

From Zero to Full Capacity? Personnel expansion in clusters of excellence

In clusters funded under the Excellence Strategy, researchers carry out joint investigations into an overarching topic in groups that can number from a few dozen up to as many as several hundred. Little has been done to date to examine the “life cycle” and internal dynamics of such projects, so this Infobrief takes a look at how quickly the clusters of excellence have grown to date and what their personnel structure was like in 2020. Based on personal data and participation figures, the composition of the clusters is differentiated according to career level, gender, subject area and the international background of the researchers involved.

1 Question

57 clusters of excellence began their work in January 2019 when the funding period began for the federal and regional government Excellence Strategy (ExStra). In order to achieve the overarching and long-term goal of this funding programme – namely to strengthen excellent, internationally competitive research – the foundations have to be laid at the outset: the recruitment of professionally qualified individuals. To this end, those responsible are called upon to swiftly assemble researchers who complement each other as a team in terms of previous experience, career stage, international background, subject specialism and other parameters.

This Infobrief looks at the start-up phase of these clusters of excellence. The following questions are addressed:

- How does the personnel structure of the clusters develop?
- Are there differences between clusters with and without a preceding project under the Excellence Initiative?
- With a view to the predecessor programme – the Excellence Initiative that expired in 2018:

are the clusters of excellence under the two funding programmes comparable in terms of their personnel structure? If not, what are the differences?

- What conclusions can be drawn regarding the gender and diversity of researchers in the clusters of excellence based on the data available?
- As part of the Coordinated Programmes Survey, the DFG reviews the clusters of excellence every year and has done so ever since they were first established (Section 2). Based on this data, Section 3 describes developments in the area of personnel within the clusters of excellence. Section 4 is devoted to the distribution of researchers in terms of subject specialism as well as the involvement of female researchers and those from other countries. Section 5 provides a summary of the analysis.

2 Background and data basis

The aim of the Excellence Strategy is to sustainably strengthen Germany as a research hub and further improve its international compet-

itiveness. In addition to the funding line Excellence Clusters (ExStra-EXC), ExStra also includes the funding line Universities of Excellence (EXU). This carries forward the objectives of the Excellence Initiative (2006–2019) in a similar format but without the Graduate Schools funding line. The clusters funded under the Excellence Initiative (ExIn-EXC) came to an end in December 2018 (clusters with an ExStra follow-up project) or in October 2019 (clusters without an ExStra follow-up project). Of the 57 clusters of excellence funded under the Excellence Strategy, 28 build on a predecessor project from the Excellence Initiative (DFG, 2018).

The data used for this Infobrief is drawn from the annual Coordinated Programmes Survey. Here the DFG collects data on researchers involved in consortia funded under the Excellence Strategy, Collaborative Research Centres and Research Training Groups¹. Conceived of as a full-scale survey, these annual questionnaires provide an extensive database. In 2020, data was collected on exactly 45,393 people involved in the Coordinated Programmes, 10,363 of whom were researchers working in ExStra clusters during the 2020 reporting period.

Together with final reports and financial accounts, the survey forms part of funding recipients' reporting obligation to the DFG. Unlike the statistics on the use of financial resources, this survey focuses on information about the people involved. In contrast to final reports – which are not submitted until after the end of the project – the results of the survey provide information on the personnel situation on a yearly basis starting from the time of approval. Using the annual survey data, it is therefore possible to undertake real-time monitoring of gender representation, internationalism – based

on the involvement of researchers from abroad – and the duration of doctorates completed as part of Coordinated Programmes.

Three survey waves are used for the present analysis. The 2019 survey covers the reporting period of January (start of funding) to August 2019. The 2020 survey data set describes the reporting period of September 2019 to August 2020. The survey of Excellence Initiative clusters (ExIn-EXC), which has been included for comparison purposes, reports on the period from September 2017 to August 2018, i.e. the final phase of the ExIn research consortia.

3 Personnel increase over time

The dynamic of the increase in academic personnel involved in ExStra clusters is analysed below based on the development of recruitment, the size of the clusters and the participation of researchers at different career stages. This analysis indicates differences between clusters with and without ExIn predecessor clusters. The period under consideration – January 2019 to August 2020 – also includes the first wave of the coronavirus pandemic.

