (MeSH terms "Adolescent", "Child", "infant" and "young adult", plus terms making up the levels below them in the hierarchical MeSH structure), a group of particular interest given the early age of onset of many mental health conditions (Kessler et al. 2007). Figure 2-23 shows the corresponding network for older age groups ("Aged" and "middle aged", plus the terms below them in the MeSH structure).

The funding landscape for research relevant to young people (Figure 2-22) shows clear clusters for the United States (in purple), the UK (dark blue) and Canada (red), as well as for Australia, Sweden, China and Brazil (all towards the bottom right of the network). In addition to the government funders frequently acknowledged in a range of areas, charities including the Tourette Syndrome Association, the Simons Foundation Autism Research Institute, Autism Speaks, the MacArthur Foundation (all US), the Colonial Foundation in Australia and the Yrjö Jahnsson Foundation in Finland all feature.

The network for older people (Figure 2-23) contains a wide range of organisations, likely reflecting the broad range of topics that the selected MeSH terms are likely to cover. Nevertheless, as found in the network for neurodegenerative conditions, there is a notable cluster of mostly Swedish funders (in pink). NIA is prominent, as might be expected, while a number of Alzheimer's, Parkinson's and cancer charities are also visible.

Figure 2-16
Network of co-acknowledged funders in the entire mental health data set (coloured by modularity class). A larger-scale version of this figure has been published alongside this report.



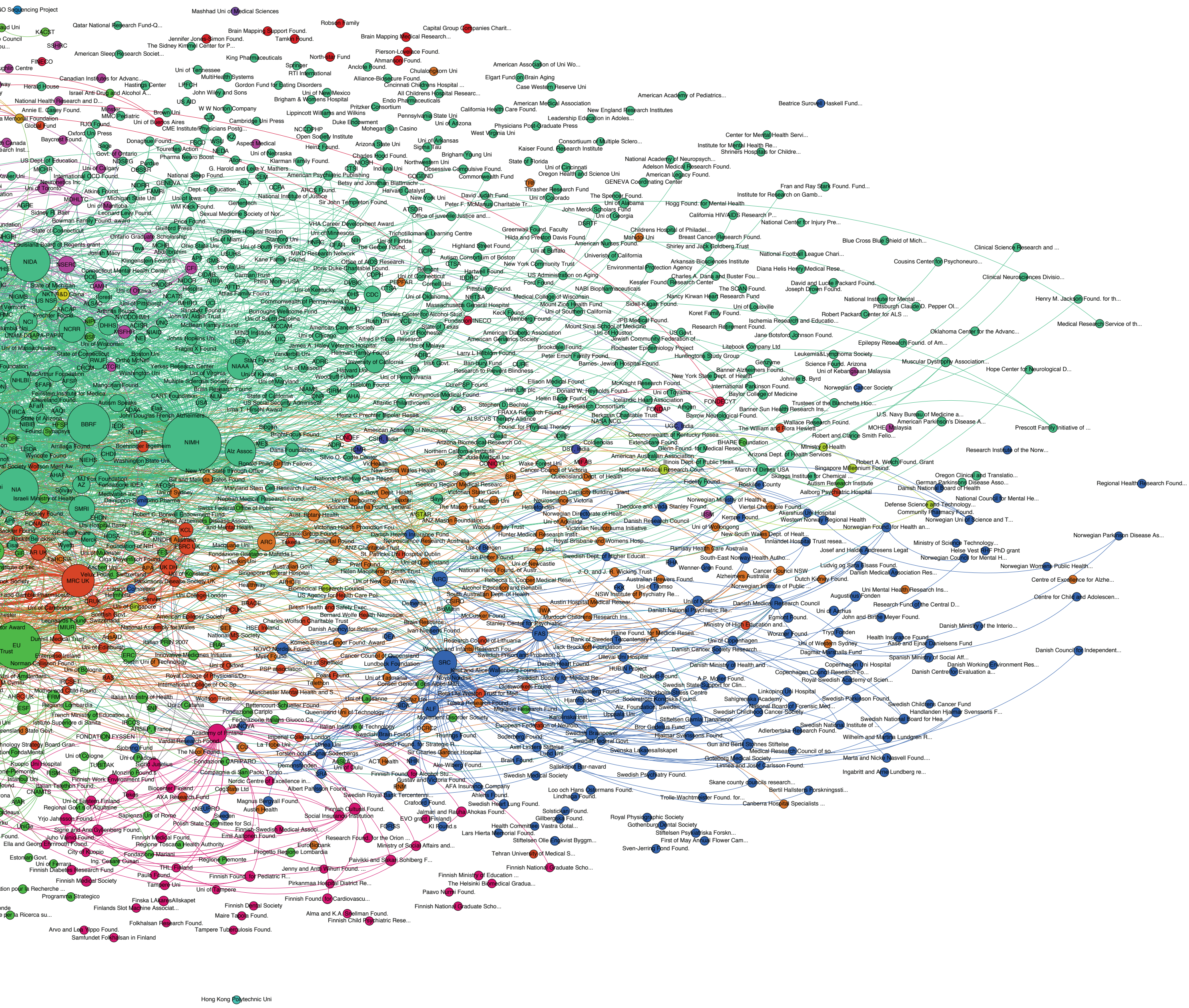


Figure 2-17
Network of co-acknowledged funders – neurodegenerative and cognition disorders (coloured by modularity class)

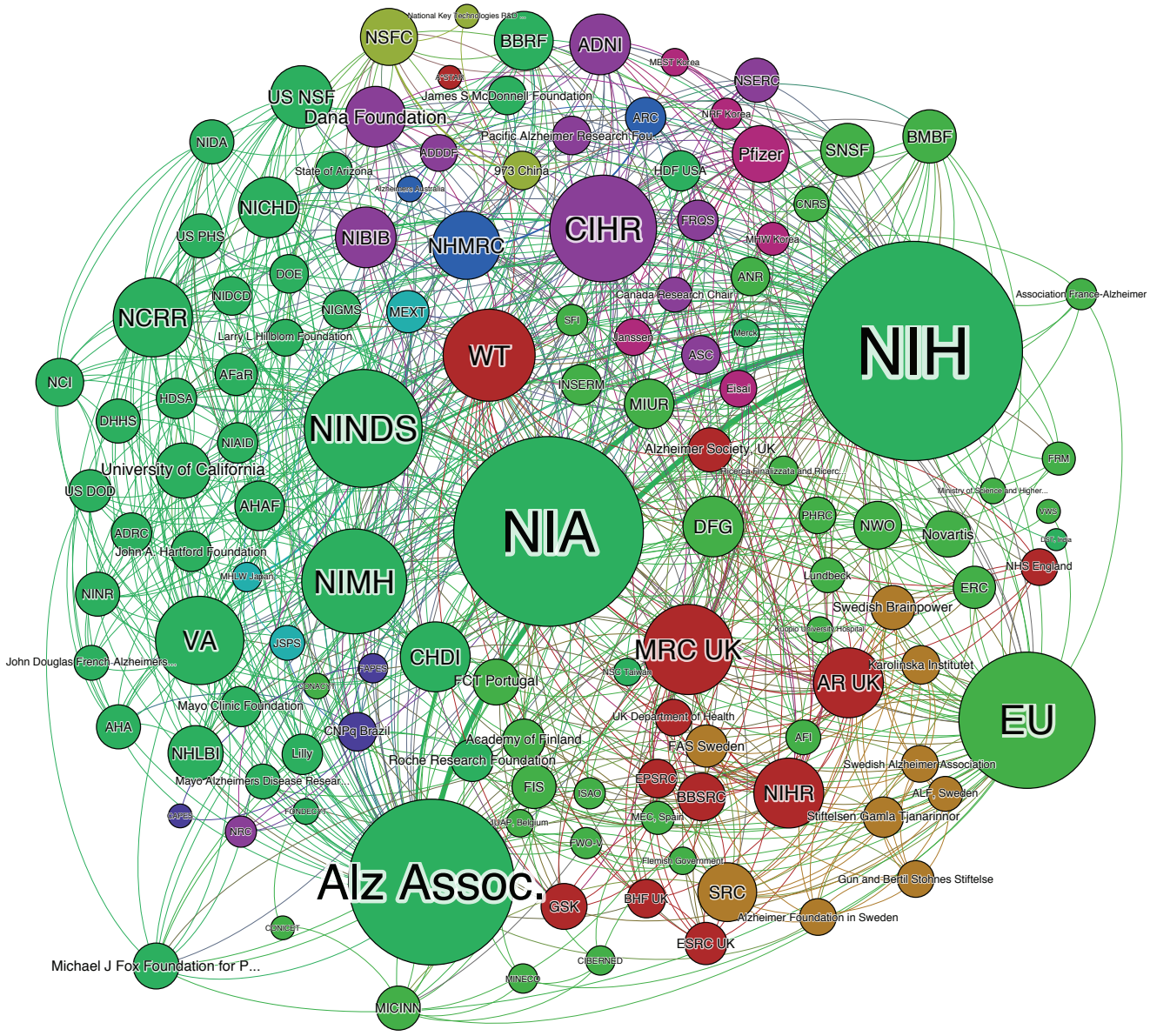


Figure 2-18
Network of co-acknowledged funders – depressive, anxiety and personality disorders (coloured by modularity class)

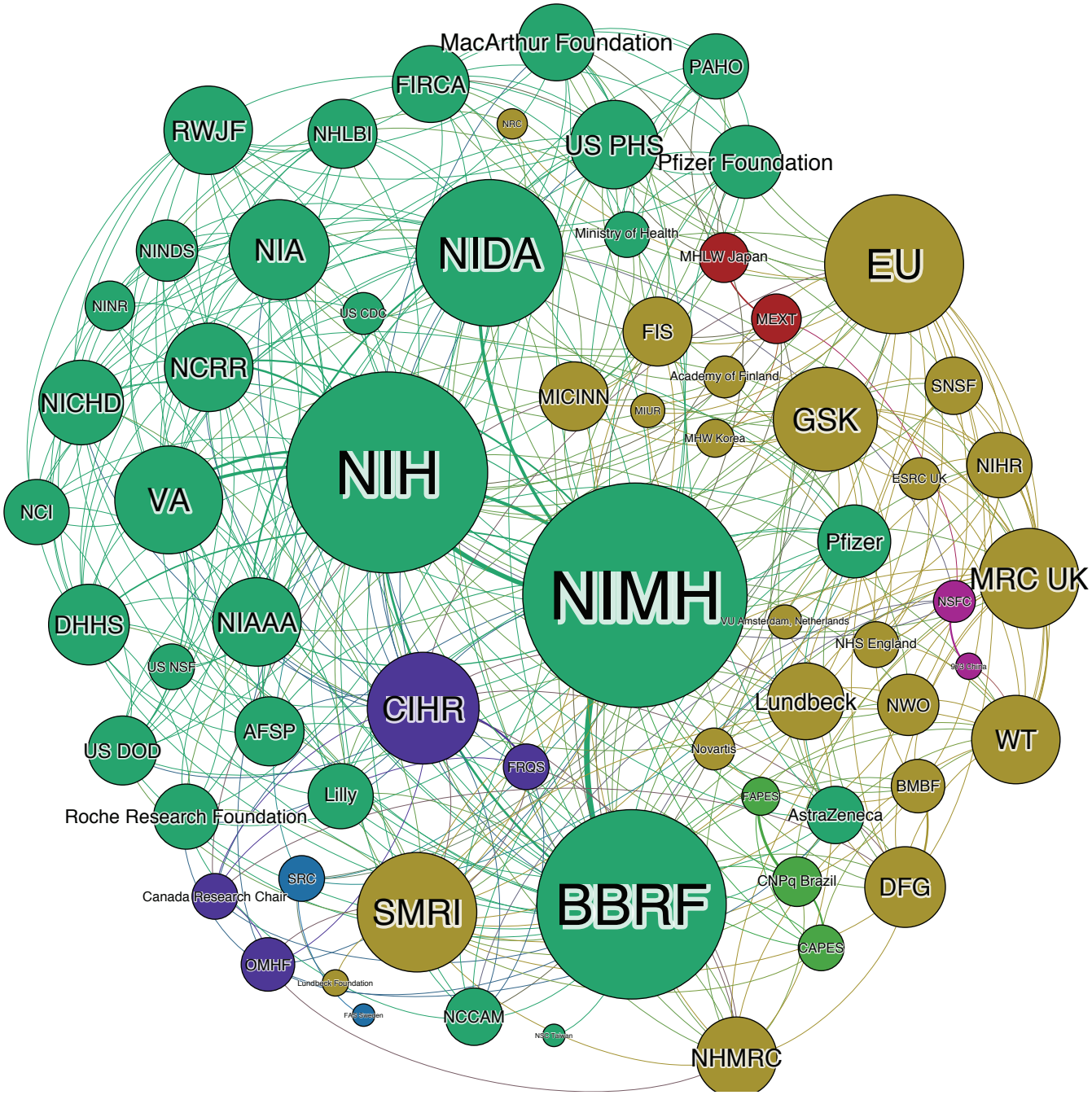


Figure 2-19
Network of co-acknowledged funders – substance use and addictive disorders (coloured by modularity class)

