Mapping
Mental Health
& Well-being

An investigation of the landscape of mental health research

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1 Executive Summary

This report aims to map and provide information on current research in mental health to inform and help funding agencies reflect on their research and innovation priorities. The emphasis lies in **spotting misalignments and gaps of current research efforts against perceived societal needs and demands in light of shifting mental health needs**.

On the basis of a bibliometric study, interviews and focus groups, desk research, we have found that:

- Policy reports and existing research indicate that there is a **need for more systemic research, including social and environmental factors, to improve mental health**. Experts and stakeholders also express a need for more broad-ranging mental health research, in contrast to the dominant model of highly medicalized research. They suggest that research should support:
  - Improvement of mental health services systems;
  - Increased prioritization of psychosocial interventions, with more attention placed in early stage (subclinical) mental health disorders.
  - Adoption of a model of mental health that takes into account factors that influence mental health at all stages of life, especially youth and adolescence.
  - Less prominence to research on drugs and new diagnostic tools within research.

- There is a **gap between research and practice**. Experts express a need for research focused on implementing and evaluating practical interventions and for researchers to be supported to develop alternative forms of engagement, such as practitioners' inclusion in the research process, to fulfil this need.

- The mapping of mental health is ambiguous given the multiple interpretations of mental health. To accommodate this plurality, we have developed an **inclusive research landscape of mental health, presented within an interactive visualisation interface** (see *Research landscape* tab in the website) for users to explore potentially relevant topics.

- Statistical **analyses of disciplinary profiles (**see *Disciplinary profiles* tab in the website**) and the **portfolios of publications and funding over the research landscape (**see *Portfolios* tab in the website**) allow us to identify topic specialisation of countries, organisations and funders.

- Research topics related to therapeutics or diagnostics are more associated with specific mental disorders and are more easily identifiable when trying to set research priorities according to conventional classification methods. Research topics related to healthcare systems and the social determinants of mental health concern more general mental health benefits. The policy implication is that the framing of research funding is likely to favour research on different types of mental health interventions.

- Statistical analyses confirm that **mental health research currently focuses on psychiatry, medical and biomedical research, and neurosciences (broadly estimated to be 60%-75% of mental health publications)**, with less focus on social science, public health and healthcare services related research (estimated at 10-20%). Funding data suggest an even higher concentration of resources.

- In this context, **Sweden and Norway stand out for their larger focus on public health and healthcare research, and social sciences** (28% and 24% of mental health publications, respectively). Finland follows with 22% (with a focus on public health) together with Australia (with a focus on healthcare).

- **Sweden is specialised in several topics related to prevention and healthcare research** such as suicide, community treatment, and various social determinants of mental health, including inequalities, job satisfaction or insecurity, and immigration. Within the identified cluster of research on community treatment, a detailed case study revealed that research from diverse disciplinary departments, such as one working on social work, are central to this research.

2 Introduction

2.1 Motivation

This project aims to produce a comprehensive and inclusive mapping of Mental Health (MH) research for informing strategic planning by public funding agencies. The focus of the project is the context of Swedish innovation relevant for Vinnova to address shifting needs in MH.

A primary motivation for developing a more comprehensive mapping is the observation that current health research and innovation is framed in primarily biomedical or clinical terms. Given the context of the global COVID-19 pandemic occurring in the backdrop of this study, it has become apparent that disease is not merely a medical phenomenon; it is interwoven with social, political, economic, among other factors. Despite this, the dominance of a medical framing persists, even within MH research[1]. Consequently, there is a tendency to prioritize research that is either fundamental or aimed at therapeutic approaches to address acute health crises. Given ongoing debates towards more systemic understandings of health, it is necessary to shift toward a mapping of health that takes into account a broader view and includes a more diverse set of research topics and innovation actors. This requires considering prevention, rehabilitation, healthcare services, and socioeconomic determinants of health as central in the future of mental health research.

The project has three objectives
- to **produce and characterize a broad map of mental health research**
- to **describe research activities across countries** and organisations in particular subfields
- to **portray the views of stakeholders on research priorities**. This includes their views on the balance between research areas, and how and why future investments should depart from current activities.

In summary, the overall goal of the project is to produce and test a methodology that combines analytical tools with expert consultation methods in order to inform and help funding agencies reflect on research and innovation priorities, with an emphasis in spotting gaps and misalignments with perceived societal needs and demands [2,3].

2.2 Mental health research

While no single agreed upon definition of mental health research exists, it is generally agreed that mental health research must extend beyond disease categories. The World Health Organization's (WHO) definition of mental health is as follows: 'a state of **well-being** in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community.'

This definition, with its emphasis on well-being and ability to engage and contribute to one's family and community, recommends a research system which is similarly broad and considerate of well-being. This encourages a research system which takes into account the contextual factors which influence mental health, often referred to as the social determinants of mental health[4,5].

2.2.1 Determinants of mental health

MH status is determined by both biological and environmental factors. These consist of one's social and economic background, the neighbourhood within which they live, the opportunities given to them early in their lives, their ethnic group, class, gender, education level, among other factors. This is a departure from the dominant way of thinking about MH, which typically revolves around disease classification, diagnosis, and acute intervention in an individualized and medicalized way.

Within this report, we heed lessons from public health literature indicating the need for this broader approach to mental health. This includes taking into account the influences of MH of different settings, such as schools, the home environment, and the workplace. This also requires thinking of how events and factors throughout the entire life-course impact one's MH, meaning that the experiences one has during their childhood has impacts on the opportunities they are able to have at later stages in life [6,7].

Finally, this broader conceptualization requires that we also consider other disciplines and forms of knowledge as relevant for the promotion of good MH and wellbeing, such as public health, sociology, social psychology, urban planning, among others, as opposed to only including fields such as clinical psychology, psychiatry, and neuroscience.

2.3 Approach to mapping mental health research

Mapping publications related to MH is challenging. First, because the definitions of MH and well-being are contested[8]. Second, because it is an issue that spans disparate disciplines, each of them with different understandings of mental health. And third, because mental disorders can be the second or third topic in a project, given that it is constitutive with many other health and wellbeing concerns or biological processes: for example, social identity among ethnic minorities is related to psychological stress (c1536); protein folding to Alzheimer (c795); sexual orientation to social stigma and depression (c859) and the financial crisis to suicide (c2624). Given these challenges, we developed the bibliometric mapping in parallel to qualitative interviews and focus groups that were used to contextualise and triangulate insights.

Given the diversity of understandings, we report the views of stakeholders in section 3, both in academia and practice, on what MH research is or should be. Building on two focus groups and several interviews, we present insights on what stakeholders perceive to be the current research foci, and what they believe are actual research priorities against what they see as most needed research directions, which tend to point to areas beyond the traditional areas of psychiatry, clinical psychology and clinical neurology.

In section 4 we present a high-level statistical analysis based on conventional medical terms and disciplinary categories on the distribution of publications across disorders, countries, organisations and funders. However, given the contested boundaries of MH and the goal to capture research topics outside mainstream (bio)medical disciplines, we complement the conventional statistical approach with an exploratory mapping.

Thus, in section 5 we introduce an inclusive research landscape with the aim of providing the readers comprehensive information on publication clusters related to MH and well-being, although some of the topics may be seen as remote to MH. We start this map with the publications tagged by Medical Subject Headings (MeSH) related to MH by the US National Library of Medicine. These publications are located in clusters of related publications within a cognitive map, i.e., a map where proximity indicates

some similarity in contents. The purpose of the research landscape is to facilitate the exploration by stakeholders of research topics beyond our initial core. For each cluster, detailed information on the contents and the main countries and organisations is provided.

In section 6, we show how the research landscape allows for the exploration of the 'portfolio', i.e., the distribution of publications over the clusters of specific countries, selected organisations, and funders. With these portfolios we can compare the issues that are being most supported by institutional research against the stated policy priorities or perceived needs of stakeholders and users. A dedicated website provides interactive access to the research landscape of mental health and the portfolios.

Two methodological choices need to be taken into account when reading this study. First, following conventional classifications (WHO's and PubMed's), we have not explicitly included neurological disorders, except for dementia. Second, publication clusters are based on citation flows, and thus reflect a particular view of research dynamics. Publications can be grouped in many other meaningful ways providing contrasting views of the same data. Against our initial hopes, this citation perspective has not proved very useful to make clear distinctions between different goals of research in terms of treatment, prevention, rehabilitation, etcetera. Instead, our clusters reflect research topics.

In the last section, we present two case studies on how the research landscape can be used as a point of departure for carrying out more specific analyses on areas of interest. In this case, the areas of interest were *Artificial Intelligence*, and *the Social Determinants of Health*. Besides the specific information provided, the aim of this section is to illustrate how complementary approaches can help in grasping the dynamics, key actors, and research environments of specific topics through a methodology which builds on the broader information provided.

2.4 Interactive visualisation website

This report is complemented by three interactive visualisations integrated in a website that are aimed at facilitating the exploration and benchmarking of MH research according to users' interests:

- The *Disciplinary profiles* visualisation aims to provide a first perspective of the distribution across disciplines of disorders, countries, organisations, and funders.

- The *Research landscape* visualisation shows the science map of the 280 publication clusters that are most related to MH. This map is aimed at supporting the exploration of the epistemic space of mental health. Thus, three interactive tabs show the distribution over the clusters of disciplines of disorders and the cluster characteristics, such as growth, publications authored by companies or hospitals, and mentions in patents, news, or policy documents.

- The *Portfolios* visualisation describes the distribution of publications by countries, organisations, and funders over the 280 clusters of the research landscape, as well as their relative specialisation (i.e., whether they publish more than expected) in the cluster.

3 Perspectives on priorities by stakeholders and experts

3.1 Studies on prioritization of MH research topics

This section will primarily describe the qualitative components of the research that were conducted on assessing experts' perceptions on the mental health research landscape within Sweden. Before describing the findings, we will first introduce some insights of existing research on mental health research prioritization.

Previous research into mental health research priorities have indicated considerable differences in which topics to prioritize depending on what kind of stakeholders are asked. Research indicated that both psychiatrists and users/carers of mental health services found the research supporting the improvement of the mental health services system (such as waiting times for treatment, sufficient services for staff, sufficient facilities) as the highest research priority [9].

However, there were also considerable differences in views. For example, psychiatrists ranked new pharmacological treatments among the highest priorities, whereas the users/carers ranked this relatively low. This reflected a general tendency of users/ carers placing less importance on new drugs and novel diagnostic tools; they instead prioritize research on psychosocial interventions and on resources in the mental healthcare system. This may reflect a tendency for users and caregivers to take an orientation closer to public health literature, rather than the more medicalized orientation of psychiatrists.

Finally, a Lancet commission on sustainability and mental health research provided various suggestions for topics to be focused on mental health research. The report indicated that key points of focus were research into increasing resource capacity within mental health care systems, increasing the emphasis on diverse points in the life-course and mental health, and increasing efforts for risk analysis, prevention, and early interventions. These recommendations closely resemble the prioritization expressed by patients and caregivers and would likely result in a more equitable mental health care system.

3.2 Stakeholders' and experts' mental health research priorities

We conducted two focus groups and three detailed semi-structured interviews with experts representing different functions that related to mental health care or research within Sweden. The interviews and focus groups consisted of exploring how experts engaged with the research system, what unmet topics they thought should receive more research attention, among other topics pertaining to mental health research. Several themes emerged from this component of the research.

3.2.1 The distance between practice and research

In each of the interviews, as well as both focus groups, experts expressed that there was considerable distance between the research community and those working in practice. This was more so the case with experts who worked on topics closer to psychosocial interventions, rather than those closer to clinical practice, with the latter group sometimes being asked to participate in research projects.

This distance was similarly felt from mental health service users - with one focus group raising that expert 'do not believe that beneficiaries shape research agendas.

The distance between research and practice originated from multiple causes. One factor was that practitioners do not have sufficient time or resources to engage with research that has been conducted, especially with research that is communicated through academic journal articles. This resulted in the recommendation of providing alternative forms of engagement with the research system for practitioners, such as online seminars, which several practitioners mentioned as useful. However, it might be more ambitious and beneficial to engage directly with practitioners in the research projects, rather than provide alternative products of research to them. These changes would require considerable modifications to the current model of training, recognizing, and rewarding activities within the research system, and will likely not function as an 'ad-hoc' adjustment to the existing system.