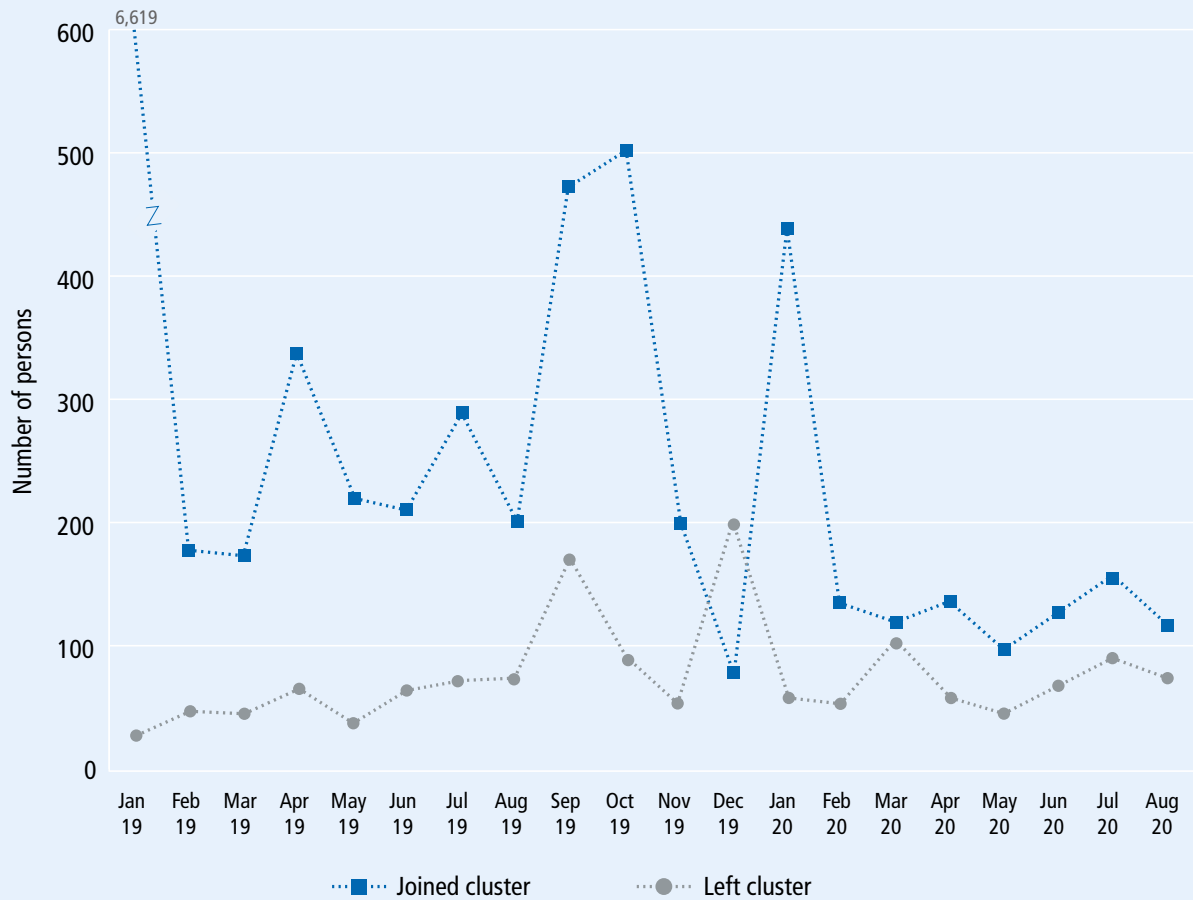
3.1 Development of incoming and outgoing personnel

When they were launched in January 2019, the clusters were already well staffed with a total of at least 6,600 researchers (Figure 1).

The number of researchers who joined the consortia in subsequent months did not develop evenly. Two major waves of recruitment are particularly noticeable: the first took place in autumn 2019, while another occurred in January 2020. Two smaller peaks can be observed in April and July 2019. Two of the peaks coincide with the start of the semester (winter semester in October and summer semester in April). From February 2020 onwards there was an ongoing increase in personnel, though this

¹ Data is collected on all persons who were involved in the consortium for at least one month during the respective reporting period and who contributed substantially to research, regardless of the source of funding. These individuals include doctoral students, postdoctoral researchers, early career research group leaders, junior professors, professors and other academic staff. Information is also collected on visiting researchers whose stay was financed out of project funds provided to the consortium by the DFG and who also worked at the consortium for a period of at least one month.

Figure 1:
Development of incoming and outgoing personnel over time in ExStra clusters (January 2019 to August 2020)



Data basis and source:
Annual Coordinated Programme Survey 2020 (N=10,784 people involved in ExStra clusters in 2019 or 2020).

was less marked than in the preceding year. Since the start of the coronavirus pandemic, no further noticeable peaks in recruitment can be observed. Even under these more difficult conditions, however, 9,397 researchers were pursuing research in clusters of excellence in the month of August 2020.