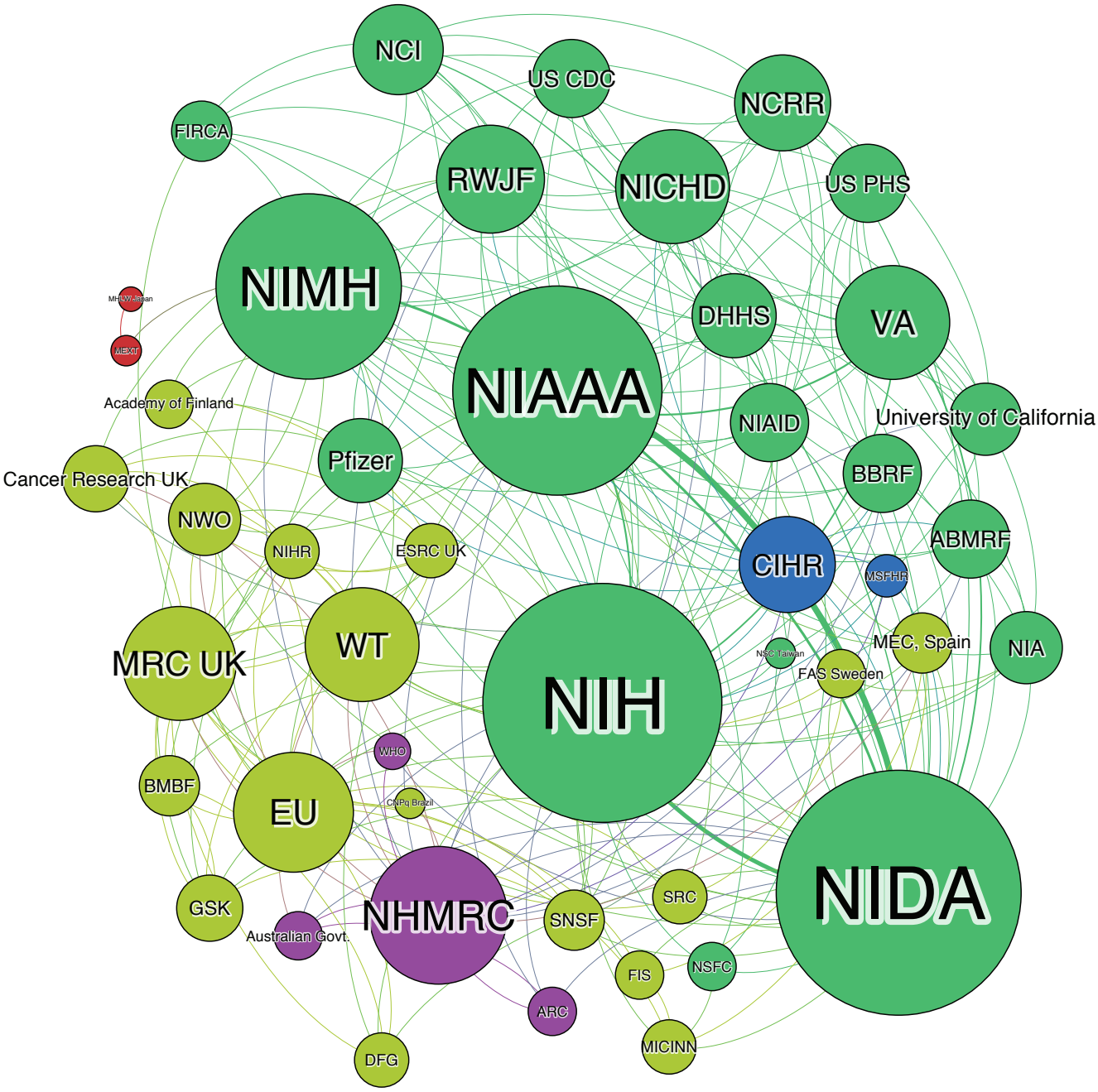


Figure 2-20
Network of co-acknowledged funders – neurodevelopmental disorders (coloured by modularity class)

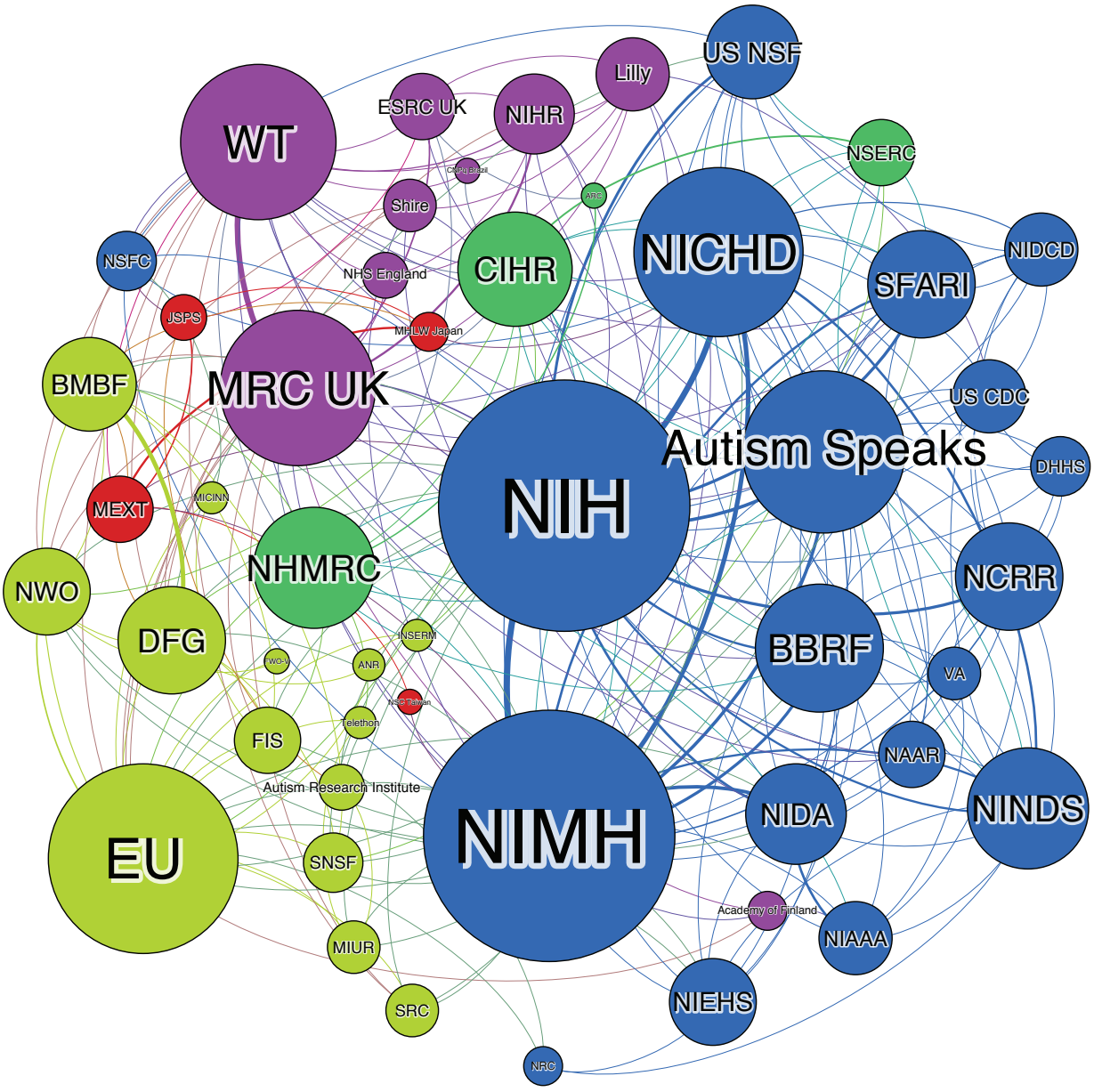


Figure 2-21
Network of co-acknowledged funders – schizophrenia, bipolar and other psychotic disorders (coloured by modularity class)

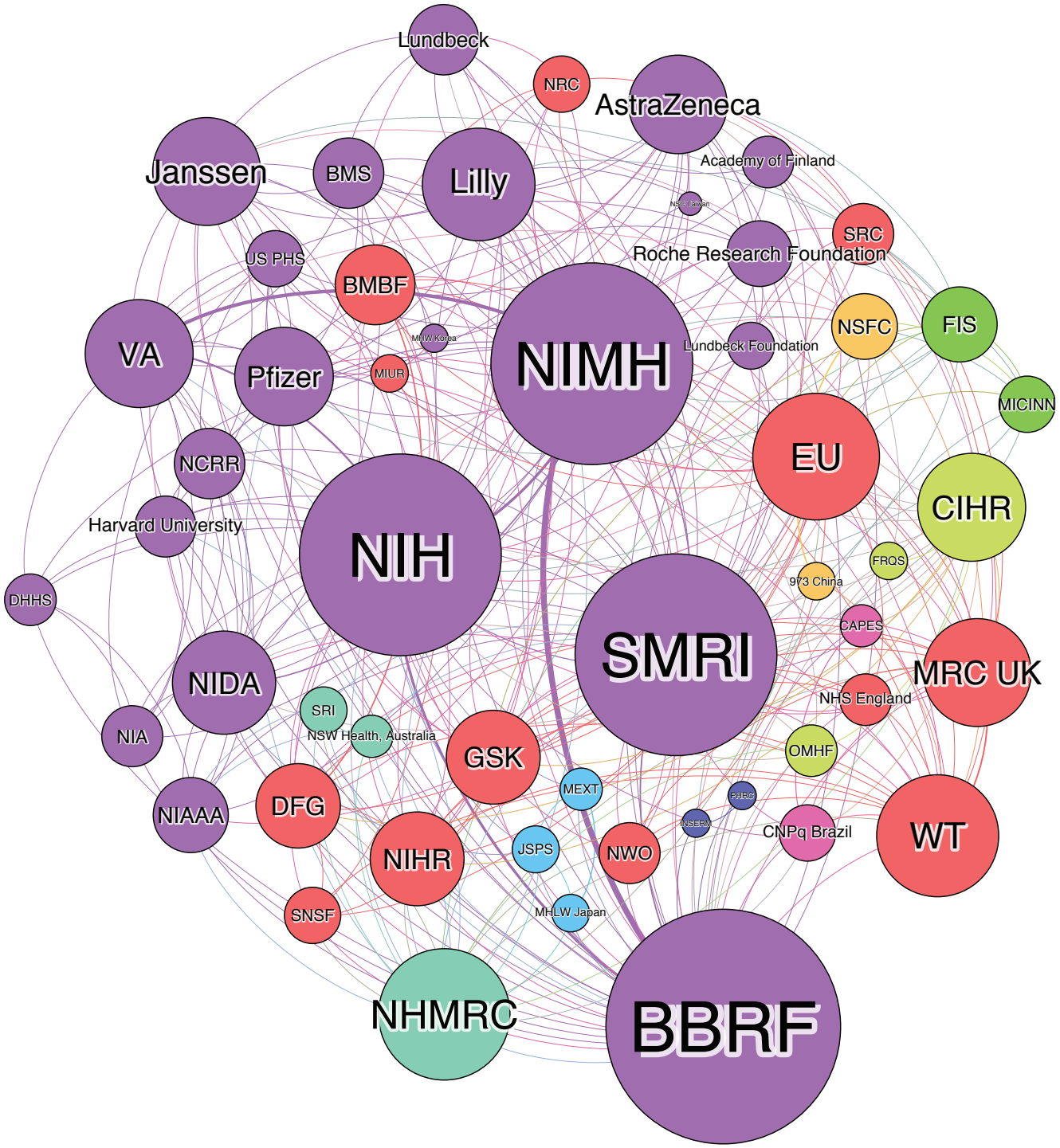


Figure 2-22
Network of co-acknowledged funders – "Adolescent", "Child", "infant" and "young adult" categories in MeSH (coloured by modularity class)