A common refrain of the need for 'intervention focused research' reverberated throughout the interviews and focus groups. The experts frequently remarked that the research they needed was closely engaged with how interventions could be implemented, rather than highly abstract or theoretical research. This could point to a need for closer engagement in research to practice, not in the form of producing publications which might be of use, but of intentionally including practitioners in the research itself, from each stage of the process, and providing material and financial resources to all collaborators to achieve this, as mentioned above.

3.2.2 Shifting needs in mental health

Experts acknowledged that a fortunate shift has been made in opening up conversations about mental health and illness. This was particularly noteworthy among the younger generation, who experts describe as having much greater awareness of mental health concerns.

This shift towards openness has resulted in perceived changes in the demands on the mental health care system. Experts noted that there was a considerably higher rate of individuals seeking mental health care services who do not meet the criteria for diagnosis. These were termed 'sub-clinical' cases. This was particularly true for experts working on mental health issues for students.

The way that the current model of mental health care provisioning is organized is ill-suited to provide care for these cases, with considerably more resources being placed on the most severe cases, and the majority of treatment and care taking place in the contexts of the medical system, such as by general practitioners or psychiatrists.

Experts noted that when cases did not meet the threshold for clinical attention, burden was then imposed on other potential contexts of interventions, such as through teachers, counsellors, coaches, among others. While the importance of these actors cannot be understated in the promotion of good mental health, the increasing rate of individuals experiencing these subclinical levels of mental distress results in an increase in responsibility and workload on these actors.

The Lancet commission on sustainability and mental health[10] provided several recommendations for mental health care systems experiencing this transition. One proposed solution is the concept of 'task sharing', which is when material resources are provided for training and supporting tasks that other actors complete when assisting those with subclinical levels of mental health distress. This requires retraining individuals such as nurses and teachers to fulfil this function. However, it **crucially** requires resources to be distributed to these actors so that they do not simply take on **additional** tasks without training in new skills, adequate compensation, and support.

This task sharing model fits well with the model of mental health care provisioning provided by the Lancet Commission, entitled a 'stepped care' approach to mental health (Figure 3). This model lays out the different levels of care and needs that individual experience and ensures sufficient resources at each level of mental health distress. The report indicated that additional resources are often needed at the lower levels of distress, which have the added benefit of preventing further (and often more severe) distress later in life.

Experts identified these key transitions that are needed within the mental health care system as lacking adequate research. In particular, experts recognized the value of the aforementioned recommendations, but found that knowledge for how to make these transitions was lacking from the research system. These recommendations would result in research needing to be broader in the concerns that it includes, beyond only individualized highly medicalized approaches. Research should also be supported on issues such as how to support teachers and nurses in promoting good mental health. Additionally, the increase in number of subclinical cases must be reflected in a shift in research attention towards how to address subclinical mental health distress.

A final conclusion mentioned by many of the interviewees was the importance of the mental health research system transitioning from a *disease perspective* towards a *health and well-being perspective*. This requires the inclusion of disciplines such as urban planning, public health, pedagogy, among others in mental health research. Experts also emphasized the need to think of the life-course of mental health and the benefit of intervening early on to prevent mental ill-health later in life.

4 The disciplinary profile of mental health research

In the face of ongoing debates on the need to broaden the scope of mental health (MH) research, it becomes relevant to inquire into its current disciplinary profile. To do so, we analyse MH research in terms of eight broad disciplines by mental disorder, by country, by organisation and by funders. Such analysis provides a first, tentative, coarse but indicative perspective of the research focus of a given research system or unit. See *Disciplinary profiles* tab in the website for interactive visualisations.

4.1 By mental disorders

Figure 1 shows that each mental disorder is studied relying on a different disciplinary profile. Idiopathic intellectual disabilities, such as Down's syndrome, rely more on biomedical research. Within Alzheimer and dementias, neurology plays a large role. Psychology is relatively more important in autism and eating disorders, whereas psychiatry has a central role in most disorders. Social science, public health and healthcare studies are relatively small except in intellectual disability and dementia.
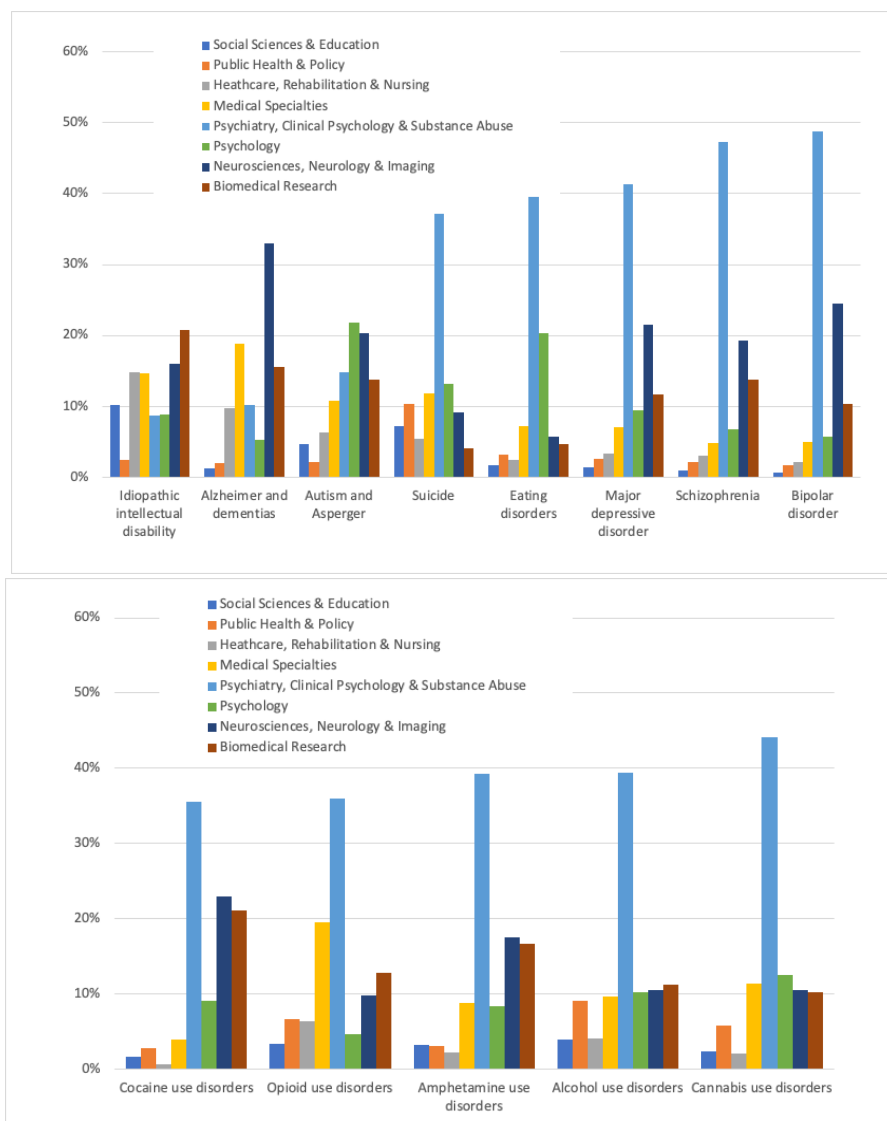

Figure 1. Disciplinary profile of mental disorders. Bars show the percentage of publications that belong to each discipline.

4.2 By countries

Figure 2 shows the disciplinary profile by country. While focusing on specific diseases highlighted the role of psychiatry, we find that neuroscience also has a large share of publications, both at the world and European level, when considering all publications tagged by Medical Subject Headings related to MH. Another significant proportion of research goes to research associated with psychology and general medical specialties. In the latter case, this high proportion appears to be related to co-morbidity of mental disorders with many health conditions (perhaps compounded by the accuracy of the classification).

For the focus of our study on prevention and rehabilitation, the most relevant information in this graph comes from the smaller categories of social science, public health and healthcare. Together, these three categories make only 13-16% of mental health research at the European and global levels, but almost twice as much, in Australia (22%), Finland (22%), New Zealand (23%) Sweden (24%) and Norway (28%), Iceland (32%) and South Africa (33%), the countries with the biggest world share. Given these shares, we might expect these countries to be among the most active in topics related to prevention, rehabilitation and social determinants of MH. It should be noted that this is a relative comparison. Though in relative terms biomedical research is only 6.9% of Swedish publications and 9.3% in the EU27, Sweden has 25 publications per million capita, which is more than twice the EU27 average of 11 publications per million capita.
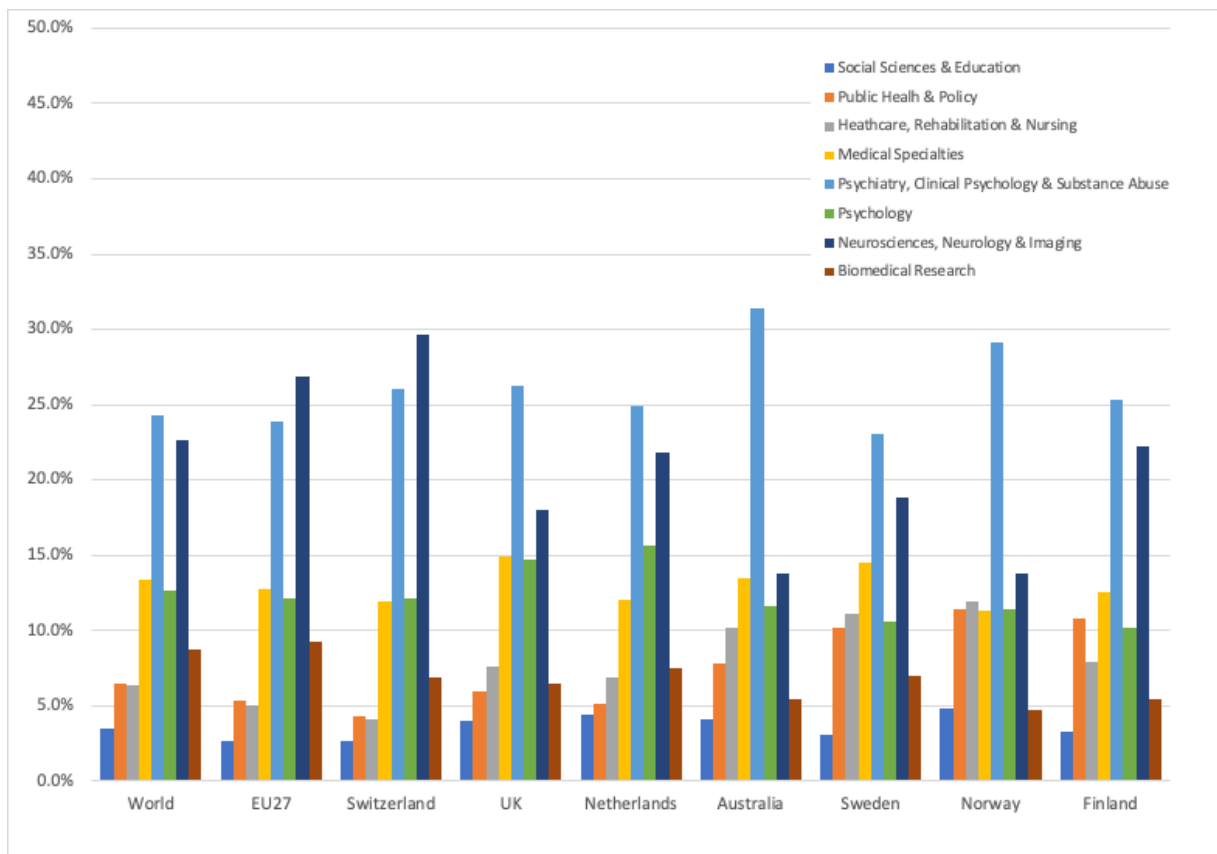
Figure 2. Disciplinary profile of MH research by country. See website for interactive visualisations.