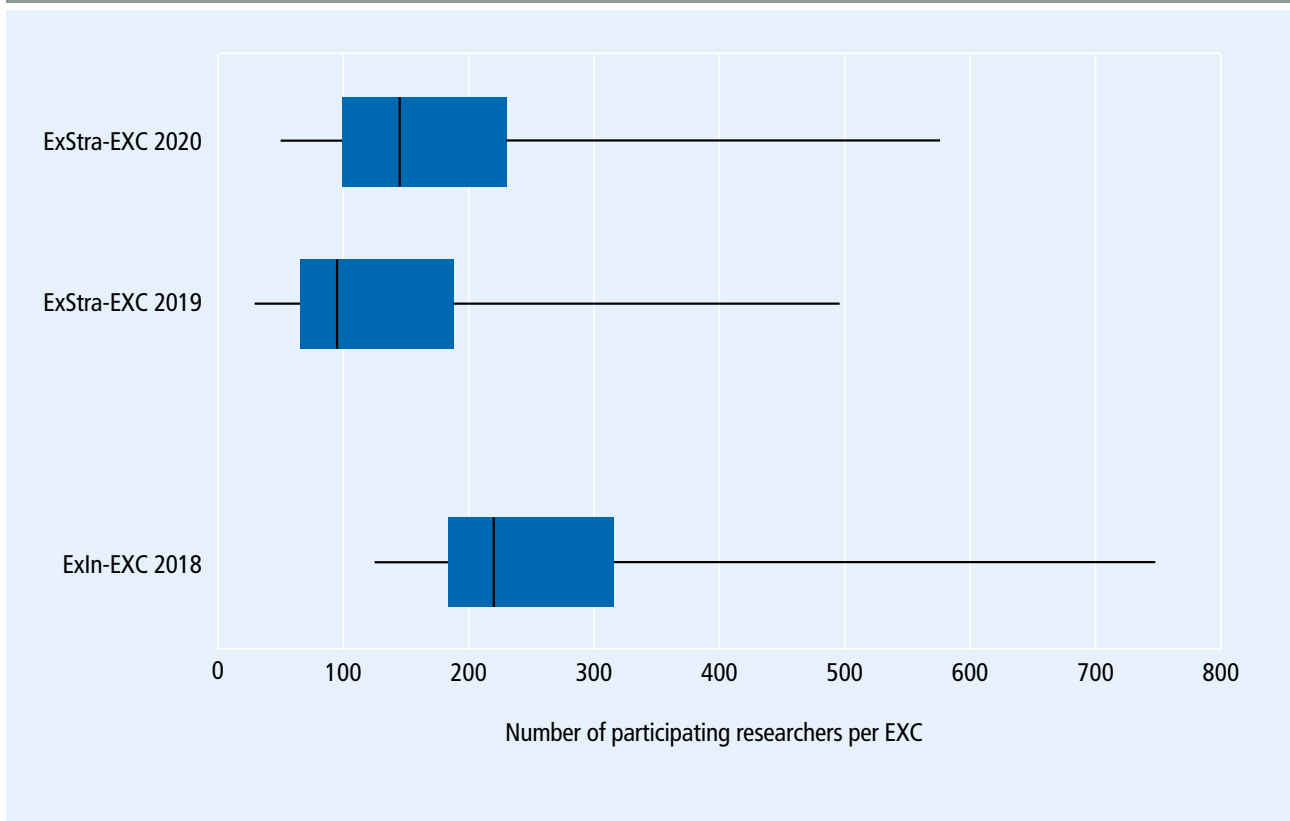
In addition to the new recruitments, there were departures, too. The development here only shows smaller peaks in September 2019, i.e. before the start of the winter semester, and at the end of the year in December 2019. By August 2020, 1,385 people had left, in other words 13 percent of all those involved at least for some of the time since January 2019. Leavers include 243 doctoral students who completed their doctoral studies in 2019 or 2020, as well as 232 visiting researchers.

3.2 Development of cluster size over time

It is possible to trace the development of cluster size by comparing the 2019 reporting period with the 2020 reporting period (Figure 2). The number of researchers involved in the clusters increased significantly within one year: from an average of 93 researchers in 2019 to 145 researchers in 2020 (median in each case). As such, the clusters grew to the size of a medium-sized enterprise.

The boxplot shows the median, quartile intervals and range. 25 percent of clusters are below the lower quartile and 25 percent are above the upper quartile, so 50 percent of the clusters are within the range between the lower and upper quartiles. The quartile distance is marked by the box. The median divides

Figure 2:
Number of researchers per cluster and reporting period (boxplot)



Data basis and source:

Annual Coordinated Programme Surveys 2018, 2019 and 2020 (N=11,521 persons in ExIn clusters 2018, N=7,895 persons in ExStra clusters in 2019 and N=10,363 persons in ExStra clusters in 2020). Median, lower and upper quartile and range.

the box as a vertical line. The horizontal line shows the range of results (minimum to maximum value).

From the beginning, there are obvious differences between the clusters in terms of their staffing levels. In the first reporting period of 2019, the lower quartile is 64 and the upper quartile is 186 researchers per cluster. This means that for 50 percent of clusters, the number of participating researchers lies in the range in between. During the 2020 reporting period the clusters continue to grow but the diversity in cluster size remains: the lower quartile is 99 and the upper quartile 230 researchers per cluster.

One reason for this wide range is the previous history of the clusters. ExStra clusters that built on a predecessor project from the Excellence Initiative – and were therefore able to transfer existing research staff – were significantly larger from the start: with 150 research-

ers in the 2019 reporting period, they already had twice as many staff on board as the newly established clusters with 75 researchers (median in each case). One year later, this difference in staff numbers persists: 205 researchers are involved in clusters with an ExIn predecessor project, while 115 researchers are involved in clusters without an ExIn predecessor project (median in each case).