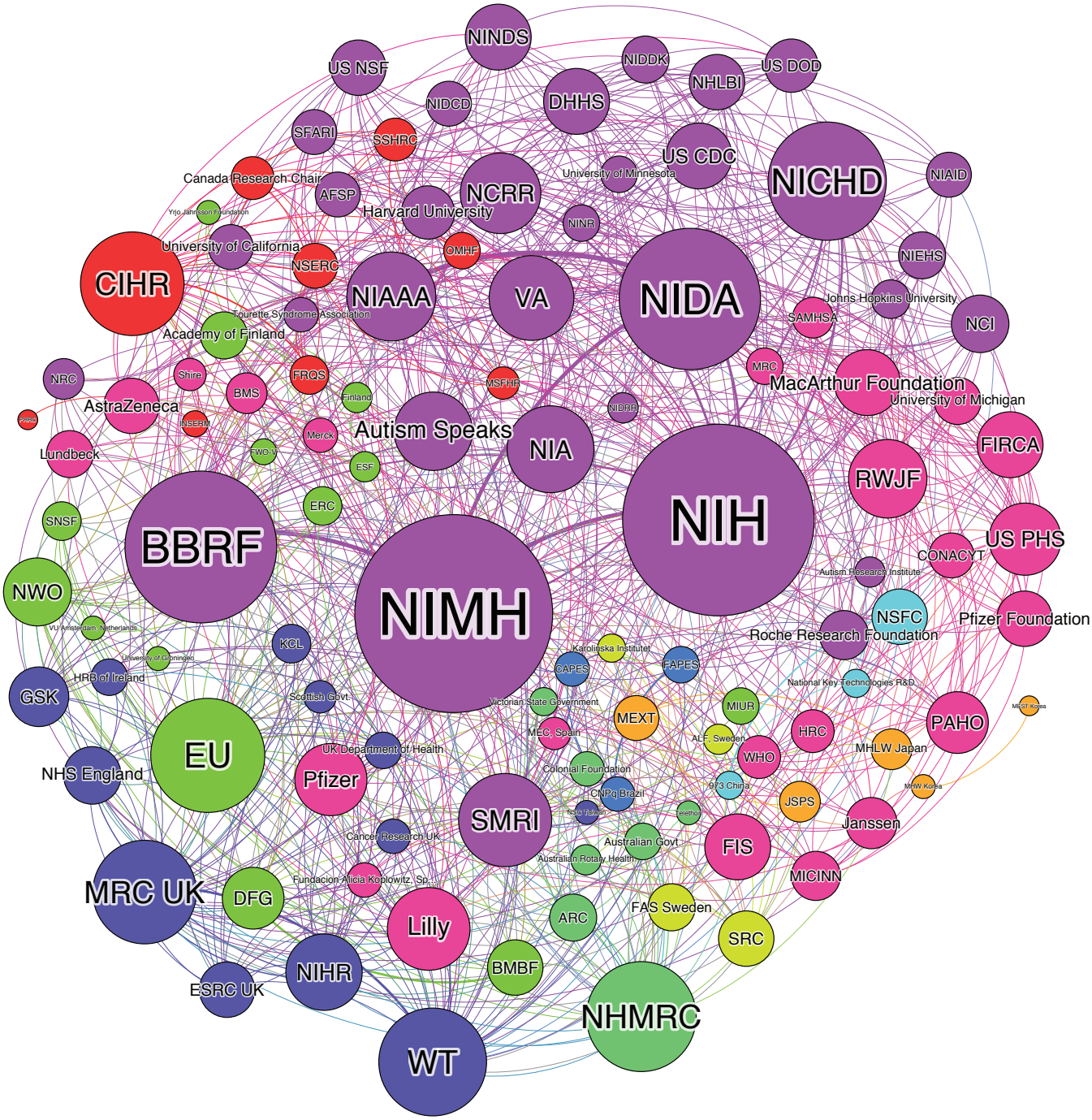
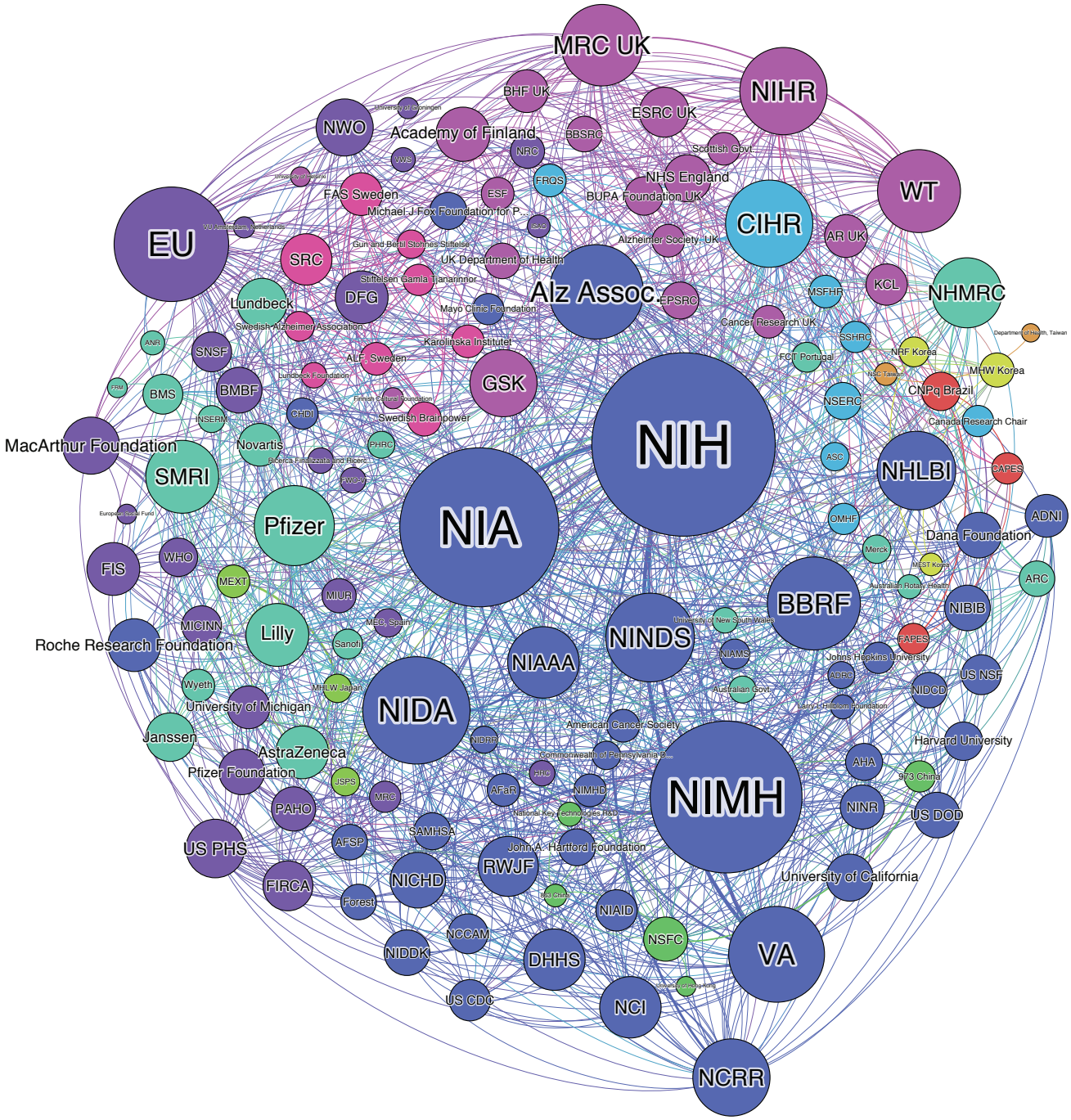


Figure 2-23
Network of co-acknowledged funders – "Aged" and "middle aged" categories in MeSH (coloured by modularity class)



Chapter 3 What does the future hold?

Key points

1. Most funders we spoke to expressed a desire to widen existing collaborations and develop new relationships and some discussed particular research areas which they plan to prioritise.
2. Some funders talked about plans to increase their evaluation activities beyond measuring immediate outputs, while none expressed plans to decrease evaluation.
3. Challenges were highlighted in relation to:
   - Maintaining funding levels, in light of a decline in industry support and pressure on public spending.
   - Working in a field which is complex and fragmented, both in terms of the stakeholder groups involved and the research areas and approaches employed.
   - Translating research into practice and effectively scaling up the resulting interventions.
4. Opportunities identified included:
   - Increasing collaboration, including working with different stakeholder groups and across sectors.
   - Developing shared definitions and classification systems to promote collaboration and facilitate advocacy.
   - Capitalising on mental health being a priority area for some governments.
   - Developing a key role for non-governmental funders in taking a long-term view on priorities and filling gaps in funding.
   - Using new technologies, such as new research tools and data sharing platforms, to support the researchers they fund and facilitate collaboration and shared working.

3.1 Overview of deep dives

We carried out in-depth reviews of a sample of funders to explore current practices and future plans, in terms of amounts, types, mechanisms and areas of funding (as described in Section 1.2). Our aim in selecting this sample was to cover the major funders globally, as well as in Canada and the UK specifically, while at the same time ensuring diversity in the organisations covered. Our set of 32 profiles comprises organisations of different sizes; from government, charitable and industry sectors; focused on different types of research (basic, applied, translational, health services, etc.); of different ages; and with different ways of working. In addition, all willing members of the International Alliance of Mental Health Research Funders were covered. The organisations included are set out in Table 3-1 (asterisks indicate members of the International Alliance of Mental Health Research Funders, as of April 2015).

The deep dive profiles were built up from interviews, desk research and analysis of the bibliometric data. We looked at aspects of research funding including areas and mechanisms of funding, collaborations, evaluation practices and strategy development, in each case looking at both current practices and future plans. The full set of funder profiles has been published alongside this report, while the interview protocol used is provided in Appendix A.

Six cross-cutting themes emerged from our analysis. The first of these (research areas and definitions) was a topic we planned to explore further with funders from the outset, given the challenges we faced in the first phase of this study in defin-

Table 3-1
Funders included in deep dive profiles

	Funder	Location	Sector	Research focus
1	AIHS *	Canada	Government	Health general
2	Alz Association	US	Charity/ Foundation/ Non-profit	MH condition
3	BBRF *	US	Charity/ Foundation/ Non-profit	MH general
4	Beyondblue	Australia	Charity/ Foundation/ Non-profit	MH condition
5	BHF	UK	Charity/ Foundation/ Non-profit	Other non-MH area
6	BMBF	Germany	Government	General
7	CIHR *	Canada	Government	Health general
8	CNPq Brazil	Brazil	Government	General
9	ERC	EU	Government	General
10	ESRC	UK	Government	Non-health
11	Fondation FondaMental *	France	Charity/ Foundation/ Non-profit	MH general
12	FRQS *	Canada	Government	Health general
13	GBF *	Canada	Charity/ Foundation/ Non-profit	MH condition
14	Grand Challenges Canada *	Canada	Government	Health general
15	Lundbeck Foundation *	Denmark	Charity/ Foundation/ Non-profit	Health general
16	MHRUK	UK	Charity/ Foundation/ Non-profit	MH general
17	Movember *	Australia	Charity/ Foundation/ Non-profit	Health general
18	MQ *	UK	Charity/ Foundation/ Non-profit	MH general
19	MRC	UK	Government	Health general
20	NHMRC *	Australia	Government	Health general
21	NIDA	US	Government	MH condition
22	NIHR *	UK	Government	Health general
23	NIMH *	US	Government	MH general
24	NSF	US	Government	General
25	OBI	Canada	Government	MH general
26	OMHF *	Canada	Government	MH general
27	Pfizer	US	Industry	Health general
28	Stanley Medical Research Institute	US	Charity/ Foundation/ Non-profit	MH condition
29	VA	US	Government	Health general
30	Wellcome Trust *	UK	Charity/ Foundation/ Non-profit	Health general
31	YAWCRC *	Australia	Charity/ Foundation/ Non-profit	MH general
32	Zon MW	Netherlands	Government	Health general

ing the mental health field. The other five themes emerged from a cross-cutting analysis of the deep dive reviews as the topics which seemed the most pertinent in the field at this time. The six themes are:

i. **Research areas and definitions**
   As noted above, there is no agreed definition of mental health, although a number of diagnostic or research classification systems exist. This theme looks at funders' reasons for using (or not using) a particular definition and compares their portfolios of research by topic, as found in our data set.
ii. **Attitudes to collaboration**
   While conducting research is becoming increasingly collaborative, less is known about collaboration between funders. This theme explores funders' attitudes to different kinds of collaboration in mental health and considers some of the opportunities and challenges associated with collaborative working in this area.
iii. **Types of funding**
   Research funders support research through a variety of funding vehicles (grants, fellowships, etc.) and differ in the degree to which they specify research topics and aims. This theme discusses the types of funding provided by funders in our sample and highlights a number of examples of less common practices in the field.
iv. **Strategy development**
   The funders in our sample vary in how they develop and implement their strategies. This theme considers some of the ways in which strategies differ, including their level of formality, how broad or targeted they are and the stakeholders involved in their development.
v. **How funding decisions are made**
   Deciding which research applications to support is an important and often resource-intensive task for funders. This theme looks at the decision-making processes used by the funders in our sample, including the kinds of criteria used and the stakeholders involved.
vi. **Evaluation practices**
   Most research funders carry out some evaluation of the research they fund. This theme summarises the range of approaches employed by funders in our sample, in terms of their reasons for evaluating, the indicators and methods they are using and their future plans in this area.

These themes have been written up as a set of six short analyses, each discussing the range of practices observed across our set of 32 funders. They are provided alongside this report to accompany the deep dive profiles (available at www.randeurope.org/mental-health-ecosystem).

In the sections that follow we focus on future plans, challenges and opportunities, summarising information collected for the funder deep dives from interviews and document review.

3.2 Views on the future

An important part of the deep dive profiles was to explore the future plans of our sample of funding organisations. In doing so we hoped to be able to highlight areas of complementarity and potential collaboration, as well as compare the anticipated challenges and opportunities of organisations of different sizes and in different sectors and countries.