4.3 By organisations

Significant differences in disciplinary profile are also found at the organisational level. As shown in Figure 3, Nordic and Australian universities have a relatively high specialisation in public health and healthcare. Universities such as Helsinki, Bergen, Lund and particularly Stockholm, have a high proportion of public health related research, whereas Gothenburg, Lund and Monash specialise more on healthcare services.
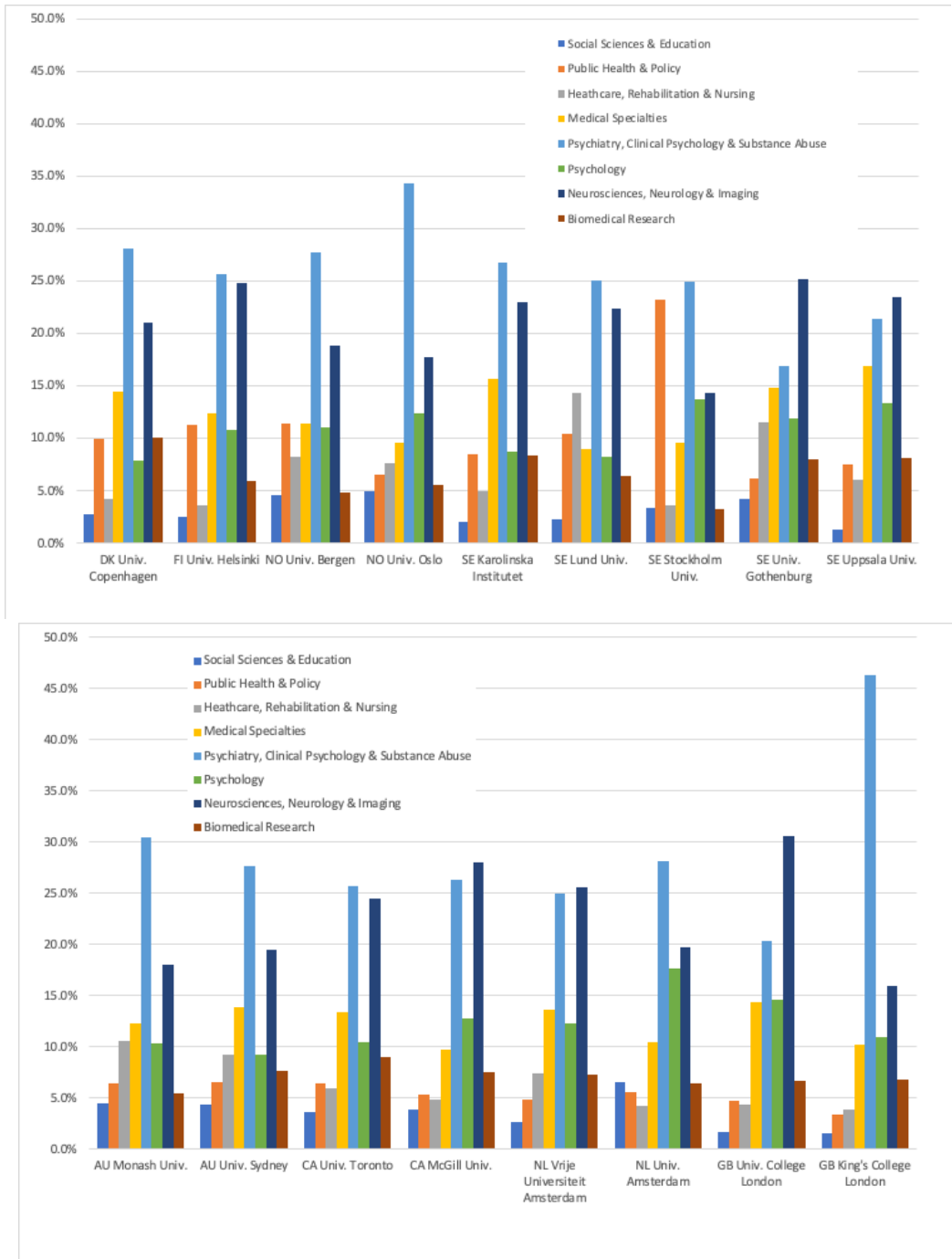
Figure 3. Disciplinary profile of MH research by selected organisations.

4.4 By funders

There is an even lower percentage of publications in Social Sciences, Public Health and Healthcare in terms of funded projects than in publications. This relative neglect is quite commonplace, with the exception of Norwegian funders and FORTE (Swedish Research Council for Health, Working Life and Welfare), which have a very high share of public health research. The Academy of Finland provides significant support for public health, but not for healthcare. European funding is high in neuroscience and biomedical research, two disciplines that receive relatively more funding than their publication share.

Figure 4. Disciplinary profile of MH research by selected funders. See website for interactive visualisations.

5 A bird's view on mental health research

5.1 The mental health research landscape

While the analysis in the previous section helped us to explore the disciplinary balance of MH research, it did not provide a f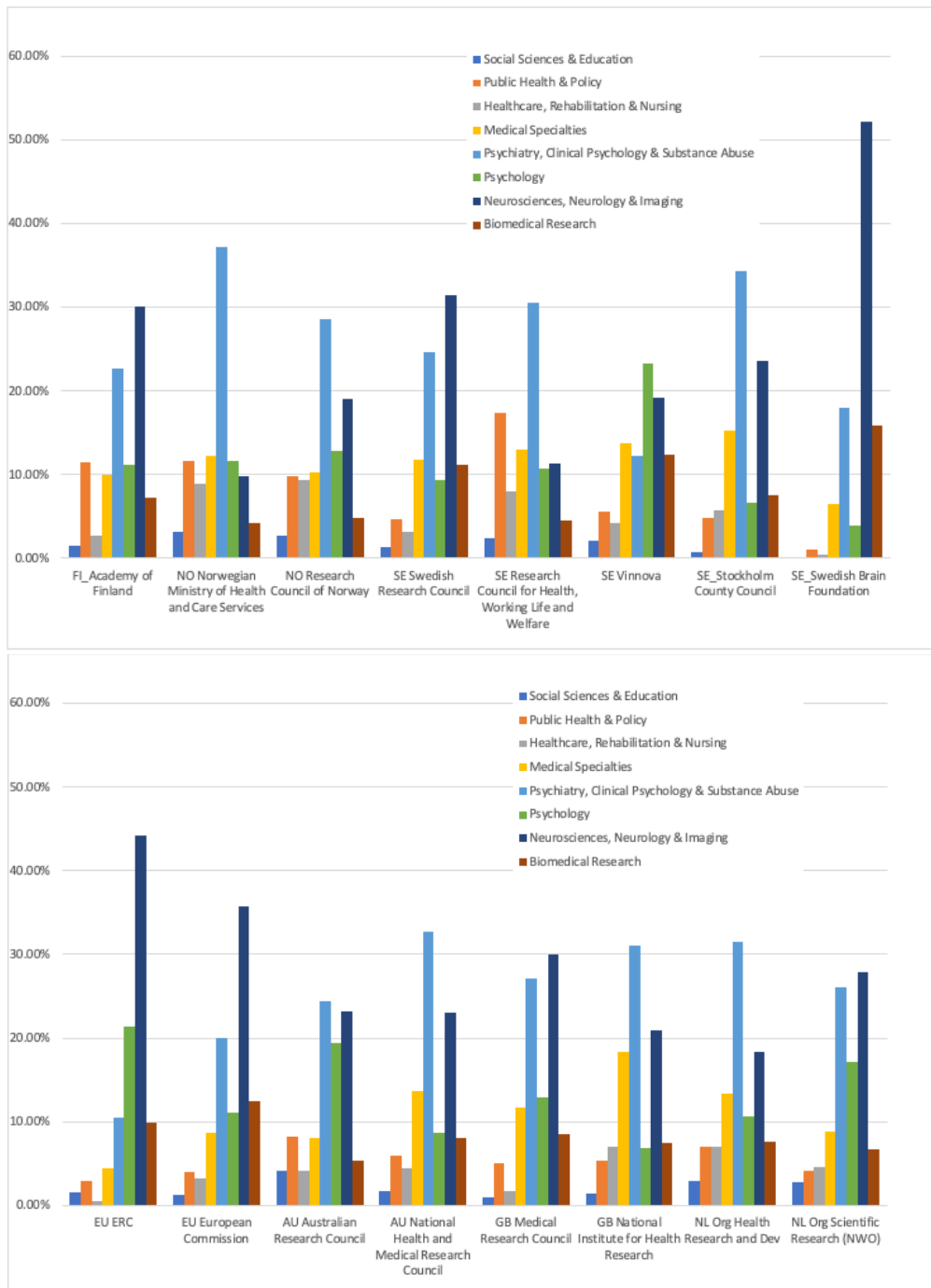ine-grained picture of the topics currently addressed by MH research. To do so, we introduce a research landscape as a heuristic tool to help us orientate within a fine-grained epistemic space of MH research topics. This research landscape is based on a selection of 280 publication clusters out of 4,013 citation clusters that represent all the specific research topics in science, according to citation patterns in the Web of Science (WoS) database [11,12]. The selection of clusters is based on the frequent presence of keywords from a controlled vocabulary (Medical Subject Headings, MeSH) in the publications. The shape of the landscape is based on the relative citation similarity between clusters, as shown in Figure 5.

The landscape can be explored on *Research landscape* tab in this *website*. By clicking a cluster, a window pop-up with a description of the cluster in terms of keywords, journals, top countries, organisations and authors can be found. Three tabs on the website allow users to explore more characteristics of the maps. (i) the distribution of publications of WoS subject categories; (iii) characteristics of clusters such as relative participation by hospitals or by industry in authorship; (ii) the position of publications of specific mental disorders.
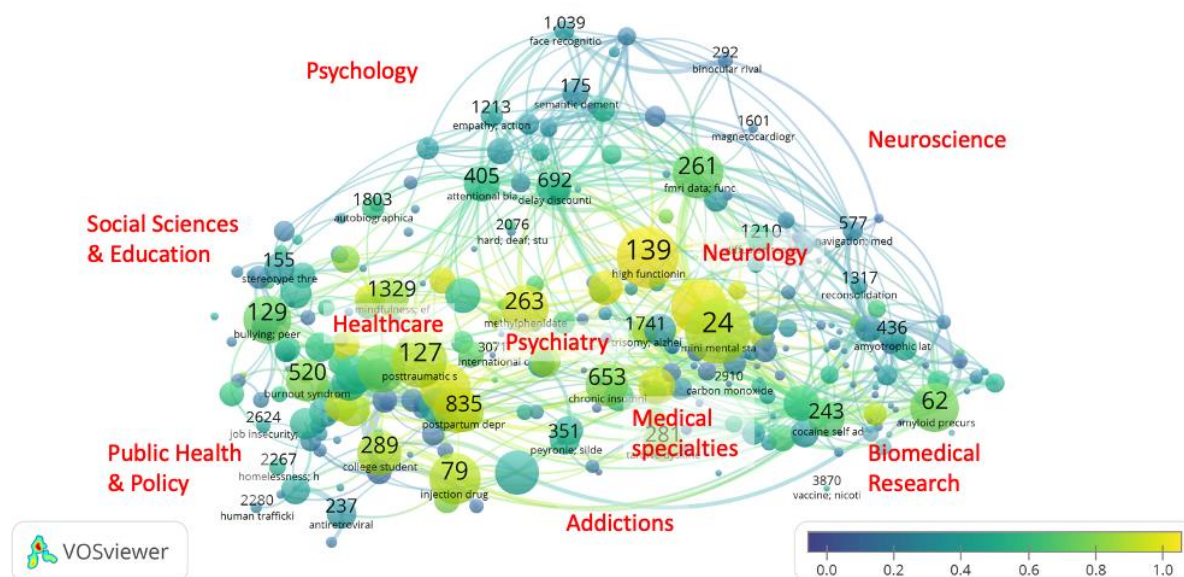
Figure 5. Research landscape of mental health. The size of a node shows the number of MH publications on a given topic. The colour portrays the proportion of publications in a cluster: yellow means high concentration (above 80%) of MH publications; green medium concentration (about 50%); blue, low concentration (below 20%). Nodes are positioned according to their similarity with neighbouring areas. The red labels signal the dominant disciplines in certain areas, but they should be read as broad signposts: most disciplines are spread over large parts of the landscape. Thus, clusters have a high overlap of various disciplines. The number in the cluster node is a label to identify the cluster. See website for interactive visualisations.