A look at the ExIn clusters in the last year of the Excellence Initiative 2018 – i.e. in its final phase – shows that the spread in staff numbers is comparable here. The 50 percent interval ranges from 182 to 322 researchers per cluster. This means that the difference in the number of researchers involved in research projects does not just depend on the speed of personnel recruitment. More than anything, it reflects the research questions being addressed and the varying needs of the specific research project in this regard. When

comparing the personnel figures of ExStra to ExIn clusters, it should also be taken into account that Excellence Initiative clusters were in their last funding year, while the data presented here for the Excellence Strategy clusters was collected 20 months after the start of funding.

3.3 Development of the clusters over time according to researcher career stages

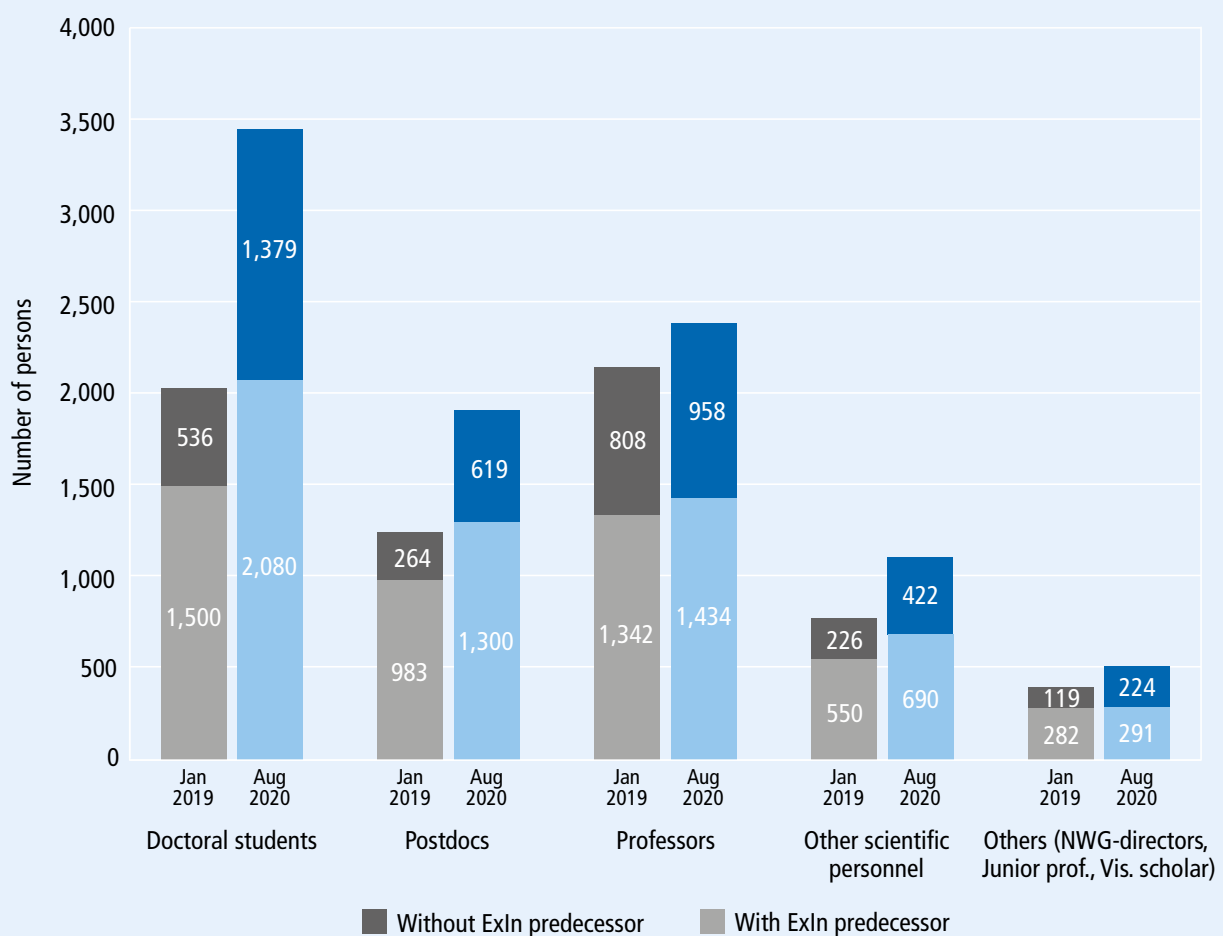
The total figures discussed above refer to researchers at differing stages of their career. Typically, research projects are initiated by a core of experienced researchers at higher career levels – the principal investigators. As projects develop, there is increasing recruit-

ment of researchers who are at other career stages.

In January 2019, professors initiating the cluster form the largest group (N=2,150), immediately followed by doctoral students (N=2,036, Figure 3). The starting position of ExStra clusters with an ExIn predecessor (N=28) in terms of personnel differs significantly from those without a predecessor cluster (N=29): On average, almost three times as many doctoral students and almost four times as many postdocs are involved in clusters with a predecessor than in those without.