The interviews revealed that among many funders, particularly government agencies, there is uncertainty around the level, distribution and research focus of future funding, often due to an obligation to align with potentially-shifting government priorities or a dependency on uncertain funding allocations. Nevertheless, some organisations did highlight areas of focus for future investment. Funders including MQ in the UK and CIHR in Canada mentioned a greater emphasis on youth mental health, something which is already a priority area for some of the other funders in our sample (e.g. the Graham Boeckh Foundation, Young and Well CRC). Given the early age of onset of many mental health conditions, this is consistent with an increasing focus on the prevention of mental illness, as mentioned by others including beyondblue. Another area of growing interest is the use of technology in mental health, both in terms of the potential benefits for research of advances in big data and bioinformatics and in relation to e-health and the development of technology-based treatments. The importance of new technologies is discussed further below.

Most funders we spoke to plan to expand current collaborations with other funding organisations and develop new relationships. In some instances, such arrangements were seen as a way to extend an individual organisation's reach (e.g. OMHF), while in others, and particularly in relation to collaborations with private sector organisa-

tions, they were seen as a valuable way of diversifying the research funding base and potentially facilitating translation of findings to practical application (e.g. AIHS, CNPq, NIDA). Challenges relating to both funding and research translation are discussed further below.

The final area in which a number of organisations discussed concrete plans was the expansion of evaluation practices beyond measuring outputs. This was mentioned by a range of government and charitable funders in the United States, Canada, Australia and Europe. An increasing emphasis internationally on demonstrating impacts beyond the generation of knowledge has created a pressing need for both researchers and funders to think beyond traditional academic outputs, but measuring downstream impacts, which often occur over long timescales, across a broad portfolio of funded work is not a straightforward task. The challenges in linking impacts to specific funding are discussed further in Chapter 4.

Challenges are anticipated in relation to funding, the diversity of the field and research translation

Funding organisations globally are facing challenges in maintaining (sufficient) funding for mental health research, with the largest mental health-specific funder in the world, NIMH, commenting that it has lost more than 20 per cent of its purchasing power in the past ten years. Several organisations mentioned the importance of protecting funding by engaging government and demonstrating the potential benefits of mental health research, while others mentioned the crucial role that other sectors can play. In particular, many highlighted the need for greater private sector funding to offset reduced government support, while also noting that, in contrast to this, the trend has been for investment from the pharmaceutical industry to decline in recent years (e.g. Insel & Gogtay 2013). Limited resources also create the challenge of how best to allocate funding, with some organisations finding it challenging to make decisions on which areas are most likely to produce the greatest benefits and how to balance their portfolios between, for example, research focused on treatment versus prevention, or between pharmacological and psychosocial approaches to therapy.

The challenges of allocation and selection are accentuated by the diversity of the mental health field and the complexity of the issues that research is trying to address. Often the precise mechanisms underlying particular conditions are unknown, meaning that the most promising research targets or approaches are unclear. As shown in our analysis in Chapter 2 and in the deep dive profiles, research from many different areas can be relevant to mental health and the funding organisations supporting such work vary in their scale, remit and approach. This fragmentation, along with silos and barriers between different groups of stakeholders, creates challenges in maintaining an awareness of the current state of the field as a whole, in identifying gaps and opportunities and in raising the profile of mental health research generally.

Finally, a number of organisations, particularly in Canada and the UK, highlighted difficulties in facilitating the practical application of research findings in improving mental health services. Some commented that insufficient funding is available for research in this area, while it was also mentioned that when successful interventions are identified, it is not easy to scale them up in the mental health care system.

Opportunities may exist in increased collaboration, developing shared definitions, capitalising on government priorities, the key role of non-governmental organisations and advancing technology

Most funders contacted in compiling the deep dive profiles expressed a desire (or willingness) to work with other organisations and often this was seen as a way of overcoming the fragmented nature of the mental health field. Suggested forms of collaboration or cooperation include sharing expertise on grant selection processes and peer review, sharing research data or findings and working more closely with other stakeholder groups. A variety of stakeholders were mentioned, including the involvement of patient and family groups and the creation of stronger links among researchers, but also the potential benefits of working with organisations in related sectors. The fact that mental health issues both affect other sectors and are influenced by developments in other sectors suggests that building collaborations with actors in areas such as education and the justice system may be beneficial (e.g. WHO 2013).

It was suggested by some interviewees that collaboration would be aided by developing a clearer, shared classification system and set of definitions. Our deep dive reviews revealed that the majority of funders do not use a working definition of mental health. While some may not need a definition for their own funding activities (for example, if they focus on one particular mental health condition), having a definition may facilitate discussions with other organisations and support the sharing of comparable data. Common definitions might also be a useful tool for advocacy and assist in raising the profile of the mental health field as a whole in a coherent way. International initiatives, such as the International Alliance for Mental Health Research Funders, were considered as valuable tools for sharing progress and ideas internationally, while also potentially having a role in instigating efforts to develop and refine common definitions.

Several interviewees commented that mental health is gaining prominence and rising up the policy agenda in their locations (for example, this was mentioned specifically in Australia and Quebec). In these instances, funders emphasised the importance of capitalising on current government priorities to boost investment in mental health research. Similarly, the nationwide BRAIN initiative (Brain Research through Advancing Innovative Neurotechnologies) in the United States was mentioned as an indicator of the prominence of neuroscience in government priorities and an important opportunity for a range of funding organisations to collaborate and raise the profile of mental health research.

A particular opportunity was mentioned for charities, foundations and non-profits in the face of pressures on government budgets and a decline in pharmaceutical industry investment in mental health. Free from the constraints of government policy and budget cycles, non-government organisations may be able to 'fill the gaps' and take a longer-term view of priorities and initiatives that might take time to become established. One funder also mentioned that opportunities may arise from a growing level of philanthropic support specifically for research in mental health in the United States, commenting that in the past such funding tended to be targeted more towards service delivery.

Finally, as previously mentioned, a number of funders highlighted opportunities arising from advances in technology. Such progress has the potential to impact on a number of areas, including new research tools and alternative treatment options, but may also bring particular opportunities for sharing research data and findings and carrying out comparative analysis of large data sets. Several funders mentioned that they now have policies on making available on public platforms the data generated by funded research. In terms of shedding light on the global research funding landscape, new tools have the potential to allow powerful analytical approaches to mapping funding flows and linking funding with the subsequent outputs and impacts of research. This is discussed further in Chapter 4.

Chapter 4 What next?

Key points

1. This study contributes to elucidating the mental health research funding landscape and advancing our understanding of bottom-up approaches to mapping research systems.
2. Advances in technology and increasing availability of data have allowed, and continue to allow, new and/or more comprehensive approaches to mapping research funding to be developed.
3. Significant technical, conceptual and cultural challenges remain in improving the accuracy and completeness of data, developing commonly understood definitions in the mental health field to facilitate comparisons and causally linking data on funding flows to the longer term outcomes and impacts produced by research.

This report provides the first global view of the mental health research funding landscape of which we are aware. In doing so, it should help organisations that fund mental health research, by highlighting opportunities for collaboration, as well as exploring the diversity of practice in terms of setting strategy, selecting research to fund and evaluating its impacts. We also looked to the future by investigating the future plans of a sample of key funders.

However, this is only a snapshot of mental health research – this chapter considers how to build on this work and discusses the opportunities provided by new technologies in data collection and aggregation.

To understand the nature and dynamics of a research field it is necessary to understand the funding flows and the behaviour of the funders within it and to link this to the outputs and impacts from the research that is supported – over the long term the societal benefits it brings, and as a short term measure the knowledge produced and disseminated through publications. In previous studies we have explored the outputs and impacts of mental health research (Larivière et al. 2013; Wooding et al. 2013). This report looks at the 'other side of the coin', mapping the funding flows and investigating funder behaviour. The challenge that remains is to link this information together to show the causal links and identify how particular funding produces particular impacts.

Mapping funding flows

Mapping the flows of funding in a research system is conceptually simple: it involves cataloguing all the money that is spent on research and identifying what it is used for. What complicates the task is the diversity of research funders, the many different ways research is supported and, in the case of mental health, the nebulous nature of the field. As the availability of data has improved and technology has developed, different approaches have become feasible – and we are currently on the cusp of further change.

As described in Chapter 1, a number of previous studies aiming to map research funding have done so by identifying the major research funders in a particular field or locality and manually collating information about their funding portfolios (e.g. CIHR 2014, MQ 2015). This approach has the major advantage of allowing monetary values to be linked to funding awards, topics, institutions and so on. Many funders also categorise their awards according to defined classi-

fication schemes, allowing a detailed analysis of the types and areas of research supported. However, such an approach may not always facilitate a straightforward comparison or aggregation across organisations, due to differences in the classification approaches used. For example, in the mental health field, research might be categorised by condition, therapeutic area, methodological approach, or another research dimension. A top-down approach to defining the research field can also overlook smaller funders and larger funders who may not consider mental health within their primary remit, but nevertheless might support substantial work in mental health (e.g. the British Heart Foundation), in particular interdisciplinary or cross-condition research.

Bottom-up approaches to mapping

An alternative approach, and the one taken in this study, is to build a map of funding from the bottom up, aiming to find funding relevant to mental health, irrespective of the field or remit of the organisation supporting it. This has become easier in recent years with the systematic recording of funding acknowledgement information in Web of Science. Publications also have the additional advantage of linking information on funding to a range of other data points, including authors, location, topics and citations, and defining the mental health field based on topics of publications ensures that a consistent definition is used across all research funders. We highlighted a number of potential limitations of this approach in Chapter 1, particularly around the inconsistent naming of organisations and, due to the relatively recent introduction of the indicator, the absence of acknowledgement information in a significant number of papers. A further question remains around the extent to which the volume of acknowledgements can be considered a proxy for the amount of money provided: can acknowledgements represent a 'common currency'? It is, for example, unclear how relative levels of funding compare between a paper with a single funder acknowledged and a paper with a number of different organisations named. Similarly, the number of publications per grant or 'cost' per publication may well differ between disciplines or for different types of funding vehicle. Bibliometric data alone is not yet sufficient to provide answers to these questions. While we attempted to address these questions by comparing data for key funders with data provided by ÜberResearch (see below for details on ÜberResearch's approach), the comparisons were hindered by differences between the definitions of mental health used in our data set and available in the ÜberResearch database.

Collation-based approaches to mapping

In recent years, the increased use of standardised electronic systems by funders, the increased power of computers and a greater willingness to share data has seen the development of a new approach to mapping research funding, whereby award data from multiple funders is combined. Layers of meta-data are then added to the database, for example research classification systems based on textual analysis of titles, abstracts and keywords, to provide consistent analysis for all funders across the combined data set (ÜberResearch's *Dimensions* tool is an example of such an approach[11]). By collating data at a macro level, independent of any one funder's constructs, such approaches have the potential to provide comprehensive information across a field on both the structure of funding flows and the amounts of funding involved, but will require the cooperation of funders in providing their data to achieve this. In the future, by incorporating acknowledgement data and hence combining top-down (funder-driven) and bottom-up (publication-driven) approaches, it may also become possible to elucidate more clearly the links between the inputs to and outputs from a research system.

Significant technical, conceptual and cultural challenges remain

While advances in technology and data availability have provided opportunities for new approaches and tools in mapping research funding, there are still a number of challenges in constructing a comprehensive and reliable picture of the funding landscape.

First, while some forms of funding, such as project grants and fellowships, are relatively easy to recognise, other sources of research support are more challenging to identify and quantify. In our data set, the funding acknowledgements referring

[11] www.uberresearch.com/dimensions-for-funders/ (as of 17 October 2015)

to academic institutions may in part have reflected block funding provided to universities, but this is not something universally recognised in publications and our survey of researchers revealed that few acknowledge support such as estate costs or the provision of equipment. Although this may pose difficulties in assessing the overall scale of funding and the relative contributions of different actors, it does not substantially detract from the utility of such mapping exercises in showing where funders complement and overlap one another, or where opportunities exist for greater cooperation.

A more pressing issue may be the common difficulty found across all approaches in establishing where to draw the boundaries around mental health research and how to define areas within it. This clearly presents challenges for an exercise such as this one, which relies on identifying a valid data set on which to base the mapping.

Beyond this technical challenge, though, our observation that there is no agreed definition of mental health among research funders underlines that this challenge also exists at a more conceptual level and is reflected in the way that different people and organisations define their objectives, develop their strategies and talk about mental health research. Not every funder needs to use the same set of definitions in their daily operations. Indeed, it is important to acknowledge that no single system is likely to suit all funders and that there are no formal boundaries between fields in an increasingly interdisciplinary research world. However, a common perception of the landscape and robust definitions which can be shared with others would allow funders to compare their own portfolios with those of others, helping them better understand the context in which they are working and the opportunities that exist within it.