The distribution of publications in terms of disciplinary categories facilitates understanding the research landscape. MH research is positioned within a triangle where psychology dominates in the left side and

neuroscience in the right side, meeting in 'cognitive science' in the upper vertex (cluster 1039 - hereafter, we cite clusters as c1039). The bottom left vertex of the triangle goes from social psychology to public health research, through education and policy, reaching out to addictions (c79). The bottom right vertex is where biomedical research joins neuroscience (c62). Psychiatry lies spread in the middle of the triangle, with more healthcare issues such as posttraumatic disorder (c127) at the right and more neurological at the right (c24 on Alzheimer's diagnostic), and pharmacological issues at the bottom (c281 on antipsychotic drugs). These disciplinary descriptions should be understood as gradients of relative importance that can be used as guiding directions; most topics contain publications from different disciplines.

We now explore detailed cluster characteristics in the map. We observe that publications authored by industry researchers are concentrated in the bottom right side of Figure 5, an area of biomedical neuroscience. The fact that these clusters are also those most cited by patents suggests that industry engagement is highest in relation to psychopharmacology. The highest concentration of publications authored by hospitals appear in the centre-right of the triangle, in the triangle between the labels of psychiatry, medical specialties and neurology. Policy mentions to publications is highest in the bottom left part of the map, for clusters related to social determinants of health and some addictions. A tab in the interactive interface allows us to explore these options.

The highest relative growth is found for issues such as opioid analgesic prescription and abuse (c660), use of mobile technology in healthcare (c1637) and food insecurity (c2738). Suicide (c325), chronic insomnia (c653), job burnout (c. 520) and adverse childhood (c442) show the highest growth in absolute number of publications.

5.2 Locating specific mental disorders in the research landscape

The second tab shows the position of specific mental disorders, as defined by WHO's International Disease Classification. We observe different disciplinary patterns depending on the disorder. Some conditions such as dysthymia, anxiety or depression are spread over diverse clusters, potentially representing different approaches. For example, in Alzheimer's and dementia research, we find one main cluster associated with diagnostics (c24), a cluster with a focus on fundamental understanding of the amyloid precursor protein which causes Alzheimer's (c62) and a third cluster associated with family and caregiver burden (c200), as illustrated in Figure 6.

However, most conditions are concentrated in one single cluster. This is the case, for example, of autism (c139), attention deficit hyperactivity disorder (c263), bipolar disorder (c685), eating disorders (c148), opioid use (c79), schizophrenia (c72) and suicide (c325). Other disorders such as Tourette syndrome (c2711) are also localised in a cluster, although not listed in the tab, given their much lower prevalence. Another important issue with a focused cluster is stigma (c1644). There are also clusters specifically focused on non-substance related addictions, such as internet and gaming addiction (c1156) or gambling (c2601). The fact that most disorders are concentrated in one single cluster suggests that there is a dominant research approach to the disease. In most cases, this mainstream approach appears to have a focus on treatment or diagnosis. This illuminates the finding that a large part of research aimed at prevention or rehabilitation in terms of social inclusion might approach mental health in a way that is shared across disorders and is thus not necessarily labelled with specific MH disorders. Instead, it appears clustered in terms of risk factors (e.g., domestic violence (c423), inequality (c494), and the

psychosocial interventions (e.g. inclusive education (c302), community engagement (c767)), which are potentially related to a variety of disorders as we will see below.
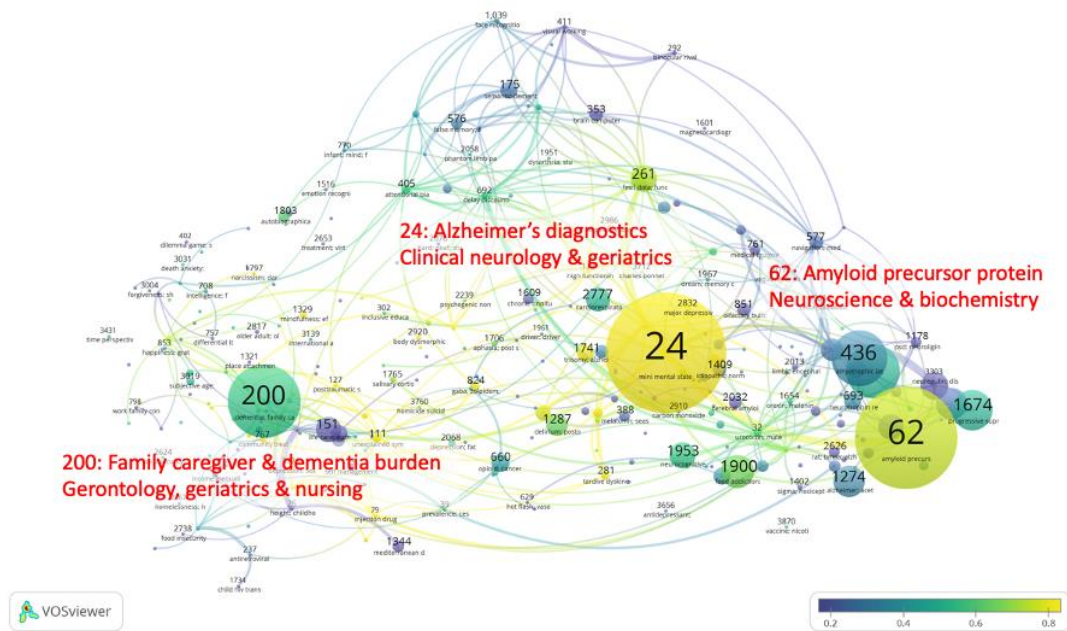

Figure 6. Overlay of dementia research over the MH research landscape. We observe one cluster associated with gerontology (cluster 200, left), one with diagnostics and neurology (c24, centre) and one with biochemistry (c62, right). See website *for interactive visualisations, including other mental disorders.*

5.3 Clusters related to prevention, healthcare, rehabilitation, and social determinants

We now transition to identifying research areas that are potentially relevant to prevention, rehabilitation, or the social determinants of mental health, which according to multiple analyses should be further supported[9]. A downside of our approach is that, for clusters focused on a given disorder such as schizophrenia, it is not clear to which extent the publications are related to different approaches. Most clusters with a narrow focus on a specific disorder describe primarily treatment and diagnosis of the disorder, with less attention to prevention or rehabilitation (suicide (c325), with a strong prevention focus, is an exception). However, the cartography of MH research described in Figure 1 can help us search for the clusters that are more likely to be related to these areas, which are likely to be found in the bottom left corner of the landscape between social sciences, public health, addictions and healthcare.

Determinants of MH:
There are many instances of clusters related to different sources of psychological stress that may trigger mental health disorders. Under this category, we have identified bullying at the workplace (2093) or among children and teenagers (c129), child adversities including abuse (c442), a variety of discriminations for example due to sexual orientation (c859), ageism (c3019) or racism (c1536), elder mistreatment (c3296), domestic violence and rape (c423), sexual harassment (c3561), sex work and human trafficking (2280), unintended pregnancy and abortion (c331), divorce (c985), work family conflict (c798), burnout syndrome (c520), job insecurity (c2624), presenteeism (c2055), homelessness (c2267), income inequalities (c494). In these issues, social contexts and determinants play a major role and are often related to public health and policies.

Healthcare system and mental health

We have also identified research on the healthcare system, including MH consequences for carers and research into healthcare provisioning and rehabilitation services. For example, one of the issues on stress in dementia caregiving (c200), of frailty in elders (664), in or helping patients make medical choices (c883). Within the ROAMER study on perspectives for setting research priorities in European MH research, MH care users and providers ranked additional research for the MH of caregivers (c200) among the highest priorities[9].

Comorbidity and mental health

The world health organization (WHO) has emphasized the importance, bidirectionally, of considering comorbidities with mental disorders, and notes that this has been a considerable blind spot in how research has historically been conducted[13]. We identified various clusters of interest that relate to MH comorbidity, such as in patients of cancer (c194), during rehabilitation from heart disease (c972), and depression in renal disease (c2068).

Fostering well-being:

On topics of health promotion and fostering well-being, rather than avoiding illness, there are clusters looking into how social interventions can improve mental health, through physical exercise (c93) specially in dementia (c2777), mindfulness and yoga (c1329), or nutritional issues such as child overweight (c26), obesity management (c2974) or diet (1344). Other clusters deal with more social intervention such as work integration for elderly (c641), avoiding social isolation (c1217) and inclusive education (c302).

Related issues on the positive effects of social activities are framed more as academic questions than in terms of implementation, for example volunteering in youth (c2097), music therapy (c890), happiness and life satisfaction (c853), religiosity (c667), humour (c3079) or wisdom (c3741). In these issues, psychology and education play a central role.

6 Research portfolios in mental health

Having described the research landscape in the previous section, we can now proceed to analyse the 'research portfolio' of countries, organisations and funders. Analyses of 'Research portfolios' are a means to understand the distribution of *research efforts* over the different *research option*[14]. In this case, we estimated r*esearch efforts* in terms of number of publications, and the r*esearch options* via the different clusters in the research landscape. This analysis is aimed at finding out which topics receive the most research attention in certain contexts, and which topics benefit from direct funding. This information can then be contrasted with stated policy priorities and stakeholders' preferences. Such a reflection can help in realising that discursive priorities are not being sufficiently implemented, or that research efforts are misaligned with perceived needs by societal beneficiaries of research [2,15].

6.1 Country portfolios

We first compare the research portfolios of countries (see *Portfolios* tab in the website) over the research landscape explored in the previous section. The size of the nodes shows the number of publications in a selected country. The colour illustrates the relative specialisation, i.e., whether a country has a relatively high or low percentage of publications in a given cluster. Hence, small but yellow clusters indicate that although the cluster does not have many publications, a country is, in relative terms, highly active in a given topic. For example, Sweden has only 22 publications on job insecurity in the period 2015-18 (c2624), but this is almost three-fold the expected amount (the amount found if Swedish publications were evenly spread over all MH clusters).

Figure 7 illustrates the type of insights that can be obtained by comparing the portfolios of countries. In this figure, we see that Sweden and Denmark have strikingly different portfolios in MH. Whereas Sweden is highly specialised in dementia, particularly in diagnosis (c24) and caregiving (c200), Denmark shows a high specialisation in schizophrenia and depression (which might be at least partly related to the focus areas of the Danish pharmaceutical company Lundbeck).

Sweden has high relative activity in many clusters related to the social determinants of MH, such as presenteeism (c2055), job insecurity (c2624), income inequality (c494) and immigration (c1309). It also has a high specialisation in some of the clusters related to health services, such as community treatment (c767 - see more details in the next section), and stress of nurses (c322); as well as some of the clusters related to comorbidities of alcohol and cardiovascular health (c1584), fibromyalgia (c514) and aphasia (c1706). Sweden also presents large activity, but not such a high specialisation, in focal MH topics such Attention Deficit Hyperactivity Disorder (ADHD), chronic insomnia (c653), autism (c139), suicide (c325) and eating disorders (c148). In contrast, Denmark appears more active and more specialised in biomedical neuroscience as well as in various clusters related to psychiatric treatment of depression (c111) in particular for adolescents (c1483), grief (c1821), and postpartum (c835).

Through the interactive website one can spot the diverse specialisations of countries. The US shows high specialisation in issues such as racial discrimination (c1536), opioids (c660) and posttraumatic stress disorder (c127, related to military veterans). The United Kingdom's focus is similar to Sweden, but with more research on treatment of schizophrenia and autism, and in a variety of clusters related to the cognitive sciences. In terms of stark contrasts, South Africa has a focus on HIV co-morbidity, sex and stigma, and inclusive education, whereas India is mostly active in the molecular biomedical clusters.

The analyses within this report, based on WoS, may be seriously biased due to the under-representation of social science in WoS for countries of non-English publications. This is likely to have a considerable influence on the results for Asian, African and Latin American countries.