The majority (81 percent) of doctoral students who were involved in ExStra clusters from the very beginning in January 2019 joined the cluster with their doctoral studies

Figure 3:
Development of academic staff in ExStra clusters by career stage and ExIn predecessor



Data basis and source:

Annual Coordinated Programme Survey 2020 (N=6,610 in January 2019 and N=9,397 in August 2020 involved in ExStra clusters).

already in progress. This proportion is roughly the same for clusters with and without an ExIn predecessor (80 percent to 85 percent). So in the recruitment of doctoral researchers at the start of the cluster, clusters both with and without an ExIn predecessor opt to recruit individuals who have already started their doctoral studies.

From January 2019 to August 2020, the number of doctoral students increased by approximately 70 percent, so this becomes the largest personnel category. Postdoctoral researchers also joined clusters in large numbers (up 54 percent), and the involvement of early career researchers increased. By contrast, the number of professors remained largely stable, with growth of only 11 percent. All in all, the differences in personnel structure between the ExStra clusters with a predecessor and the clusters without an ExIn predecessor can be seen to decrease in the course of 2020.

4 Personnel structure of the ExStra clusters

The ExStra Cluster of Excellence programme is often perceived as a continuation of ExIn. In other funding programmes where new projects are approved or terminated on an ongoing basis or every six months, as in the case of Collaborative Research Centres and Research Training Groups, for instance, structural changes are fluid over time. By contrast, there is a hard cut-off between the Excellence Initiative and the Excellence Strategy: all ExIn projects were completed in 2018 or 2019, and ExStra projects started their work in 2019. This cut-off was only mitigated by the option for ExIn clusters to submit proposals under ExStra. So although the funding lines are formally identical to a large extent, their consortia and the structures these are based on are not.

4.1 Researchers by academic discipline

A major difference between the clusters of the Excellence Initiative and those of the Excellence Strategy is subject composition². This is significant insofar as personnel structures under the cluster of excellence funding line are very much shaped by the specialist background of the researchers involved.

A comparison of the two funding lines reveals the differences (Figure 4).

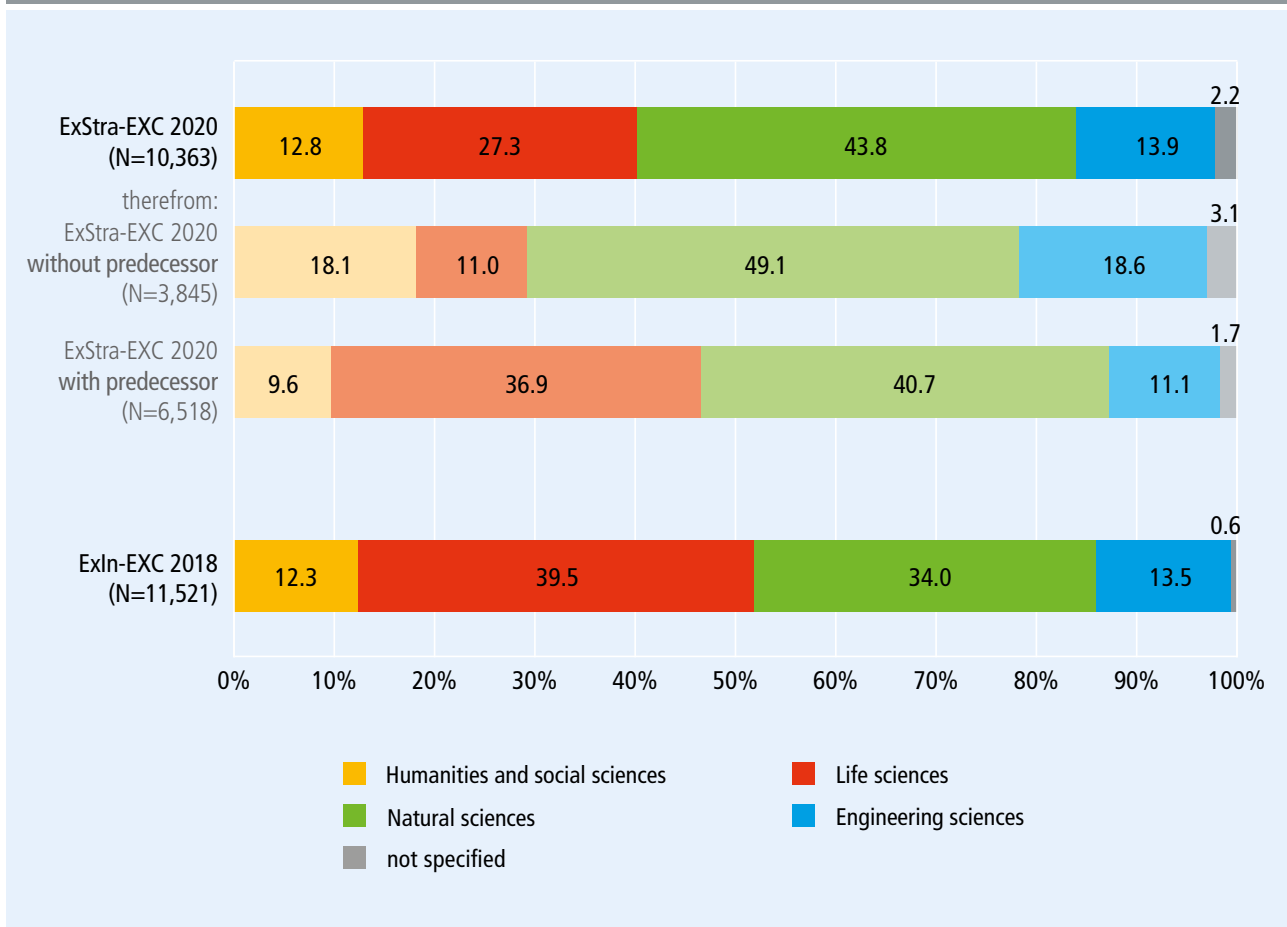
While composition by career stage shows a dynamic development in the start-up phase of the clusters, the distribution of researcher subject areas is primarily dependent on the defined research focus, which means it remains relatively stable over time. For this reason, only the subject-area distribution among researchers involved in clusters of excellence in 2020 will be discussed here.