Finally, looking beyond the inputs and immediate outputs of the research process, there is increasing emphasis internationally on understanding and measuring the downstream impacts of research. While publications can relatively easily be formally attributed to particular grants and hence funders, it is far more difficult to accurately attribute societal impacts in a systematic and comprehensive way. Doing so requires identifying both the impact itself and the pathway by which it was achieved – which may cover a significant period of time, given the length of time it can take for impacts to be produced (e.g. Hanney et al. 2015). Tools such as *Researchfish*,[12] which allows researchers to record a range of different kinds of impacts (in addition to academic outputs) in relation to individual pieces of funding, have the potential, if widely adopted, to catalogue comprehensive and consistent data. However, their utility is dependent on researchers reporting the impacts that have occurred and funders providing suitable training and support. Challenges remain around determining the relative contributions of individual pieces of funding to the achievement of an impact, particularly those arising over longer periods of time.

Concluding thought

In this study we set out with ambitious aims to comprehensively map the global mental health research funding ecosystem. Although we acknowledge that the approach taken is imperfect and that results should be interpreted with its limitations in mind, we believe that it makes an important contribution to both elucidating the mental health research funding landscape and advancing our understanding of bottom-up approaches to mapping research systems. Driven by a need to better understand the returns generated by specific research funding and advances in the technology, tools and data available to explore the research ecosystem, we hope that this is a step towards further progress in the coming few years.

[12] www.researchfish.com (as of 17 October 2015)

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Annex 1 – Canada

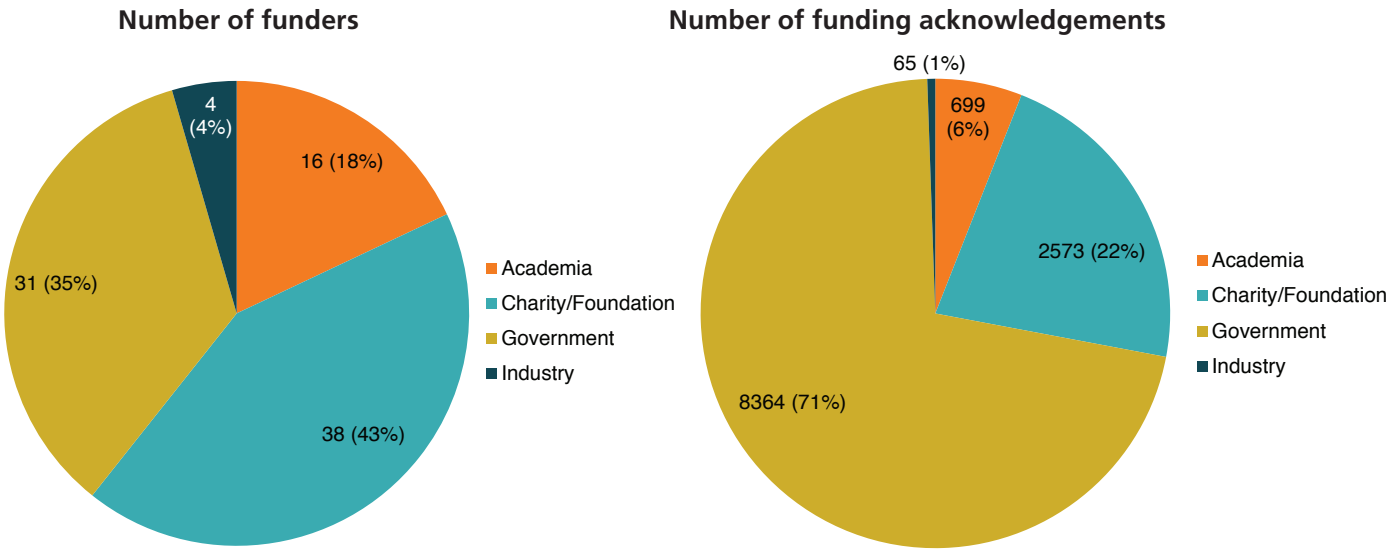
Our data set includes 10,894 papers with a corresponding author located in Canada. This is 5.7 per cent of the global mental health output in the period 2009–2014.

Ninety of our core group of 1,908 funders are Canadian organisations, the breakdown of which by sector is shown in Figure A1-1 below. Canadian funders are acknowledged on 6,077 papers during our time period. As we observe in the data set as a whole and on a similar scale to the global picture, government funders appear to typically fund more mental health research than charities, foundations and non-profits – an average of 270 acknowledgements per government funder, compared with 68 per charity, foundation or non-profit.

The ARC of Canadian-funded papers is slightly higher than in the overall data set, a result which is observed across each of the funding sectors (see Figure A1-2 below).

The most frequently acknowledged Canadian funders are shown in Table A1-1 below.

Figure A1-1
Breakdown of number of Canadian funders and funding acknowledgements by funder sector[13]



[13] Note that one funder acknowledged was a publisher, accounting for 11 acknowledgements

Figure A1-2
Average relative citations by funder sector – Canada

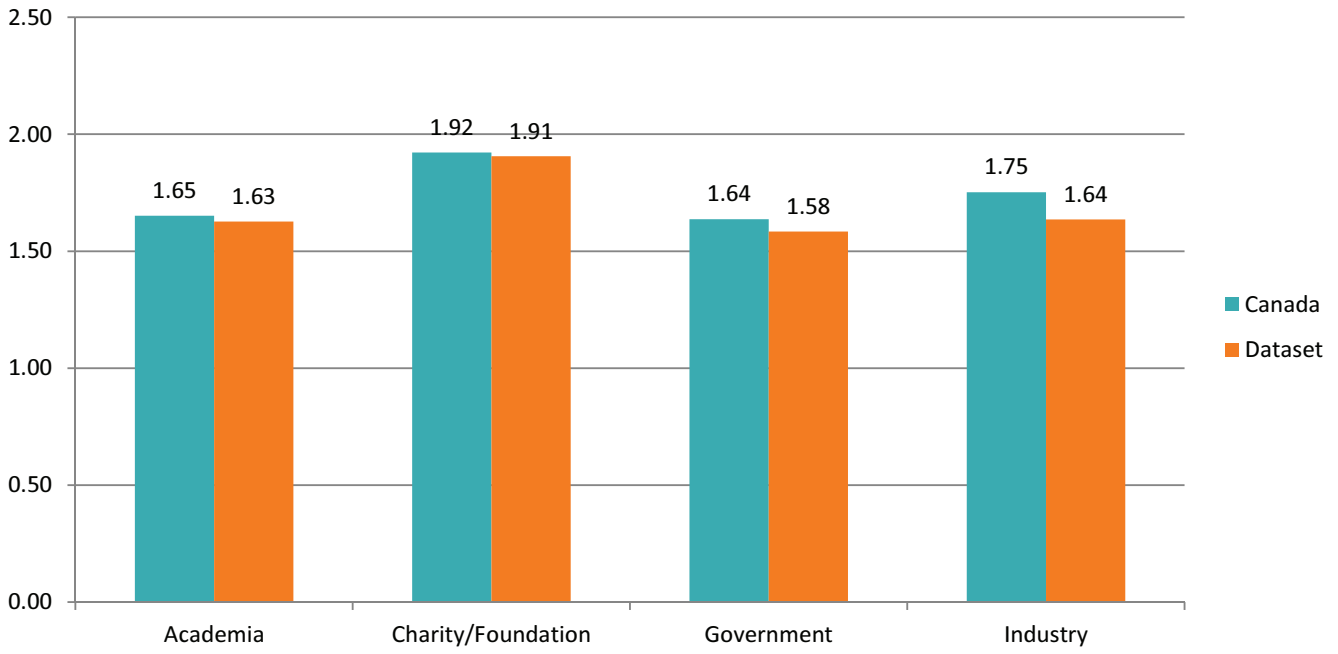


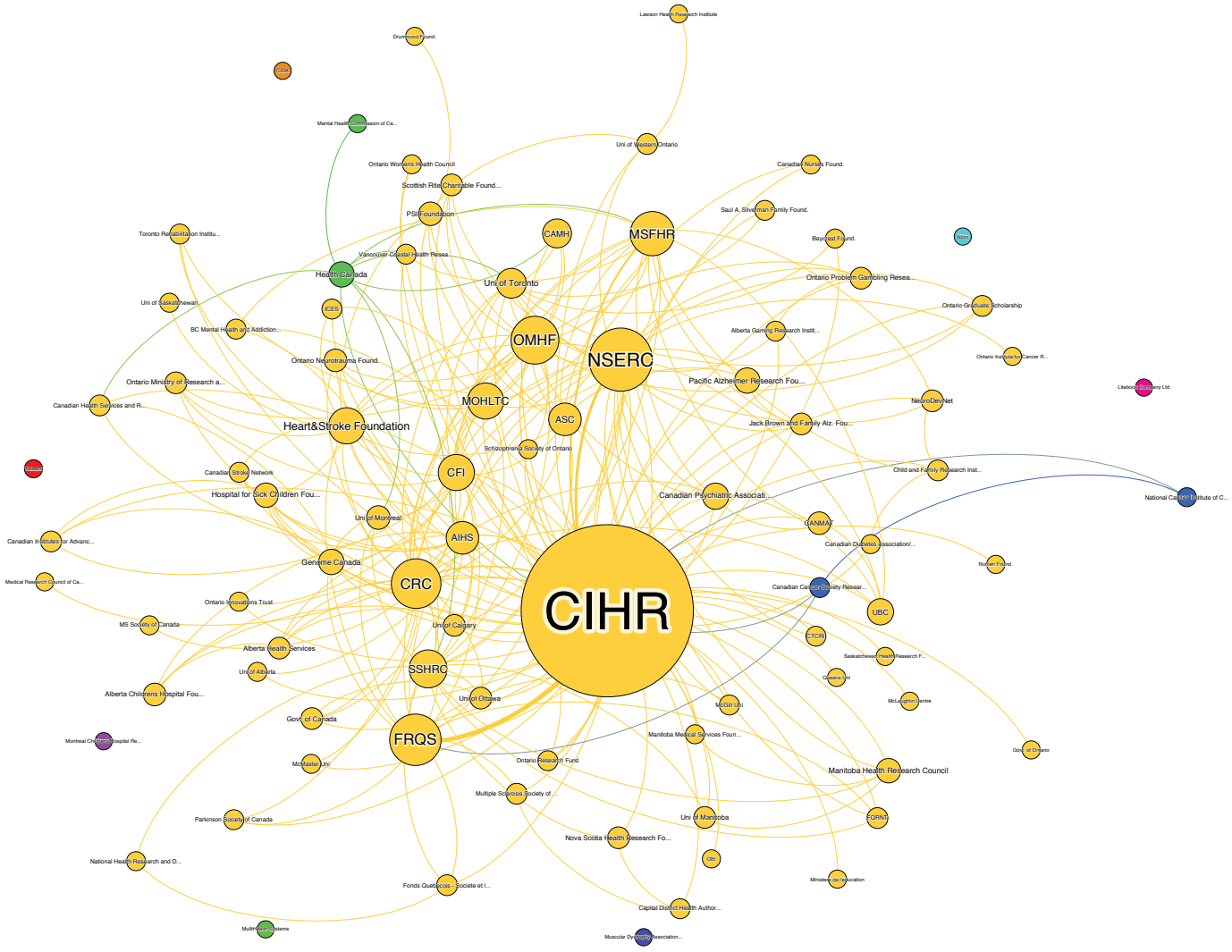
Table A1-1
Top 30 funders in Canada

Rank	World rank	Funder	No. of papers	Sector	Proportion of Canadian papers	Proportion of global papers
1	5	Canadian Institutes of Health Research (CIHR)	4701	Government	77.4%	4.2%
2	42	Fonds de recherche en santé du Québec (FRQS)	838	Government	13.8%	0.7%
3	47	Natural Sciences and Engineering Research Council of Canada (NSERC)	784	Government	12.9%	0.7%
4	75	Canada Research Chair	446	Government	7.3%	0.4%
5	83	Michael Smith Foundation for Health Research (MSFHR)	391	Charity/ Foundation	6.4%	0.3%
6	93	Ontario Mental Health Foundation (OMHF)	342	Charity/ Foundation	5.6%	0.3%
7	104	Social Sciences and Humanities Research Council (SSHRC)	296	Government	4.9%	0.3%
8	115	Ontario Ministry of Health and Long-Term Care (MOHLTC)	258	Government	4.2%	0.2%
9	121	Alzheimer Society of Canada (ASC)	247	Charity/ Foundation	4.1%	0.2%
10	125	Alberta Innovates Health Solutions (AIHS)	242	Government	4.0%	0.2%