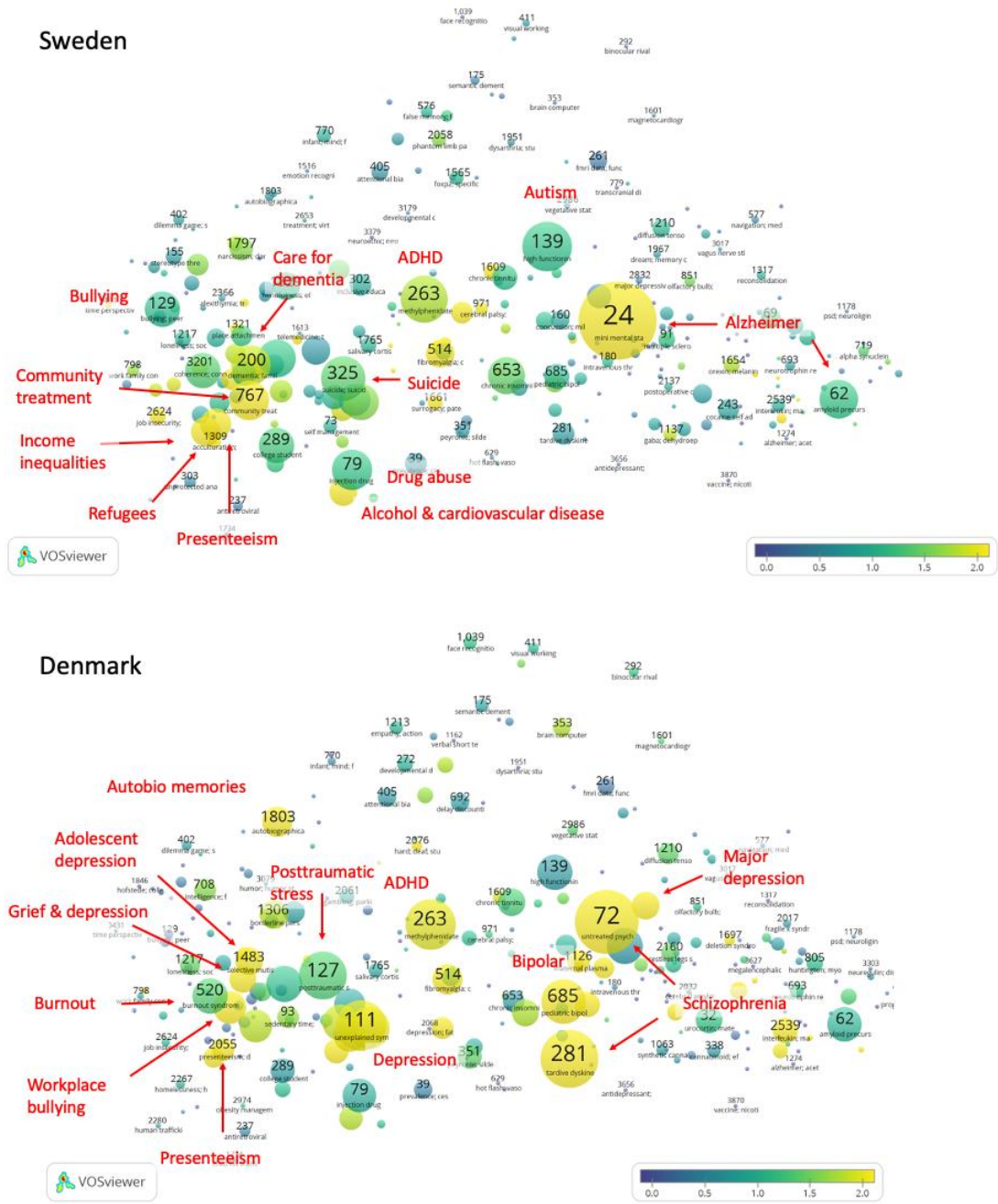*Figure 7. Overlays of MH publications of Sweden and Denmark over the research landscape. The size of the node indicates the number of publications. The colour shows the relative specialisation of the country in each topic. Yellow: specialised in this topic. Blue-Green: active, but not specialised. Deep blue: not active in the topic. See interactive [website](#) for other countries, organisations and funders.*

6.2 Portfolios of research organisations

Universities display more contrasting profiles than countries. Figure 8 provides examples of some relevant universities to illustrate how the interactive visualisation can inform on the focus of universities. For example, we can see that Harvard University has a broad profile. Being the university with the highest number of publications in MH it is active in many fields, it does not have a high specialisation in its largest topics. In contrast, Cambridge University has a specialisation in all neurosciences (upper-right side) areas from neuroimaging (c261 and c692) to molecular neurology (c805 and c2539). The Vrije University of Amsterdam specialises in specific topics both on psychosocial and medical issues. Helsinki, Bergen and Monash are examples of universities with a higher relative focus on public health and/or healthcare and a lower relative engagement with biomedicine.

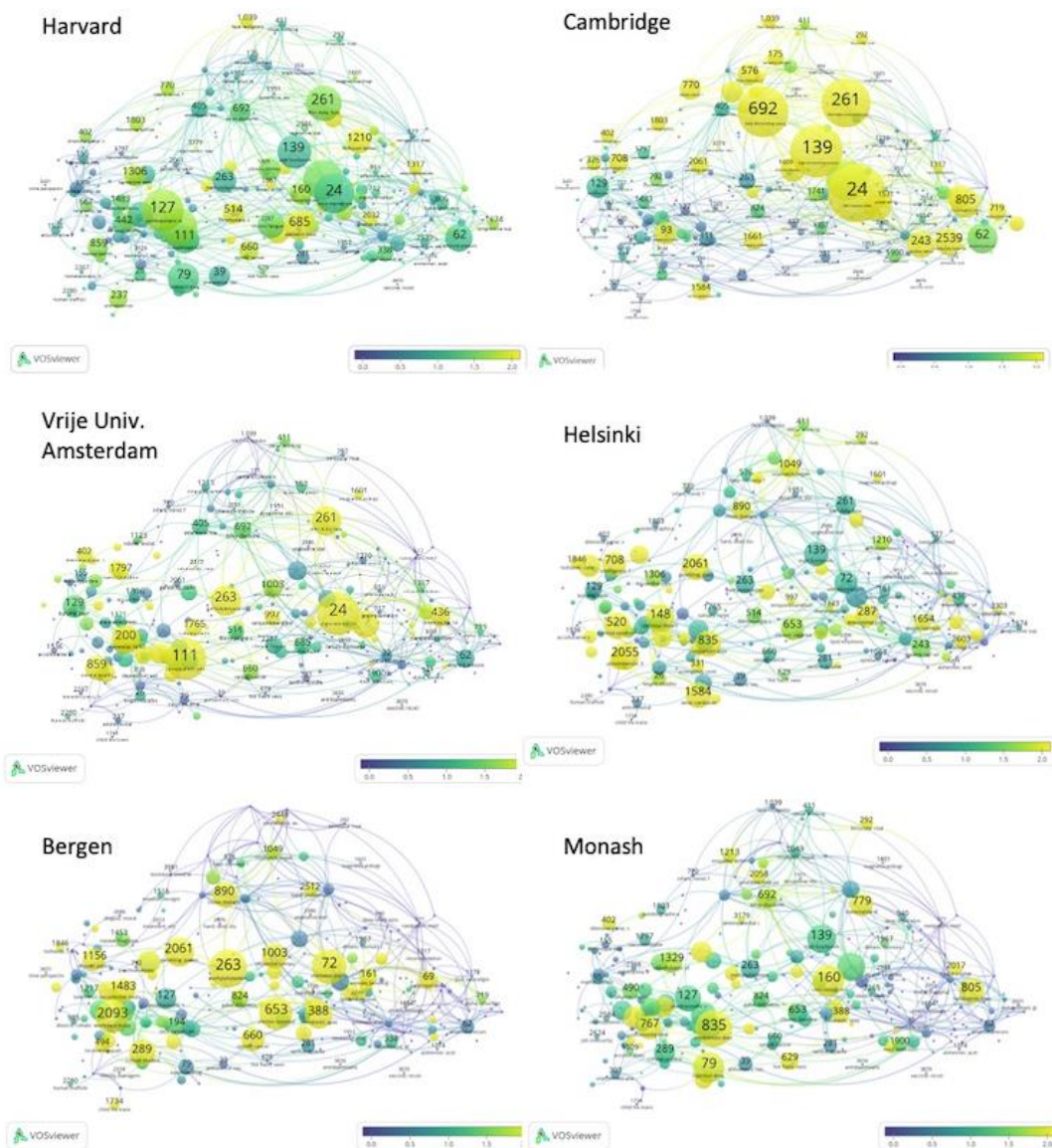*Figure 8. Overlays of universities with contrasting profiles over the mental health research landscape.*

Let us now turn our attention to Swedish universities. Karolinska Institutet has a broad orientation, covering mainstream psychiatric research (c24 on Alzheimer), more psychosocial interventions (suicide prevention in c325), and social factors (c2044 on presenteeism). Gothenburg University is much more

focused on pharmacology. Although relatively broad, Uppsala University is relatively specialised in treatment of specific disorders such as ADHD (c263), insomnia (c653) and perinatal depression (c835). Stockholm University focuses on public health issues such as job burnout (c520) as well as substance abuse (c79).

Figure 9. Overlays of Swedish universities over the mental health research landscape.

6.3 Portfolios of funders

The research landscape also allows us to investigate the topics supported by funders. Here we use funding acknowledgements in publications to trace the support of a funder to a topic. The analyses shown in Figure 10 show that funders also tend to specialise in supporting particular approaches.

We observe that the European Commission and the European Research Council are heavily focused on neuroscience and experimental psychology, in issues such as bioimaging (c261, c1210) and face recognition (c1039). Yet they provide strikingly little funding addressed to social determinants or healthcare aspects of mental health. The bias against the topics which are perceived as most relevant by stakeholders may require some further research.

In the case of the UK, we see a complementarity between the Medical Research Council (MRC), which is more focused on biomedical approaches, and the National Institute of Health Research (NIHR), which is more focused on healthcare. The Economic and Social Research Council (ESRC, not shown) covers the area from social determinants to experimental psychology. The Australian Research Council covers all non-medical issues in the MH research landscape, including social determinants and social

psychology, while the Australian National Health and Medicine Research Council is quite evenly spread over all the medical issues from healthcare to biomedical neuroscience.
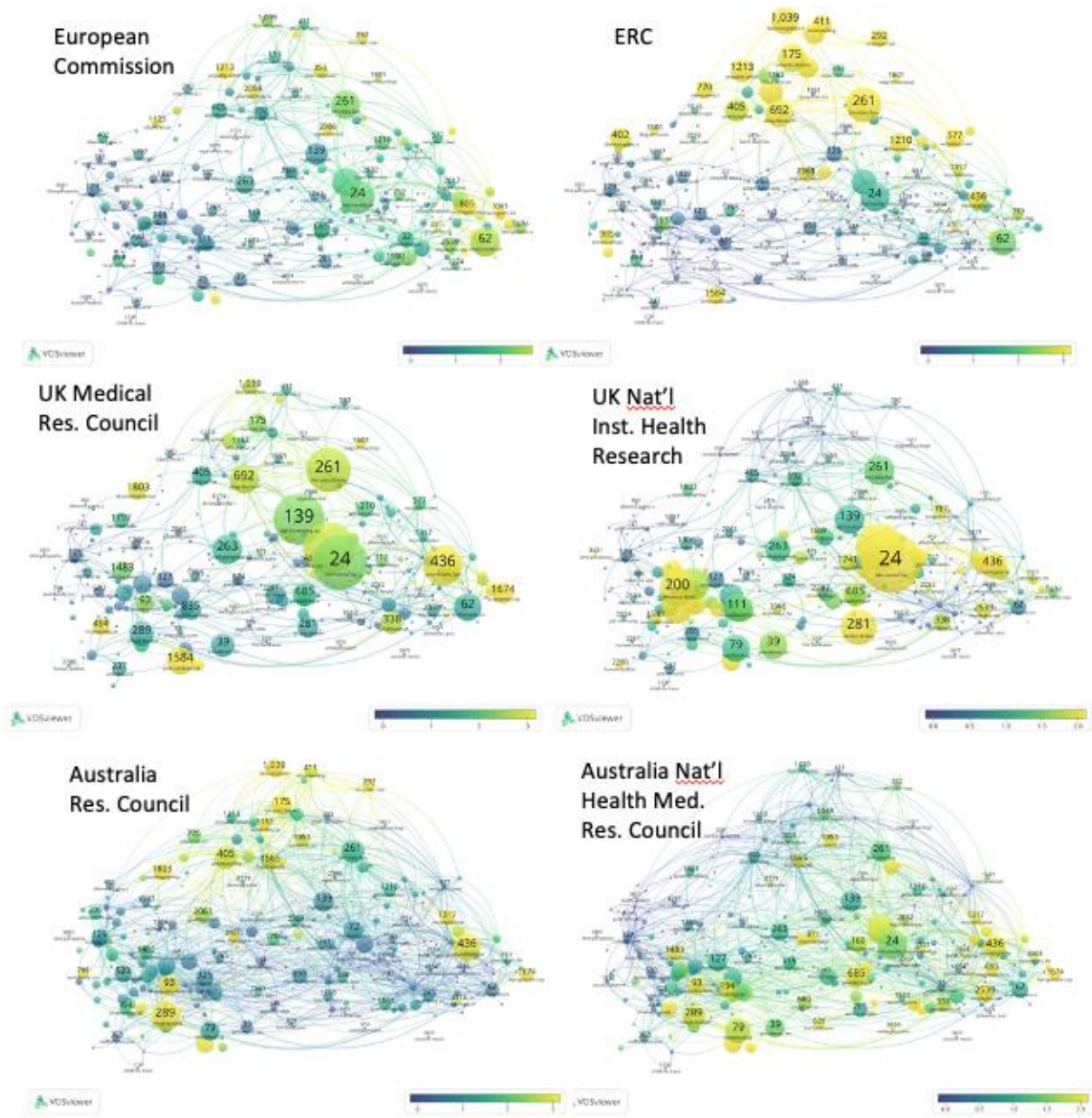

Figure 10. Overlays of funding agencies over the mental health research landscape.