Natural science specialists are the largest group among ExStra-EXC researchers, accounting for 44 percent. Life scientists make up the second largest group at 27 percent. Researchers in the engineering sciences account for 14 percent, almost the same as the share of researchers in the humanities and social science subjects, which is 13 percent. This means that the subject-area distribution among researchers involved in ExStra clusters differs significantly from those in ExIn clusters. In the latter, most researchers were focused on the life sciences (40 percent), followed by the natural sciences (34 percent).

A differentiation between ExStra clusters with and without cluster predecessor from the Excellence Initiative shows significant differences: in clusters without a predecessor, almost half the researchers specialise in a natural science subject, with only just over a tenth specialising in the life sciences. In the clusters with an ExIn predecessor, the ratio is more balanced

² The researcher's subject area is surveyed individually for each person. The subject classification used here is that defined by the Federal Statistical Office (so-called teaching and research areas), which is transferred to the DFG system of classification.

Figure 4:
Participating researchers by academic discipline (in percent)



Data basis and source:
Annual Coordinated Programme Surveys 2018 and 2020 (N=11,521 persons in ExIn clusters and N=10,363 persons in ExStra clusters).

and bears greater similarity to the subject composition of the ExIn-EXC.

4.2 Researchers by gender

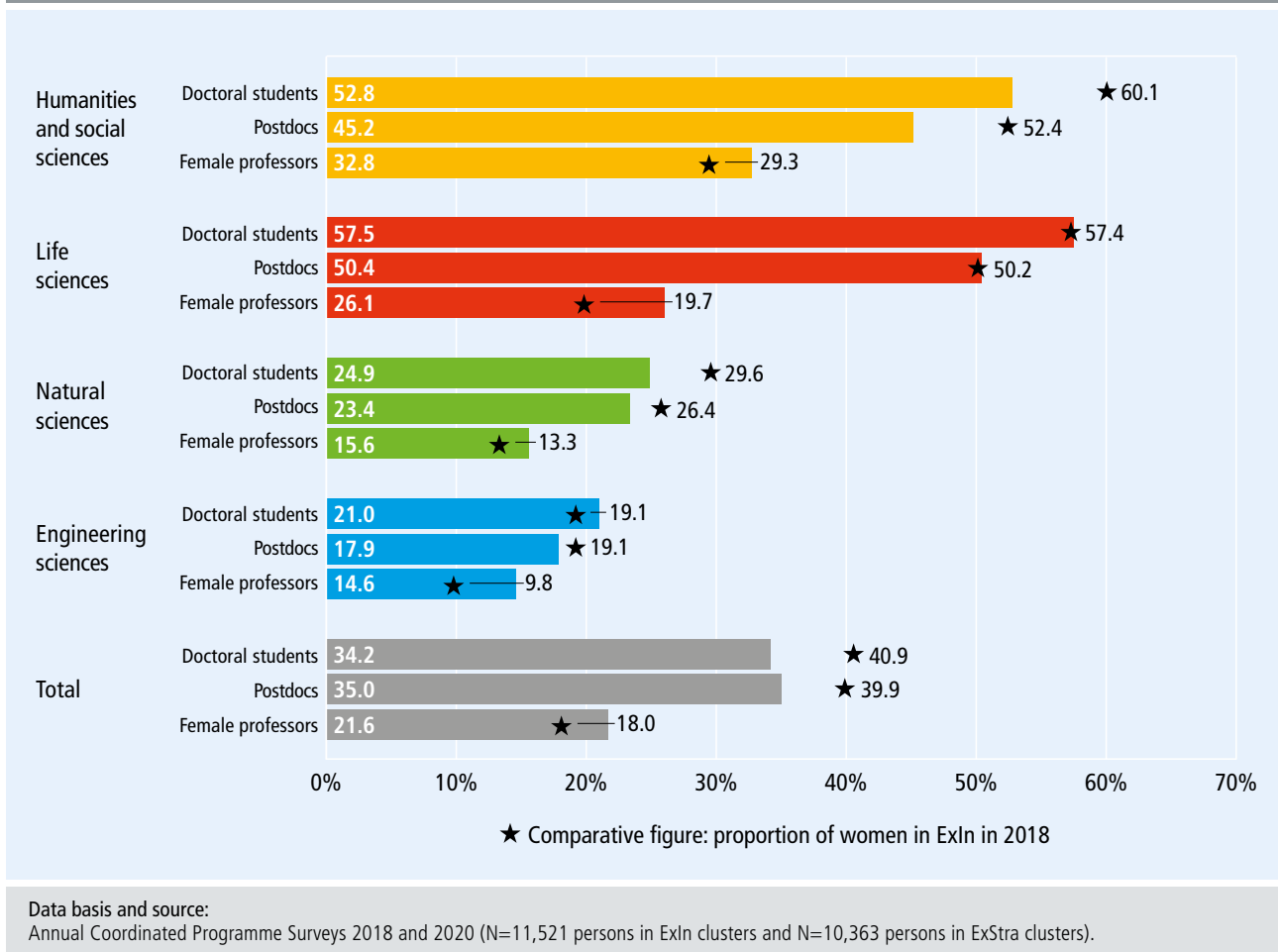
Equal opportunity is explicitly anchored in the funding criteria of the Excellence Strategy. Based on the data available, information can be provided here regarding one aspect of this equal opportunity, namely the involvement of female researchers. A suitable basis for comparison is provided by the Excellence Initiative – previous funding programme with comparable funding objectives.