Rank	World rank	Funder	No. of papers	Sector	Proportion of Canadian papers	Proportion of global papers
11	136	Canada Foundation for Innovation (CFI)	228	Charity/ Foundation	3.8%	0.2%
12	152	Heart and Stroke Foundation, Canada	202	Charity/ Foundation	3.3%	0.2%
13	253	Canadian Psychiatric Association Foundation	119	Charity/ Foundation	2.0%	0.1%
14	254	Manitoba Health Research Council	119	Government	2.0%	0.1%
15	262	University of British Columbia (UBC)	114	Academia	1.9%	0.1%
16	274	University of Toronto	110	Academia	1.8%	0.1%
17	289	Genome Canada	106	Charity/ Foundation	1.7%	0.1%
18	296	Centre for Addiction and Mental Health (CAMH)	104	Academia	1.7%	0.1%
19	365	Pacific Alzheimer Research Foundation Centre	79	Charity/ Foundation	1.3%	0.1%
20	383	Hospital for Sick Children Foundation, Canada	75	Charity/ Foundation	1.2%	0.1%
21	400	Health Canada	70	Government	1.2%	0.1%
22	419	University of Montreal	66	Academia	1.1%	0.1%
23	451	University of Calgary	62	Academia	1.0%	0.1%
24	463	Muscular Dystrophy Association Canada	59	Charity/ Foundation	1.0%	0.1%
25	483	Government of Canada	56	Government	0.9%	0.0%
26	492	Ontario Ministry of Research and Innovation	55	Government	0.9%	0.0%
27	493	Canadian Tobacco Control Research Initiative (CTCRI)	55	Charity/ Foundation	0.9%	0.0%
28	514	Nova Scotia Health Research Foundation	52	Charity/ Foundation	0.9%	0.0%
29	521	Ontario Graduate Scholarship	51	Government	0.8%	0.0%
30	526	Canadian Cancer Society Research Institute	51	Charity/ Foundation	0.8%	0.0%

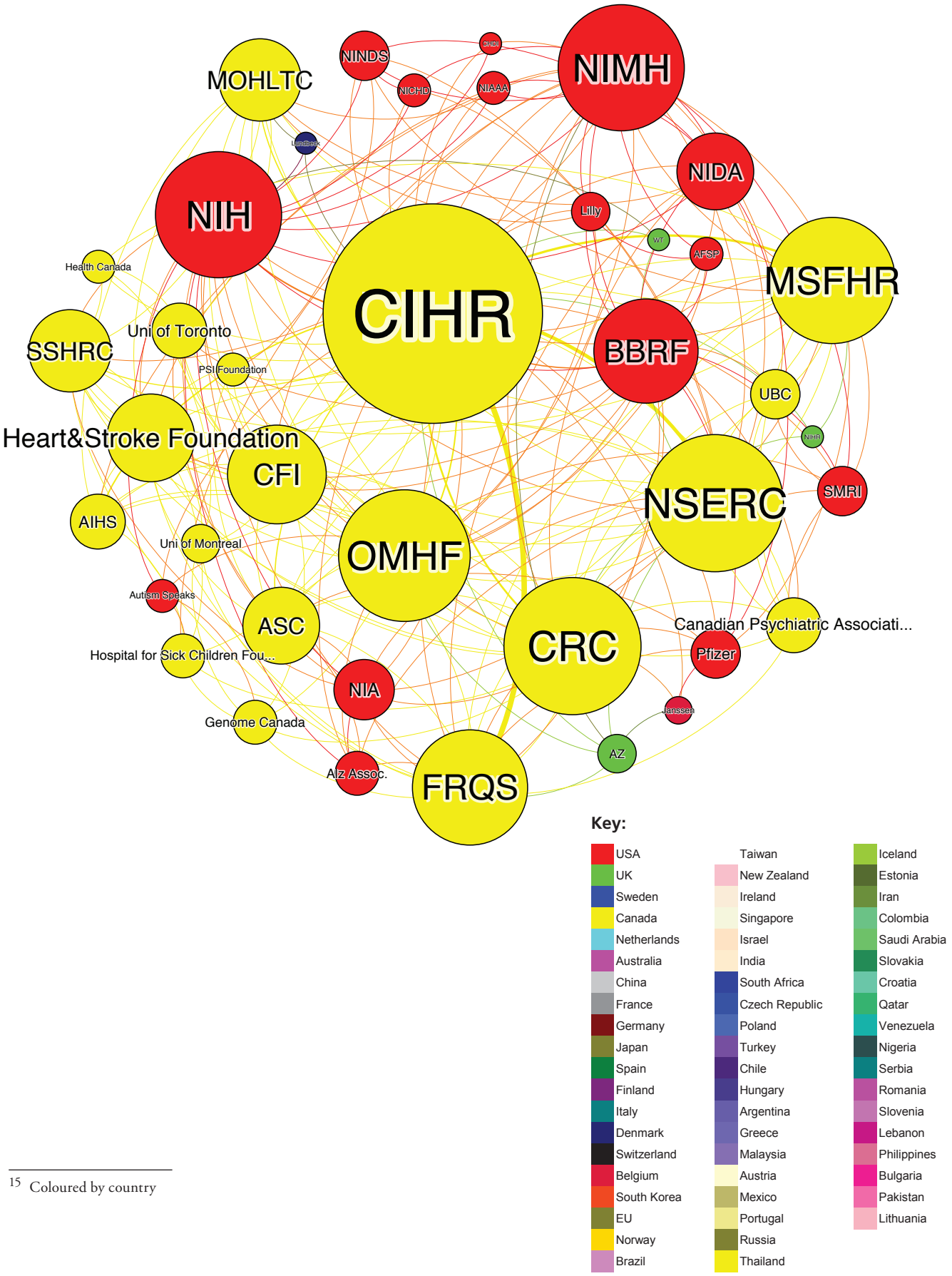
As for the global research landscape, we also developed network maps for Canada showing, firstly, all Canadian funders based on their co-acknowledgement on papers (Figure A1-3) and secondly, the funders acknowledged on papers with a Canadian address (Figure A1-4). As one would expect, CIHR dominates both networks, with the provincial research funders and other research councils also clearly visible. In Figure A1-4 we can see the relatively large involvement of US funders.

Figure A1-3
Network of co-acknowledgement of all Canadian funders[14]



14 Coloured by modularity (see Appendix A for details)

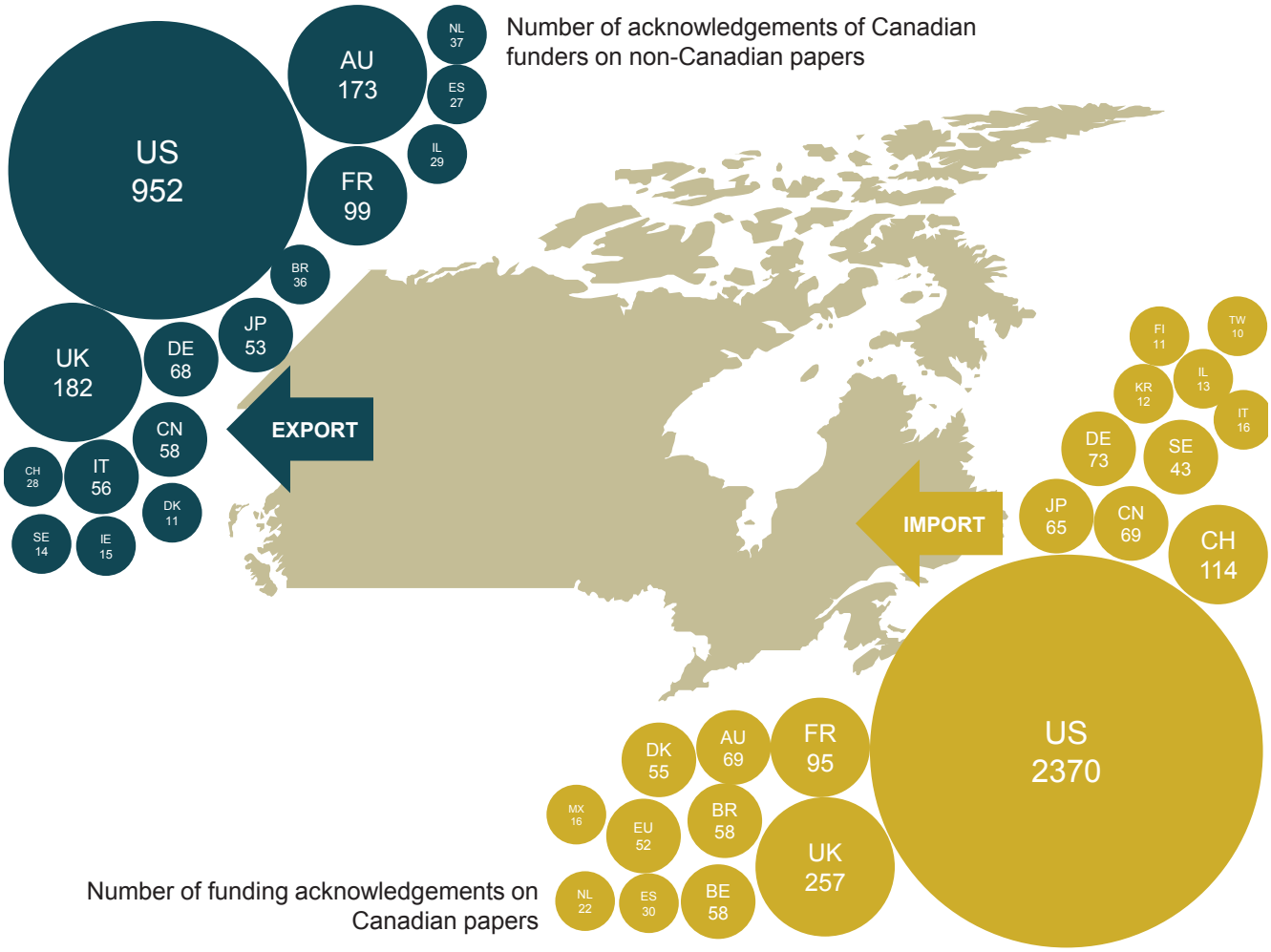
Figure A1-4
Network of co-acknowledged funders on Canadian papers in the entire mental health data set[15]



15 Coloured by country

Finally, we carried out an analysis of the flows of research funding into and out of Canada. In this we use each paper's funding acknowledgements and corresponding author address as proxies for the source and destination of research funds. In these terms, Canada is a net 'importer' making 3,592 funding acknowledgements to overseas funders on papers in our data set. The majority of these acknowledgements relate to US funding organisations. This compares with 1,910 acknowledgements of Canadian funding on papers with a non-Canadian corresponding address. Again, the largest portion of these acknowledgements correspond to papers with a US address.

Figure A1-5
Flows of research funding: (i) Canadian funders supporting papers with corresponding authors outside Canada and (ii) papers with Canadian corresponding authors acknowledging non-Canadian funding[16]



[16] Numbers represent individual acknowledgements, of which there may be more than one on a paper. Countries with ten or more acknowledgements are presented in the figure.

Annex 2 – The UK

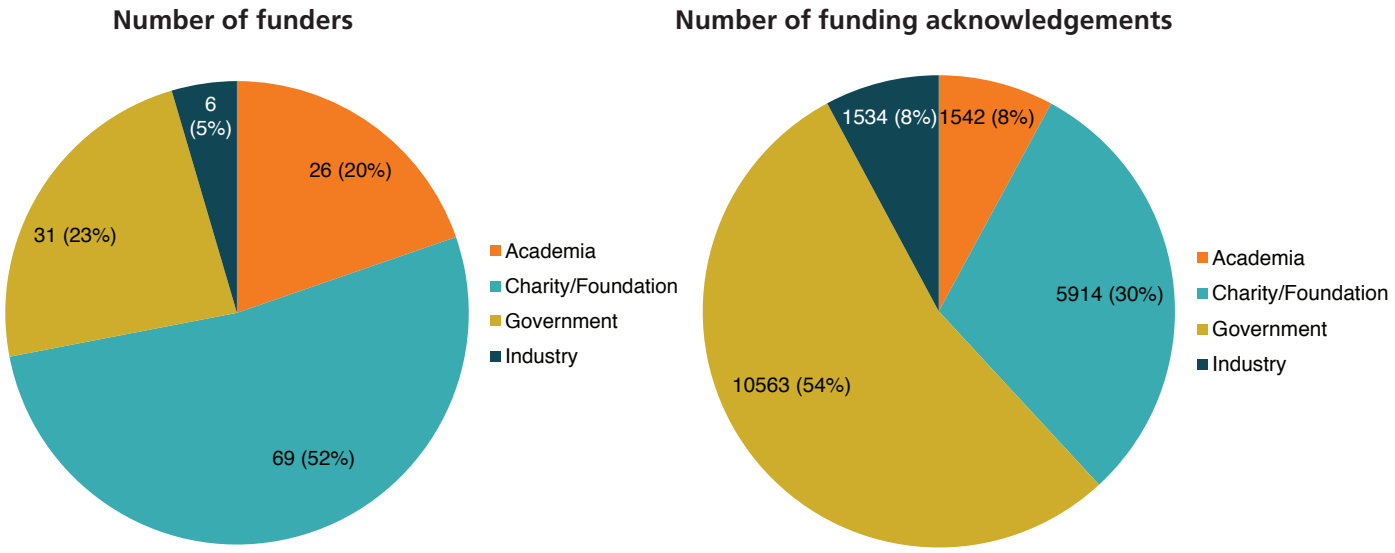
Our data set includes 18,138 papers with a corresponding author located in the UK. This is 7.9 per cent of the global mental health output in the period 2009-2014.