Figure 11 shows the portfolios of Nordic funders. In these counties, we observe that the medical funders in a country (FORTE[1] in Sweden or the Ministry of Health in Norway) cover, as expected, a narrower area related to healthcare (more in Norway) and public health (more in Sweden) than the general research councils. Nevertheless, in these cases both medical and generic funders do support some research in healthcare and public health. Hence, the analysis confirms that Nordic countries have substantially higher focus on psychosocial research than the rest of Europe. Vinnova has produced relatively few publications in MH (104) of which 25 are concentrated in autism.

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[1]FORTE is the Swedish Research Council for Health, Working Life and Welfare.

Figure 11. Overlays of funding agencies in Nordic countries over the mental health research landscape.

7 Case studies for specific mental health research topics

This section presents two case studies that aim to illustrate how the research landscape introduced in section 5 can be used as a point of departure to conduct more focused explorations on relevant topics.

7.1 'Broader' Mental health research in Sweden, a case study

Mental health has a range of determinants that extend beyond the patient or the disease. These determinants include social, economic, political, and environmental factors, such as housing conditions, employment, social status, among others. Recent reports have indicated that shifting health system resources to address these issues is a cost-effective and more equitable way to improve health[6,7,10,16].

With these benefits in mind, we sought to explore where in the Swedish MH research landscape these topics fit, and who might be the main researchers working on these topics.

In order to locate these topics within Sweden, we inspected the pages of the major Swedish research organizations and sought for departments that are conducting this form of research. Subsequently, we collected the research conducted by these departments and performed a detailed analysis of the main clusters that the research performed by these authors were found in.

7.1.1 Cluster 767 - Community treatment

The cluster with the most publications authored by the identified authors was cluster 767, which was also identified as a cluster with a high specialization index for Sweden (see above section entitled 'country portfolios'). The cluster is highly related to community treatments with considerable emphasis on researching the MH needs of caregivers for people with disorders. The cluster is located in the bottom left of the map of mental health research, among healthcare services and public health clusters (Figure 12).

Sweden has a specialization index of 2.4 for the cluster Community treatments (c767), indicating that this is a cluster for which Sweden contributes more than two-fold its expected number of publications. For this case study, we sought to look at a closer level at the Swedish authors that contribute to research in this cluster.

First, we looked at the university departments within Sweden that are the most active within this cluster. The most active department was Lund University's department of health sciences. This department has the following foci:
- promotion and prevention efforts;
- treatment measures;
- health and social care;
- and rehabilitation.

These are precisely the topics that we were hoping to uncover. Furthermore, the department has the following sub-units, which are of interest for making a transition towards a health system focused on these other determinants of health:
- Active and healthy aging
- Care in high technological environments
- Integrative health research

- Mental health, activity, and participation.

Community treatment (c767) has various researchers of interest from Sweden who are quite central in the network of the cluster. The first researcher we identified was Professor Mona Eklund.
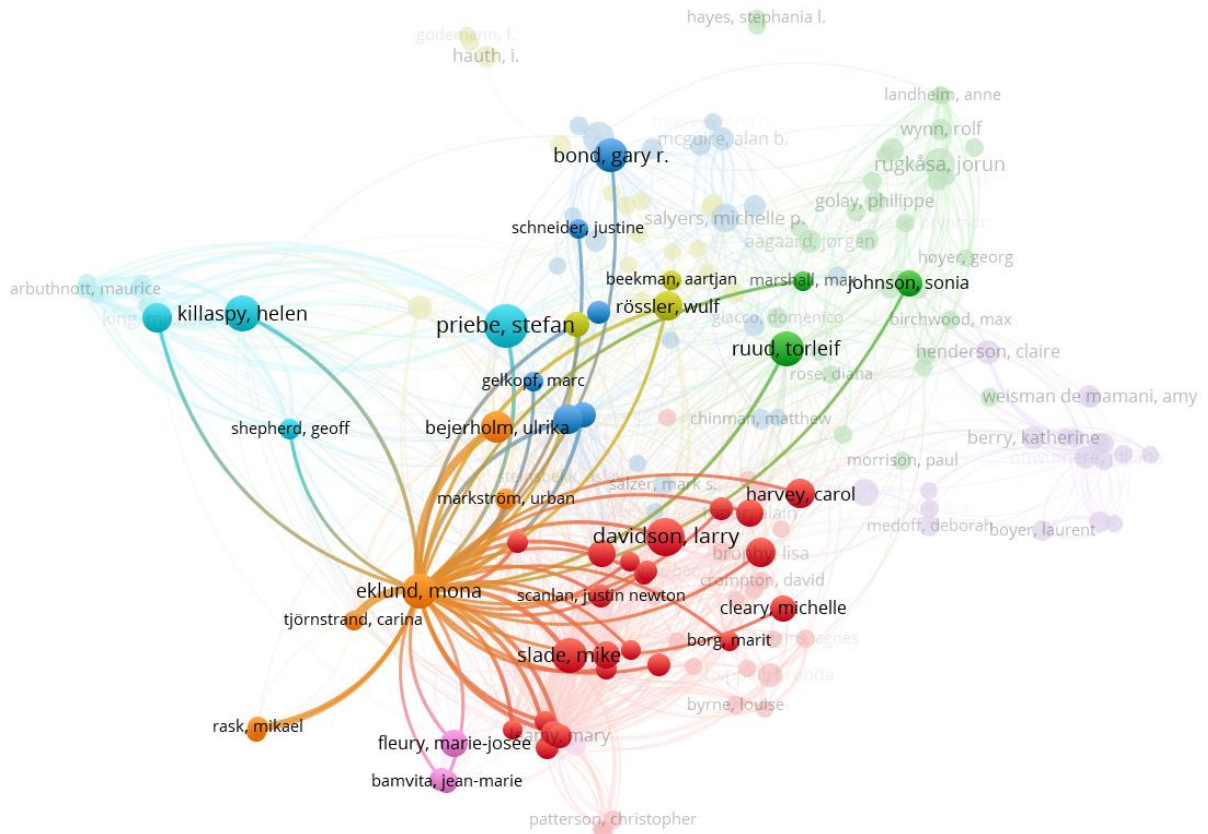

Figure 12: Network of main authors in community treatment (c767), where network links show the similarity of their publication topics (bibliographic coupling). In this image, Mona Eklund is highlighted.

Professor Mona Eklund's primary research topics are highly intervention focused and contribute to research into lifestyle-based interventions on individuals with mental health distress. More information on Mona Eklund's research can be found on her website.

The next researcher that we found as being central in the network of Community Treatment (c767) is Alain Topor from the department of social work at Stockholm University. Alain Topor conducts research on recovery for individuals experiencing prolonged psychiatric distress from the perspective of social services. This is noteworthy as the research appears not to be from an orientation originating from psychology, psychiatry, or the medical world, but instead indicates the importance of thinking of mental health in relation to broader societal circumstances, such as housing and the built environment. For more information on Alain Topor's research see [website.](website)

These two cases present illustrative examples of the kind of research which centres circumstances and the broader environmental (social, economic, health system) factors that influence mental health.

Figure 13: Network of main authors in community treatment (c767), where network links show the similarity of their publication topics (bibliographic coupling). In this image, Alain Topor is highlighted, and Mona Eklund is also visible at the left-hand side.

7.2 Applications of ICTs and AI in mental health research

Information and Communication Technologies (ICTs) and Artificial Intelligence (AI) have had a considerable impact on the way scientific research is conducted, and how healthcare is provided. This has been shown to be particularly true throughout the COVID-19 pandemic, as we have become considerably more dependent on virtual conferencing and service delivery, including in health. Researchers in MH have long sought to integrate ICTs and AI in novel ways in mental healthcare and research. Early examples include the use of computers to predict suicide risk as early as in 1973, well before the use of personal computers was widely spread.

The development of faster and more powerful information processing technologies, and the large amounts of data that are becoming increasingly available (e.g., health records, social media, MRI/fMRI, wearables, etc.) have allowed researchers in the MH domain to study algorithmic diagnosis and prediction of mental disorders using AI. Additionally, these technologies have been used to support healthcare in a variety of ways; especially in the use of telecare in healthcare, when patients are unable to reach caregivers or vice versa.

We have identified within the mental health research landscape (Figure 5) a variety of clusters related to ICTs and AI. These clusters include issues such as: delivery of healthcare using ICTs in what is known as telemedicine (c1613) and mobile health (c1637); the use of internet by older people including issues relevant to gerontology (c2817), internet addiction and virtual social network effects on wellbeing (c1156); the use of social robots (c1123) and virtual reality (c2653) to support healthcare or therapies of mental disorders such as anxiety, phobic disorders or autism; and finally the use of pattern recognition algorithms for emotion recognition (c1516), for brain computer interfaces and electroencephalograms (c353) and neuroimaging, in particular related to brain tumours and MRI data (c261).

7.2.1 Cluster 1123 – Social robots and mental health

Based on our search of ICTs-related publications within the MH research landscape, we selected cluster 1123 as an illustration. The overarching topic of this cluster is social robotics, and part of the publications included in this cluster are related to the use of robots in a variety of contexts within MH. In this cluster, we find research on skill training (e.g. development of communication skills) for patients with autism. A number of studies focus on the use of social robots to support therapies for specific mental and related disorders (e.g. autism, anxiety, dementia, depressive disorders, etc.). Besides this therapy-oriented research, other studies in this cluster also deal with the use of robots to support the automatic detection of mental disorders. There are also studies that focus on the ethical aspects of the use of robots in these contexts.

Publications in this cluster are most often published as proceedings papers (as is often the case in engineering), and often conducted by a single organization, i.e., without interorganizational collaborations. As a result, the cluster cannot be well-represented by co-authorship networks of organisations or authors. However, it is possible to observe some particular organisations and specific researchers within these organisations who are very active on these topics. This can be done through networks that show similarity in research topics among authors, as illustrated in Figures 14 and 15.

At Eindhoven University of Technology in the Netherlands, for instance, Emilia Barakova is one of the researchers active on these topics. She is an Assistant Professor of Socially Intelligent Systems in the department of Industrial Design. She is also the head of the Social Robotics Lab (see website). Having done a PhD in artificial intelligence, her current research lines include, among others, embodied social interaction or the designing of technologies for individuals in social isolation and special needs groups.

Another example is Hiroshi Ishiguro, the director of the Intelligent Robotics Laboratory at Osaka University (see website). Among the many projects he leads related to robotics, some are related to the MH domain, such as the project "CommU Support" (see website). In this particular project, researchers experimented with the use of robots to treat and educate patients with autism spectrum disorders.