In 2020, 32 percent of researchers in clusters of the Excellence Strategy were female. This is less than in the Excellence Initiative, where the figure was 36 percent. Since the proportion of female researchers usually var-

ies significantly between subjects (see for example DFG 2020 a, DFG 2020 b, DFG 2020 c) and there is differing subject area representation in ExStra and in ExIn, gender distribution has to be considered from the point of view of the researchers' subject background. In addition, we already know that the proportion of women decreases at higher career levels (see e.g. DFG Equal Opportunities Monitoring 2020). So in the following, gender distribution is differentiated both by career level and academic discipline. Where there are sufficient numbers – even at the level of the more detailed DFG subject areas – and differences can be observed, these are also indicated.

The known subject-specific and career-specific patterns in gender distribution are also to be found among researchers in the clusters of excellence: women are more involved in the

Figure 5:
Proportion of female researchers by academic discipline in ExStra 2020 (in percent)



humanities, social sciences and life sciences than in the natural sciences and engineering sciences. The proportion of female professors is lower than that of female postdocs and doctoral students (Figure 5). The distribution at individual career levels has changed somewhat as compared to the Excellence Initiative, however.

Among professors, the proportion of women in the ExStra clusters is higher (22 percent) than in ExIn clusters (18 percent) – the levels differ but reflect the same overall trend in all academic disciplines. At the other career stages, the situation regarding the participation of female researchers is different, however.

At 34 percent, women are significantly less represented among doctoral researchers across all academic disciplines than they were in ExIn clusters (41 percent). This difference in the overall figure can be attributed in part to

the higher proportion of researchers from the natural sciences. In the following, therefore, the results are differentiated according to academic disciplines and, where this makes sense, according to subject areas.

In the humanities and social sciences, women account for 53 percent (ExIn-EXC: 60 percent) of all doctoral researchers. This puts their involvement in ExStra clusters a few percentage points behind their level of involvement in ExIn clusters.

In the natural sciences, 25 percent (ExIn-EXC: 30 percent) of doctoral students are women. However, there are differences here between the DFG subject areas that fall within this academic discipline and have large numbers of staff: while in mathematics the proportion of female doctoral students (ExStra-EXC: 26 percent, ExIn-EXC: 19 percent) has increased, it is lower in the subject areas of phys-

ics (ExStra-EXC: 20 percent, ExIn-EXC: 24 percent) and chemistry (ExStra-EXC: 32 percent, ExIn-EXC: 35 percent) as compared to ExIn.

In the life sciences, female doctoral candidates make up the majority of doctoral students (ExStra-EXC: 58 percent, ExIn-EXC: 57 percent). Differentiation by DFG academic discipline shows an increase in the participation of female doctoral researchers in medicine (ExStra-EXC: 58 percent, ExIn-EXC: 54 percent), while in biology the participation of female doctoral students remains at a high level (ExStra-EXC and ExIn-EXC: both 58 percent).

At 21 percent, female doctoral students in the engineering sciences are in fact slightly better represented in ExStra clusters than they were in ExIn clusters (19 percent). This increase is mainly due to one subject area: in mechanical engineering and production technology, 22 percent of doctoral students are women (ExIn-EXC: 17 percent).