In our core group of 1,908 funders, 136 are UK organisations, the breakdown of which by sector is shown in Figure A2-1 below. UK funders are acknowledged on 10,257 papers in the data set. As we observe in the data set as a whole, government funders appear to typically fund more mental health research than charities, foundations and non-profits – an average of 341 acknowledgements per government funder, compared with 86 per charity, foundation or non-profit. These averages are substantially higher than the corresponding averages across the whole (global) data set.

The ARC of UK-funded papers is substantially higher than we see in the data set as a whole, although this difference is less pronounced for industry-funded research (see Figure A2-2 below).

The most frequently acknowledged UK funders are shown in Table A2-1 below.

Figure A2-1
Breakdown of number of UK funders and funding acknowledgement by funder sector[17]



[17] Note that four funders acknowledged were publishers, accounting for 122 acknowledgements

Figure A2-2
Average relative citations by funder sector – UK

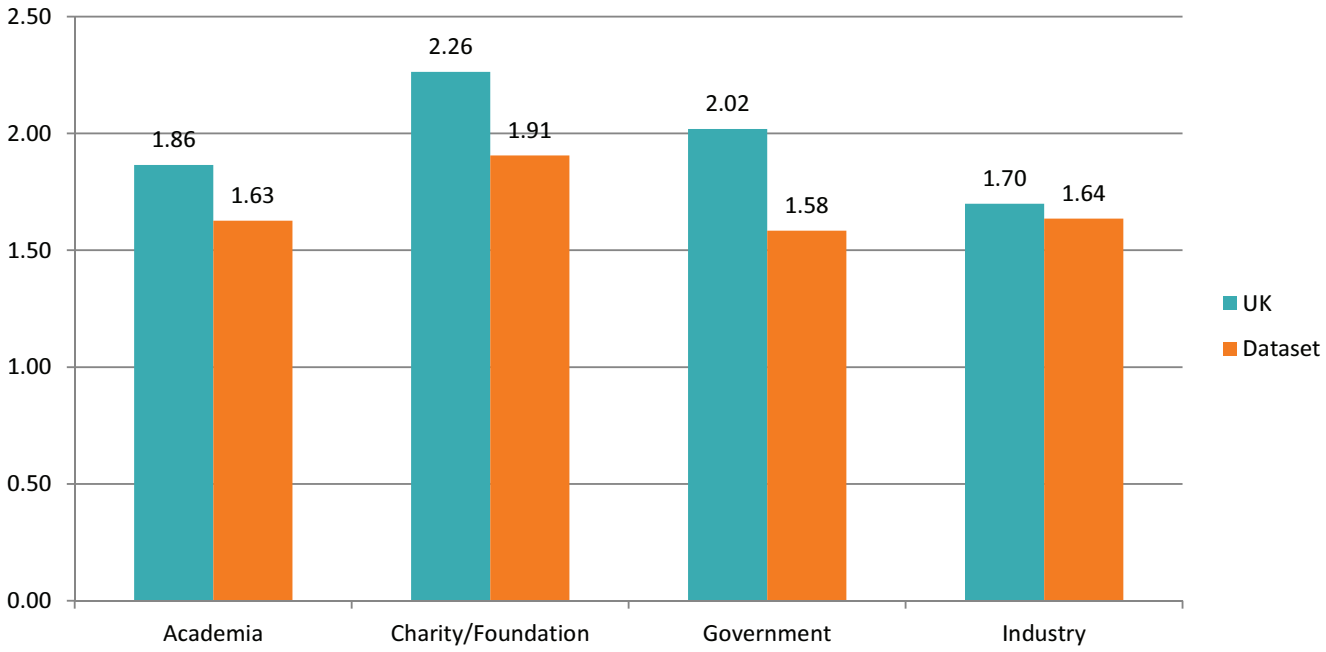


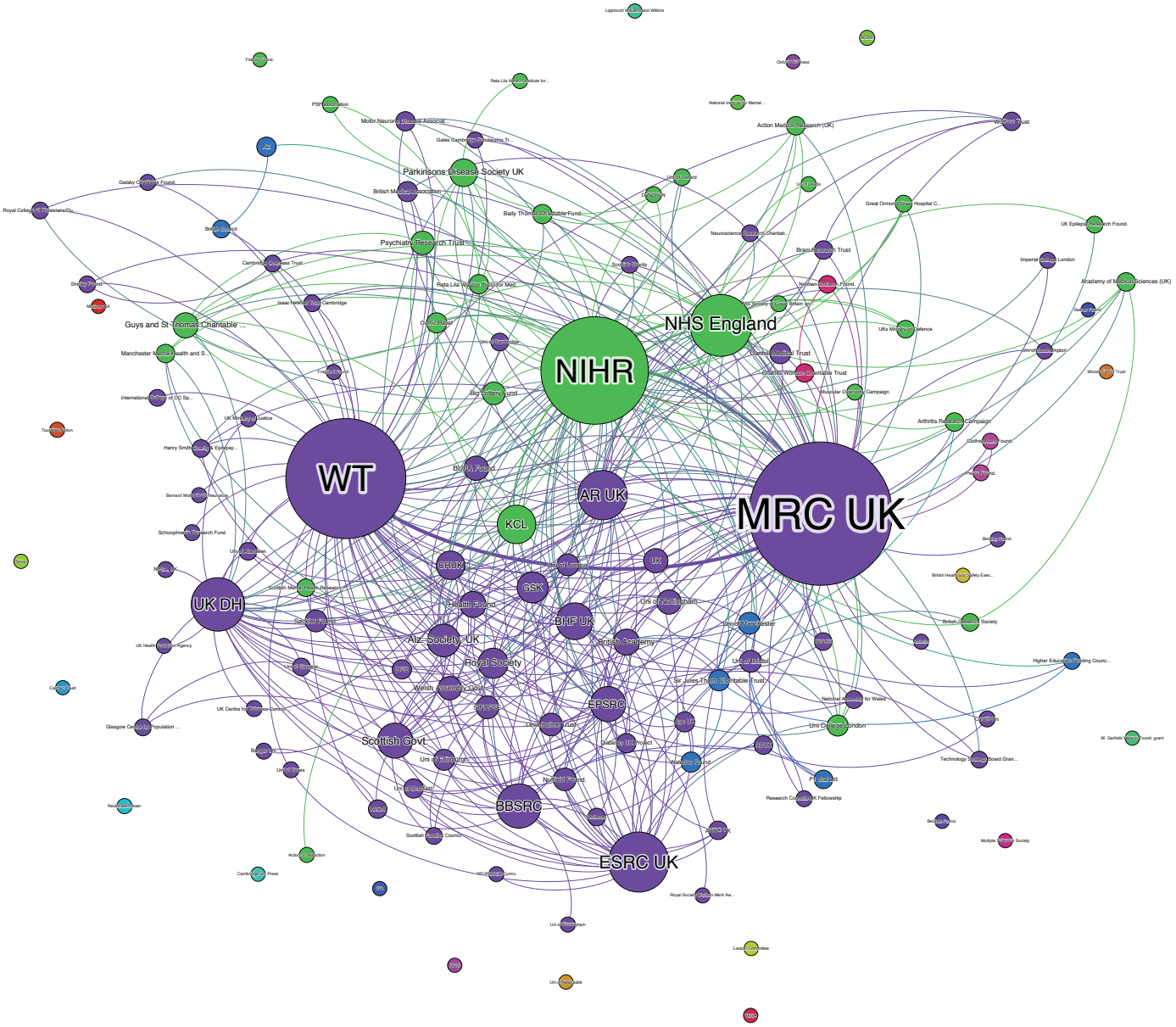
Table A2-1
Top 30 funders in the UK

Rank	World rank	Funder	No. of papers	Sector	Proportion of UK papers	Proportion of global papers
1	10	UK Medical Research Council (MRC UK)	3503	Government	34.2%	3.1%
2	13	National Institute for Health Research (NIHR)	3062	Government	29.9%	2.7%
3	15	Wellcome Trust	2434	Charity/ Foundation	23.7%	2.2%
4	31	NHS England	1126	Government	11.0%	1.0%
5	49	Economic and Social Research Council (ESRC), UK	751	Government	7.3%	0.7%
6	51	UK Department of Health	700	Government	6.8%	0.6%
7	56	GlaxoSmithKline	653	Industry	6.4%	0.6%
8	60	Kings College London (KCL)	594	Academia	5.8%	0.5%
9	62	AstraZeneca	569	Industry	5.5%	0.5%
10	65	Alzheimers Research UK	528	Charity/ Foundation	5.1%	0.5%
11	92	Biotechnology and Biological Sciences Research Council (BBSRC)	347	Government	3.4%	0.3%

Rank	World rank	Funder	No. of papers	Sector	Proportion of UK papers	Proportion of global papers
12	106	British Heart Foundation UK	290	Charity/ Foundation	2.8%	0.3%
13	123	Cancer Research UK	244	Charity/ Foundation	2.4%	0.2%
14	128	Scottish Government, Health Department	237	Government	2.3%	0.2%
15	130	Engineering and Physical Sciences Research Council (EPSRC) (UK)	237	Government	2.3%	0.2%
16	139	Alzheimer Society, UK	227	Charity/ Foundation	2.2%	0.2%
17	157	Shire Development, Inc	194	Industry	1.9%	0.2%
18	203	Royal Society	150	Charity/ Foundation	1.5%	0.1%
19	259	Health Foundation	117	Charity/ Foundation	1.1%	0.1%
20	264	Parkinsons Disease Society UK	113	Charity/ Foundation	1.1%	0.1%
21	281	British Academy	109	Academia	1.1%	0.1%
22	290	Multiple Sclerosis Society, UK	105	Charity/ Foundation	1.0%	0.1%
23	294	BUPA Foundation UK	104	Charity/ Foundation	1.0%	0.1%
24	309	University of Bristol	100	Academia	1.0%	0.1%
25	315	Guys and St Thomas Charitable Foundation	98	Charity/ Foundation	1.0%	0.1%
26	343	Sackler Foundation	87	Charity/ Foundation	0.8%	0.1%
27	346	Department for International Development (DFID), UK	86	Government	0.8%	0.1%
28	351	Psychiatry Research Trust, UK	84	Academia	0.8%	0.1%
29	363	University of Edinburgh	80	Academia	0.8%	0.1%
30	366	Stroke Association (UK)	79	Charity/ Foundation	0.8%	0.1%

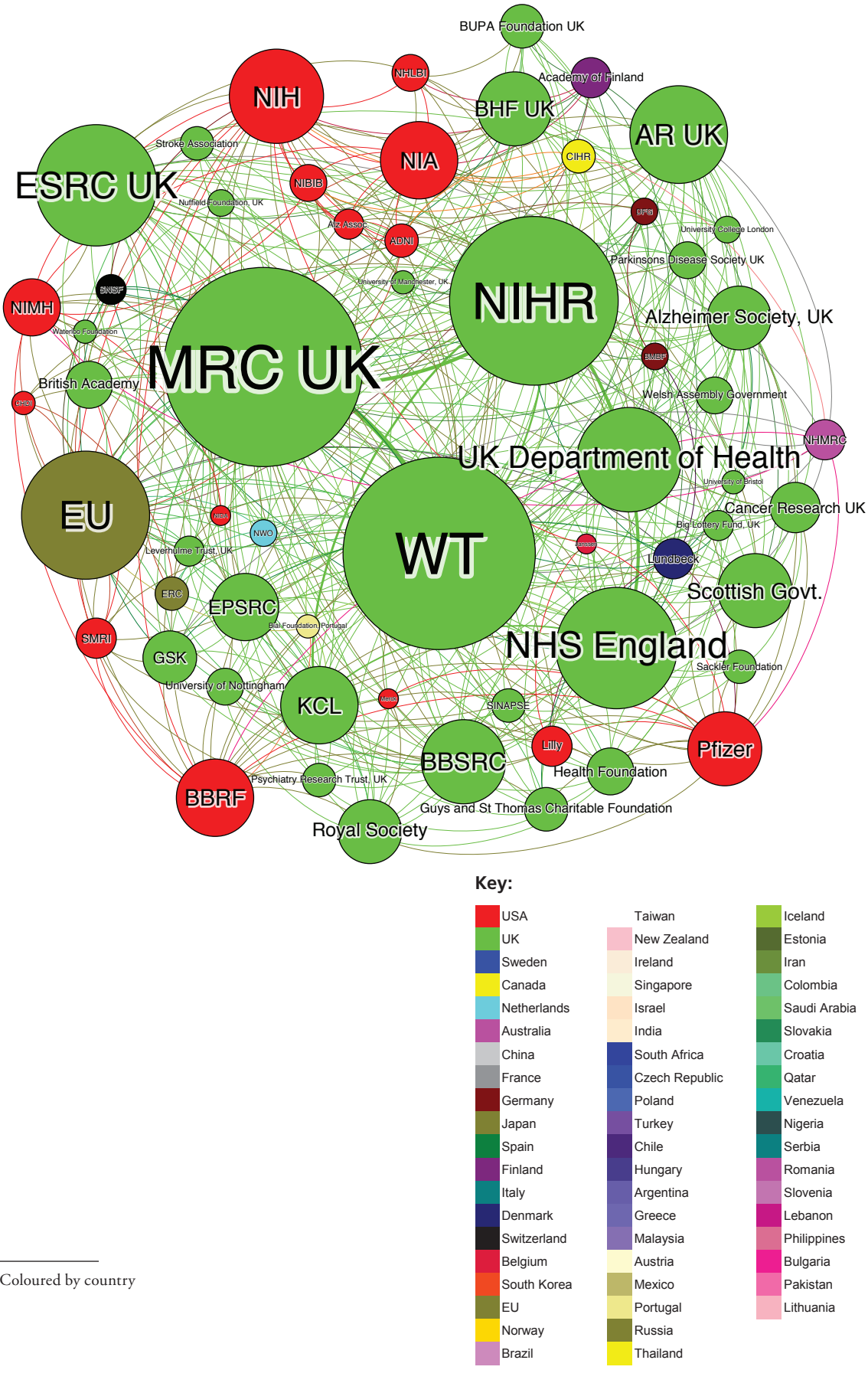
As for the global research landscape, we also developed network maps for the UK showing, firstly, all UK funders based on their co-acknowledgement on papers (Figure A2-3) and secondly, the funders acknowledged on papers with a UK address (Figure A2-4). The MRC, Wellcome Trust and NIHR are prominent in both networks, but the network of UK funders also shows the diversity of smaller charities, foundations and non-profits engaged in mental health research. In Figure A2-4 US funders (in red) and other European funding organisations are clearly visible.