This cluster shows that the disciplines and forms of knowledge in the space of MH research change as new technologies develop. It also highlights the extraordinary diversity of approaches and methodologies all working to improve MH.
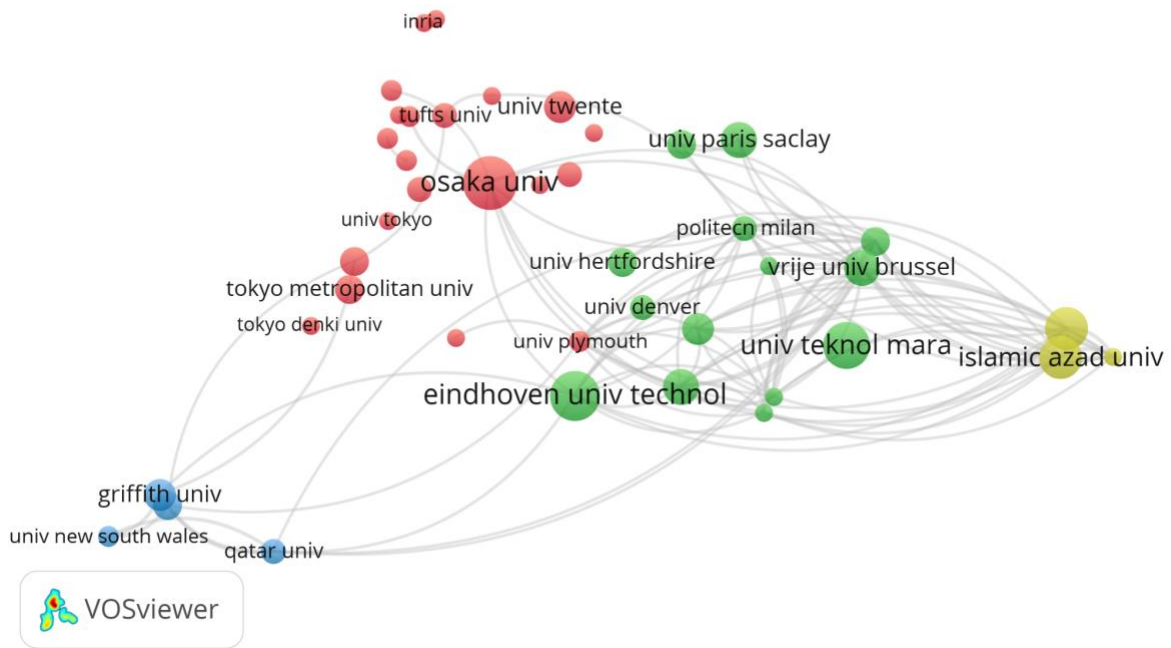
Figure 14: Network of the main organisations in social robotics applications in mental health (c1123), where network links show the similarity of their publication topics (bibliographic coupling).
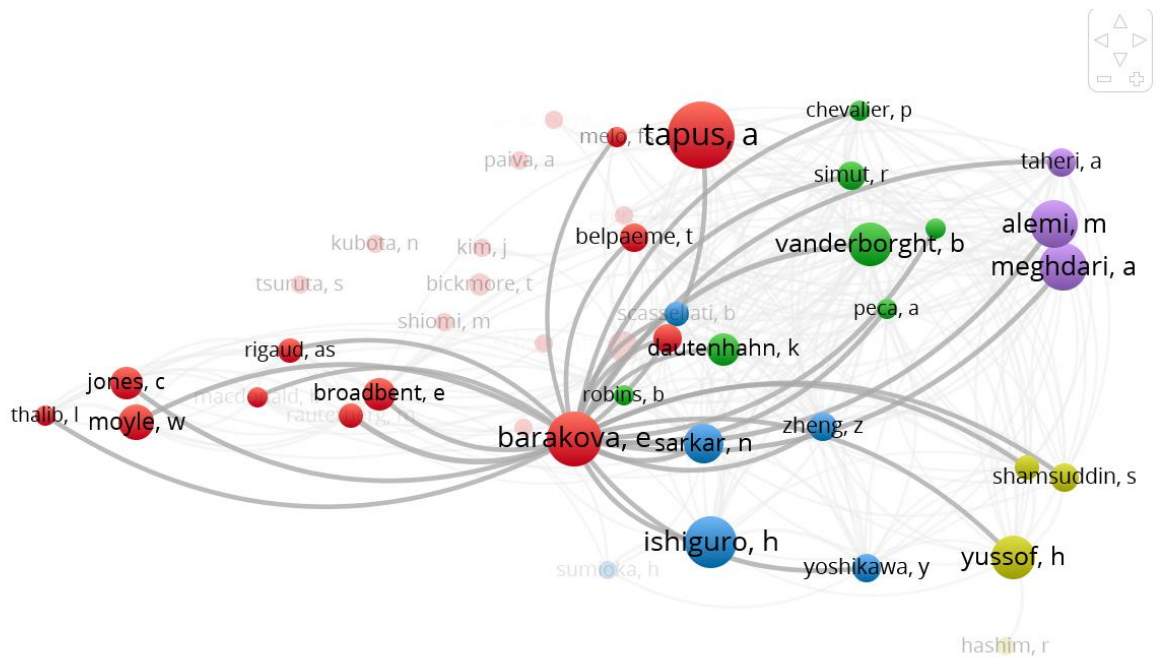

Figure 15: Network of the main authors in social robotics applications in mental health (c1123), where network links show the similarity of their publication topics (bibliographic coupling). This image highlights the position of Emilia Barakova, and some authors publishing in similar topics, including Hiroshi Ishiguro.

Appendices

A.1 Bibliography

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A.2 Acknowledgements

A.3 Focus groups and interviews methodology

A.3.1 Focus Group methodology
We conducted two focus groups with experts representing different types of knowledge. The participants consisted mostly of MH practitioners, rather than researchers investigating topics of MH.

The first focus group consisted of 4 experts working in Sweden on different topics related to MH. This included a psychiatrist, an expert in school psychology, a policy analyst working with the Swedish health ministry, and a CEO of an E-mental health company. The duration of the focus group was 1.5 hours and consisted of open-ended questions regarding the experts' relationship with MH research, and their perceived priorities and needs of the research system.

The second focus group was conducted in the Catalonian context and its format was the same. These focus groups included 8 participants, many working in the context of psychosocial interventions.

A.3.2 Interview methodology
We conducted semi-structured interviews with experts representing different forms of expertise on MH. The interviews lasted an hour each and consisted of questions investigating the interviewees' relationship with the research system and both their perception of current priorities and their ideal priorities for the MH research system.

The interviews also consisted of a small exercise where interviewees were asked to fill in their perceptions of current MH research priorities, as well as their ideal MH research priorities, into a pie chart. This allowed for a visual comparison of how these may differ. Two example pie charts are provided below.

Figure A1. Distribution of research priorities in mental health research as perceived by one stakeholder interviewed. Top: perception of current priorities. Bottom: views on ideal priorities to best address mental health. This description is only aimed at representing stakeholders' views, not the actual distribution of resources.

Current priorities of disciplines in mental health research
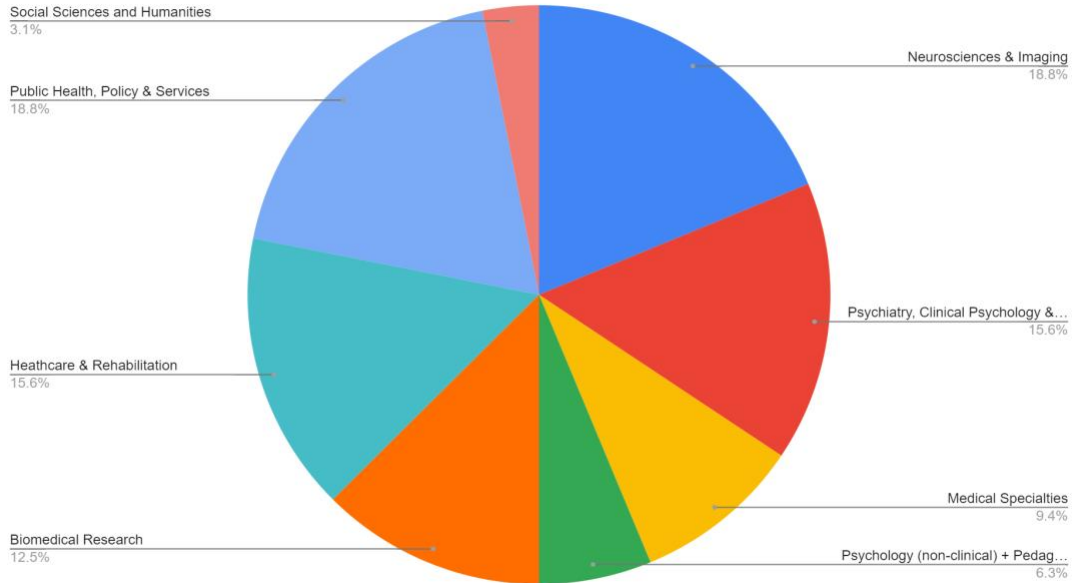
Ideal priorities of disciplines in mental health research
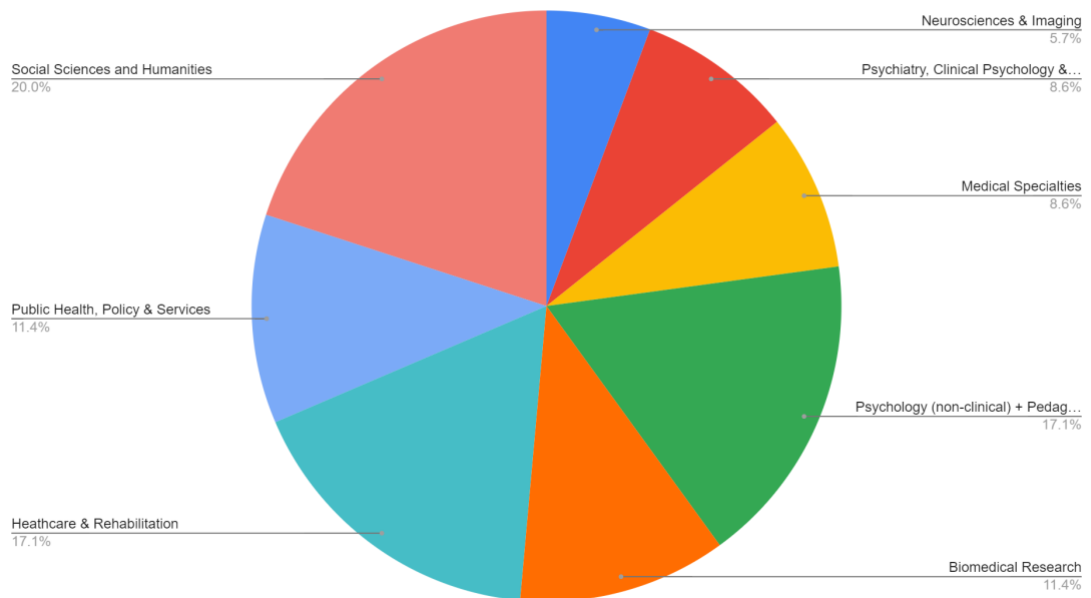
A.4 Bibliometric methodology

A.4.1 Identification of scientific publications on mental health research

In order to collect publications related to MH research a search strategy was designed to retrieve publications from PubMed. This search was based on MeSH descriptors covering a variety of aspects related to MH research (descriptors are included in the supplementary materials file), which were selected in agreement with Vinnova.

A.4.2 Identification of areas in the map of science related to mental health

After obtaining the corpus of scientific publications related to MH research as described in 8.5.1, we kept those publications also present in the CWTS in-house version of the Web of Science and we relied on the CWTS global map of science to identify the areas of research related to MH. All the publications included in this study correspond to the period of 2015-2018. Only original articles, reviews, letters, and proceedings papers were considered.

The CWTS map of science organises all scientific publications contained in the CWTS in-house version of the Web of Science into nearly 4,000 clusters of publications. Each of these clusters gathers a set of similar publications based on the analysis of their citation relations. In turn, the distance between the clusters represents the cognitive distance between different areas of research.

A manual inspection and analysis of the distribution of MH related publications across clusters within the CWTS map of science led to the identification of 280 clusters which have been considered as those most related to MH research.

A.4.3 List of disciplinary categories based on WoS subject categories

We grouped WoS Subject Categories w into 8 category groups to produce a first coarse-grained view on the distribution of publications across fields. This grouping was based on the categories discussed in previous research (as shown in Section 2) as well as on statistical similarity patterns between WoS Categories.