Figure A2-3
Network of co-acknowledgement of all UK funders[18]



18 Coloured by modularity

Figure A2-4
Network of co-acknowledged funders on UK papers in the entire mental health data set[19]



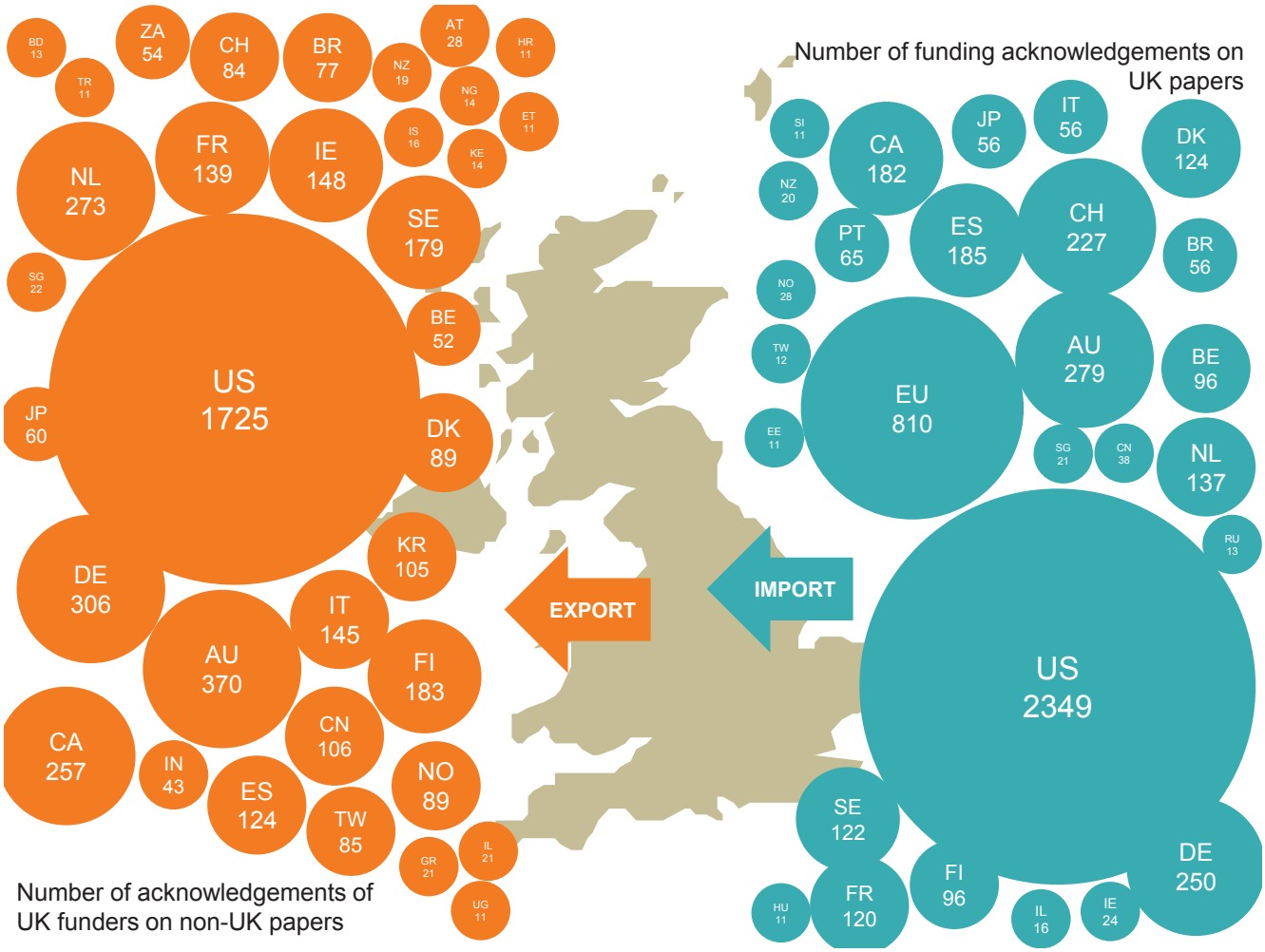
Key:

USA	Taiwan	Iceland
UK	New Zealand	Estonia
Sweden	Ireland	Iran
Canada	Singapore	Colombia
Netherlands	Israel	Saudi Arabia
Australia	India	Slovakia
China	South Africa	Croatia
France	Czech Republic	Qatar
Germany	Poland	Venezuela
Japan	Turkey	Nigeria
Spain	Chile	Serbia
Finland	Hungary	Romania
Italy	Argentina	Slovenia
Denmark	Greece	Lebanon
Switzerland	Malaysia	Philippines
Belgium	Austria	Bulgaria
South Korea	Mexico	Pakistan
EU	Portugal	Lithuania
Norway	Russia	
Brazil	Thailand	

19 Coloured by country

Finally, we carried out an analysis of the flows of research funding into and out of the UK. In this we used each paper's funding acknowledgements and corresponding author address as proxies for the source and destination of research funds. In these terms, the UK is a slight net 'importer' making 5,542 funding acknowledgements to overseas funders on papers in our data set. The largest portion of these acknowledgements relate to US funding organisations, although there is also a substantial volume of papers acknowledging EU support. This compares with 5,023 acknowledgements of UK funding on papers with a non-UK corresponding address. Again, the largest portion of these acknowledgements corresponds to papers with a US address.

Figure A2-5
Flows of research funding: (i) UK funders supporting papers with corresponding authors outside the UK and (ii) papers with UK corresponding authors acknowledging non-UK funding[20]



[20] Numbers represent individual acknowledgements, of which there may be more than one on a paper. Countries with ten or more acknowledgements are presented in the figure

Annex 3 – Funder acronyms

Acronym	Funder name
863 China	National 863 project of China
973 China	National 973 Program of China
ADNI	Alzheimer's Disease Neuroimaging Initiative
AFSP	American Foundation for Suicide Prevention
AHA	American Heart Association
AIHS	Alberta Innovates – Health Solutions
Alz Assoc.	Alzheimer's Association
ANR	Agence Nationale de la Recherche (France)
AR UK	Alzheimer's Research UK
ARC	Australian Research Council
ASC	Alzheimer Society of Canada
Australian Govt.	Australian Government, Department of Health and Ageing
BBRF	Brain and Behavior Research Foundation (NARSAD)
BBSRC	Biotechnology and Biological Sciences Research Council (UK)
BELSPO	Belgian Science Policy Office
BHF UK	British Heart Foundation UK
BMBF	Federal Ministry of Education and Research (Germany)
BMS	Bristol-Myers-Squibb
CAPES	Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Brazil)
CFI	Canada Foundation for Innovation
CHDI	Cure Huntington's Disease Initiative Foundation, Inc.
CIHR	Canadian Institutes of Health Research (CIHR)
CNPq Brazil	CNPq Brazil
CNRS	Centre national de la recherche scientifique (France)
CONACYT	Consejo Nacional en Ciencia y Tecnología (Mexico)
CRC	Canada Research Chair

Acronym	Funder name
DFG	German Research Foundation/Deutsche Forschungsgemeinschaft (Germany)
DHHS	US Department of Health and Human Services
DST, India	Department of Science and Technology, New Delhi, India
EPSRC	Engineering and Physical Sciences Research Council (UK)
ERC	European Research Council
ERDF	European Regional Development Fund
ESRC UK	Economic and Social Research Council, UK
EU	European Commission
FAPERGS	Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul (Brazil)
FAPESP	Fundação de Amparo à Pesquisa do Estado de Sao Paulo (Brazil)
FAS Sweden	Swedish Council for Working Life and Social Research
FCT Portugal	Portuguese Fundação para a Ciencia e a Tecnologia
FIRCA	Fogarty International Center of the National Institutes of Health (US)
FIS	National Institute of Health Carlos III (Spain)
FRM	Fondation pour la Recherche Médicale (France)
FRQS	Fonds de recherche du Québec – Santé
FWO-V	Fund for Scientific Research Flanders
GSK	GlaxoSmithKline
HRB of Ireland	Health Research Board of Ireland
HRC	New Zealand Health Research Council
INSERM	Institut national de la santé et de la recherche médicale (France)
ISF	Israeli Science Foundation
Janssen	Janssen

Acronym	Funder name
JSPS	Japan Society for the Promotion of Science
KCL	King's College London
Lilly	Eli Lilly and Company
MEC, Spain	Ministerio de Educacion y Ciencia (Spain)
MEST Korea	Ministry of Education, Science and Technology of the Republic of Korea
MEXT	Ministry of Education, Culture, Sports, Science and Technology in Japan
MHLW Japan	Ministry of Health and Welfare, Japan
MHW Korea	Ministry of Health and Welfare in Korea
MICINN	Spanish Ministry of Science and Innovation
MIUR	Italian Ministry of Education University and Research
MOHLTC	Ontario Ministry of Health and Long-Term Care
MRC UK	UK Medical Research Council
MSFHR	Michael Smith Foundation for Health Research (Canada)
NCATS	National Center for Advancing Translational Science (US)
NCCAM	National Center for Complementary and Alternative Medicine (US)
NCI	National Cancer Institute (US)
NCRR	National Center for Research Resources (US)
NHLBI	National Heart, Lung, and Blood Institute (US)
NHMRC	National Health and Medical Research Council of Australia
NHS England	NHS England
NIA	National Institute on Aging (US)
NIAAA	National Institute on Alcohol Abuse and Alcoholism (US)
NIAID	National Institute of Allergy and Infectious Diseases (US)
NIBIB	National Institute of Biomedical Imaging and Bioengineering (US)
NICHD	Eunice Kennedy Shriver National Institute of Child Health and Human Development (US)
NIDA	National Institute on Drug Abuse (US)
NIDCD	National Institute on Deafness and Other Communication Disorders (US)
NIDDK	National Institute of Diabetes and Digestive and Kidney Diseases (US)
NIEHS	National Institute of Environmental Health Sciences (US)
NIGMS	National Institute of General Medical Sciences (US)

Acronym	Funder name
NIH	US National Institutes of Health
NIHR	National Institute for Health Research (UK)
NIMH	National Institute of Mental Health (US)
NINDS	National Institute of Neurological Disorders and Stroke (US)
NINR	National Institute of Nursing Research (US)
NOW	Netherlands Organization of Scientific Research
NRC	Norwegian Research Council
NRF Korea	National Research Foundation of Korea
NSC Taiwan	National Science Council in Taiwan
NSERC	Natural Sciences and Engineering Research Council of Canada
NSFC	National Natural Science Foundation of China
OMHF	Ontario Mental Health Foundation
PAHO	Pan American Health Organization
PHRC	French Ministry of Health
RWJF	Robert Wood Johnson Foundation
SAMHSA	Substance Abuse and Mental Health Services Administration
Scottish Govt.	Scottish Government, Health Department
SFARI	Simons Foundation Autism Research Initiative
SFI	Science Foundation Ireland
SMRI	Stanley Medical Research Institute
SNSF	Swiss National Science Foundation
SRC	Swedish Research Council
SSHRC	Social Sciences and Humanities Research Council (Canada)
US CDC	US Centers for Disease Control and Prevention
US DOD	US Department of Defense
US NSF	US National Science Foundation
US PHS	US Public Health Service
USAMRMC	US Army Medical Research & Materiel Command
VA	Department of Veterans Affairs (US)
VU Amsterdam, Netherlands	Vrije Universiteit Amsterdam, Netherlands
VWS	Dutch Ministry of Health, Welfare and Sports
WHO	World Health Organization
WT	Wellcome Trust

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