A.5 How to use the interactive visualisation tool

The beta version of interactive visualisation is available here (November 2021):
https://public.tableau.com/app/profile/tim5920/viz/MentalHealthtool/MHtool

Motivation
Research on mental health (MH) is perceived by many stakeholders as insufficiently diverse in terms of the disciplines and issues is addresses. Different countries, organisations and funding agencies have different disciplinary and topical foci. We have developed this interactive visualisation tool with the purpose of facilitating the exploration of what are current research priorities in MH, so as to foster debate about what research lines might lead to better wellbeing and health outcomes.

Introduction
In entering the visualisation tool, the user is first presented with an 'Introduction' tab that describes the analytical options in term of the three sections of the visualisation tool.

1. **Disciplinary Profiles tab** allows to compare the broad disciplines of countries, funders and organisations.
2. **The 'Research landscape' tab** shows a detailed cognitive space of 280 issues and problems related to mental health
3. The **'Portfolio'** tab allows to compare the distribution of research over topics of two countries, funders and organisations.

We suggest starting with 'Disciplinary profiles', then explore 'Research landscape' and finally use the 'Profiles'.

The data provided is extracted the CWTS version of the Web of Science (WoS) for 2015 to 2018. The articles are selected according to a list of Medical Subject Headings of the US National Library of Medicine related to MH (See Search PubMed). This is later enriched, with controls, for as synonyms of these terms found in WoS (See Search Web of Science). All the data visualised is available in this spreadsheet.

Disciplinary profiles visualisation
This tab allows to explore the disciplinary profiles of countries, funders and organisations in terms of eight broad disciplinary categories based on grouping of WoS Subject Categories (See Broad category – WoS SCs).

Click on the types of units you want to compare (country, funder or organisation), then go to the select one unit tab to select your units of interest. Notice that units are ordered by country, with the ISO code of country (e.g. Sweden unit come appear as SE_).

The bar shows the percentage of publication of a given unit in a given disciplinary category. The underlying data is available in this datasheet.

*Tab 1. The **disciplinary profiles tab** allows to compare the main disciplines of countries, funders and organisations.*
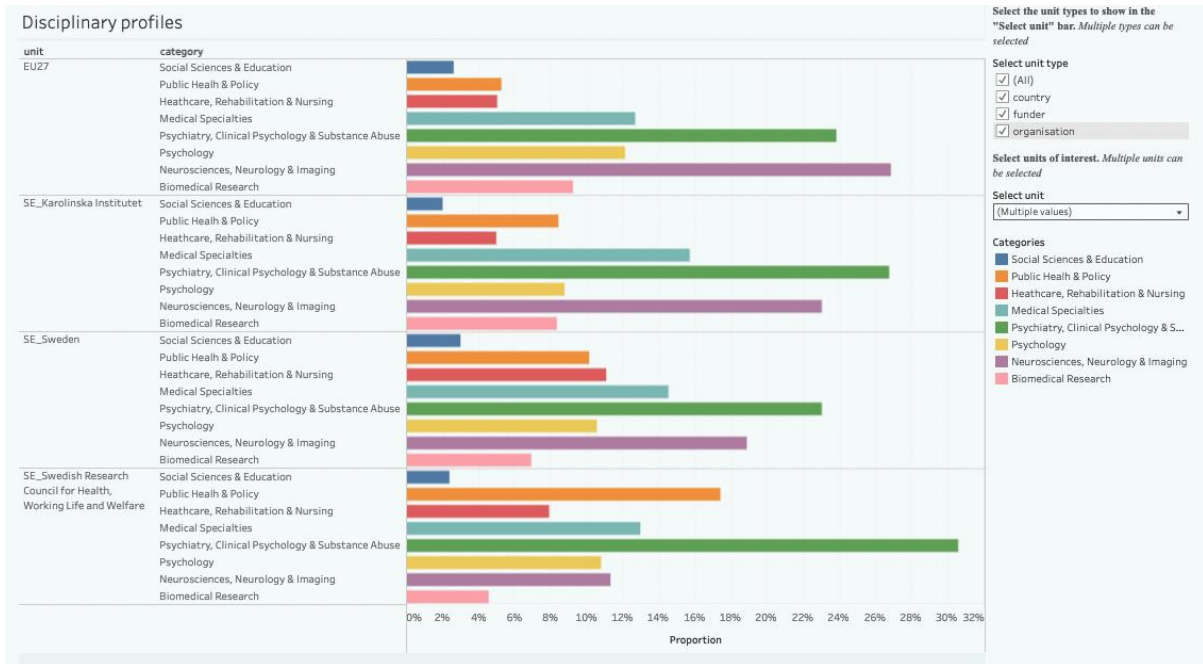

Research landscape visualisation

The research landscape shows the relative position of 280 research topics and issues related to mental health. Each circle represents a topic found through citation clustering. Similar topics are close to each other. Thus, topics on Public Health appear in the bottom left, topics on neuroscience on the top right, etc.

The size of a cluster is proportional to the number of publications about MH in the cluster, whereas the colour shows the proportion of publications about MH in the cluster (red circles have high percentage, blue have low percentage). By putting the pointer over a circle, the contents of the cluster and some statistics are described.

This tab also allows to visualise where, in this landscape, specific disorders and disciplines are located, and the characteristics of publications in the topics. To make this selection, go to the top right **'1. Choose a selection type'**, and then make a selection between 'Disorder', 'Cluster characteristics' and 'Discipline' selection. Once this selection is made, go to **2. Make your selection in the green corresponding drop menu',** to choose a given disorder or discipline, or a given characteristic. Once a selection is made, the information refers to the selection made. The underlaying data is available in this spreadsheet.

*Tab 2. The **research landscape tab** visualises the relative position of 280 topics or issues related to mental health research.*
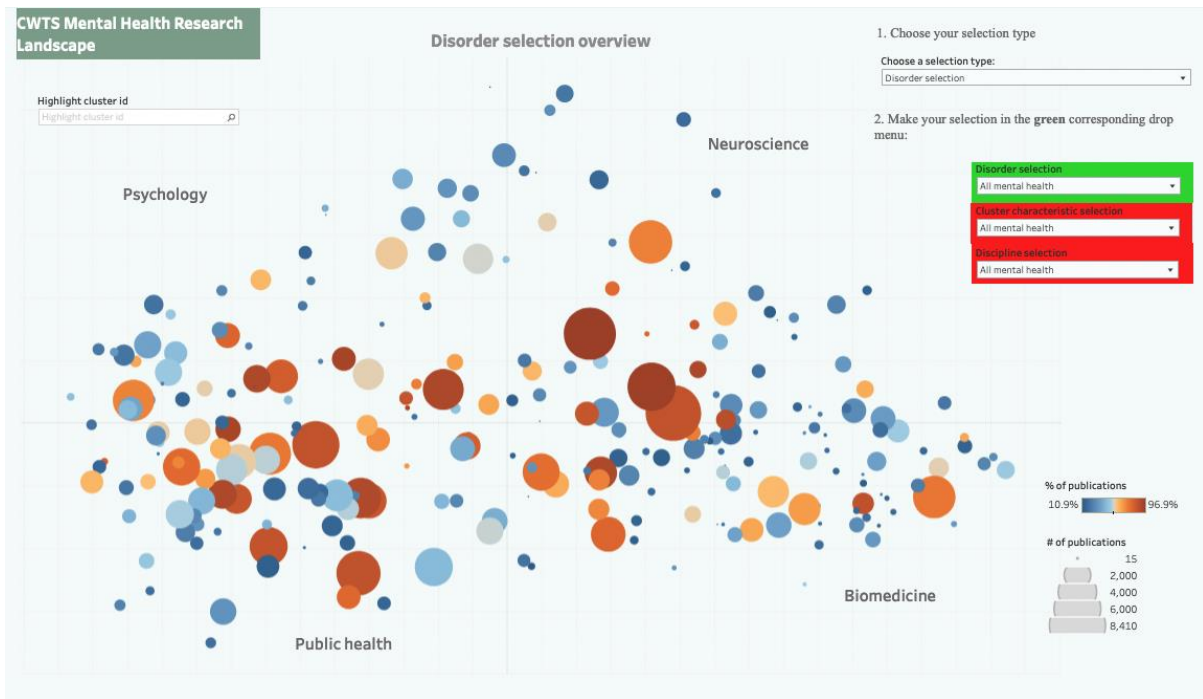
*Tab 2. The **research landscape tab** for 'Disorder selection' set to 'Alzheimer'. It shows the number of publications related to Alzheimer by the size the circles, and the percentage of publications related to Alzheimer by the colour of the circle.*
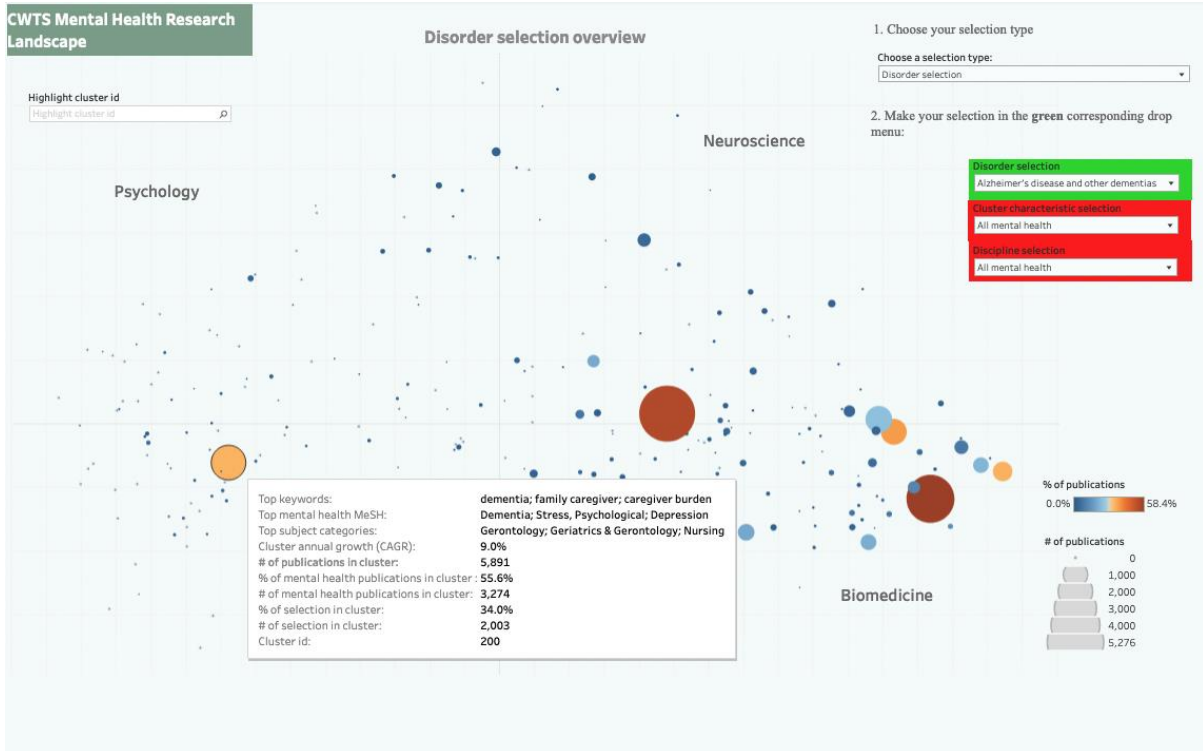
Portfolio visualisation

Finally, the portfolio visualisation allows to compare the distribution of publications of a given unit (country, funder or organisation) over the 280 topics related to mental health.

The structure of the map is the same as in the 'research landscape' visualisation, but now the size of circles shows the number of publications of a unit over the 280 topics, and the colour of circles show the relative specialisation of a country in a topic (specialisation above 1 means that a unit publishes more than would be expected).

In order to select a unit, you must first choose the type of unit (i.e. country, funder or organisation) at the top right, and then select the specific unit (e.g. Sweden or EU-27) in the drop menu in the right-hand side. **Warning:** when choosing a new unit, you should de-select the unit previously selected – otherwise the data of multiple units is added.

The underlaying data is available in this spreadsheet.

*Tab 3. The **portfolio tab** visualises the distribution of two units across the 280 topics or issues related to mental health research, thus allowing to compare their relative specialisation.*