The proportion of women among postdocs in the ExStra clusters is also lower than it was in the ExIn clusters: Across all academic disciplines, 35 percent of postdocs in the ExStra clusters are women (ExIn-EXC: 40 percent). The only exception here is the life sciences, where women and men are equally represented in the group of postdoctoral researchers (ExStra-EXC and ExIn-EXC: both 50 percent women). Further differentiation by DFG subject area reveals differences in the natural sciences: while in mathematics (ExStra-EXC: 20 percent, ExIn-EXC 23 percent), the proportion of female postdocs is lower than in ExIn, in chemistry (ExStra-EXC: 32 percent, ExIn-EXC: 31 percent) and physics (ExStra-EXC: 19 percent, ExIn-EXC: 20 percent) it is at the same level as in the ExIn clusters.

4.3 International background of the researchers

International collaboration in science and the humanities is an essential prerequisite for

competitive research. In order to promote it, researchers from abroad can be recruited to collaborate in clusters of excellence, for instance, or guest researchers can be invited for a short period of knowledge-sharing. Clusters of excellence currently face particular challenges in this regard, as the coronavirus pandemic is making international mobility more difficult (DFG, 2021).

The international quality of clusters is examined below using various indicators: the annual Coordinated Programmes Survey includes both the researcher's nationality and the country in which they worked prior to joining the cluster. German nationals might be returning from abroad, for example, while researchers of foreign nationality may already be living and working in Germany because they were either born here or they came to the country previously to take part in another research project. The involvement of guest researchers provides an additional indication of the international orientation of clusters.

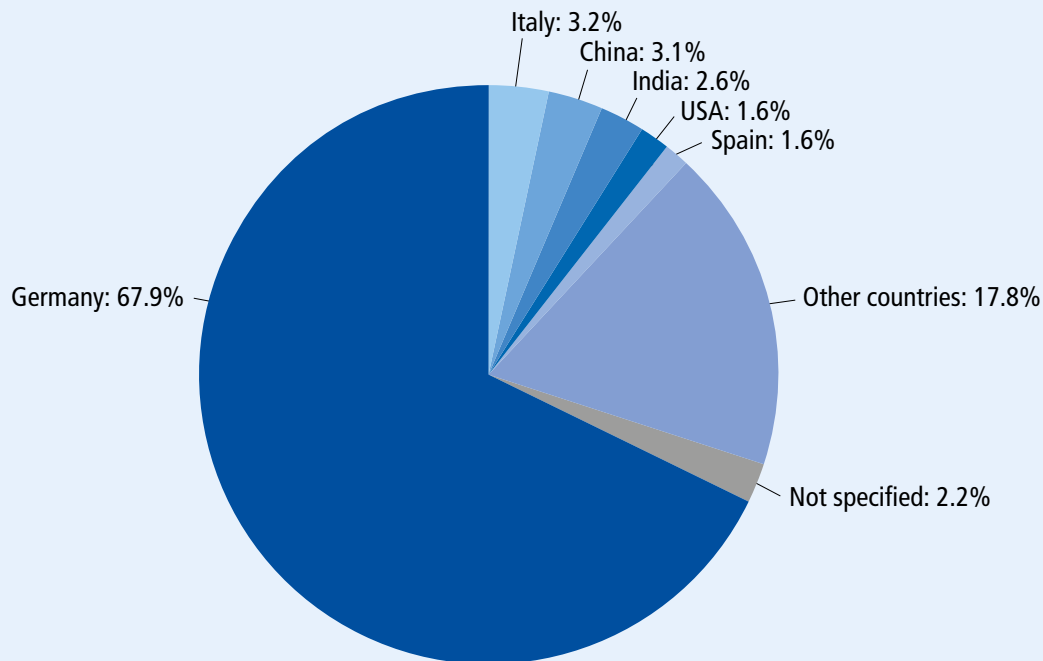
In 2020, 30 percent of researchers were of non-German nationality (Figure 6). This figure is on a par with that of the ExIn clusters in 2018 (29 percent, excluding visiting researchers in each case). Half of the researchers with foreign citizenship were already working in Germany before joining a cluster.

The nationalities of the researchers are spread over a wide variety of countries – a total of 118. After Germany, the list of nationalities is led by Italy, China and India with some 3 percent each.

In addition to medium and long-term cluster participants, 204 guest researchers are involved in clusters of excellence, 157 of whom are of foreign nationality. Among these, nationals from the USA (N=27) form the largest group.

Immediately before joining the cluster, 16 percent of researchers had worked abroad (Figure 7). As compared to the previous reporting year, this share has increased by 3 percent (ExStra 2019: 13 percent). However, it is still noticeably lower than was the case in the

Figure 6:
Nationality of researchers involved in ExStra clusters (in percent)



Data basis and source:

Annual Coordinated Programme Survey 2020 (N=10,159 persons in ExStra clusters, excluding visiting researchers).

ExIn (2018) clusters, where the figure was 22 percent.

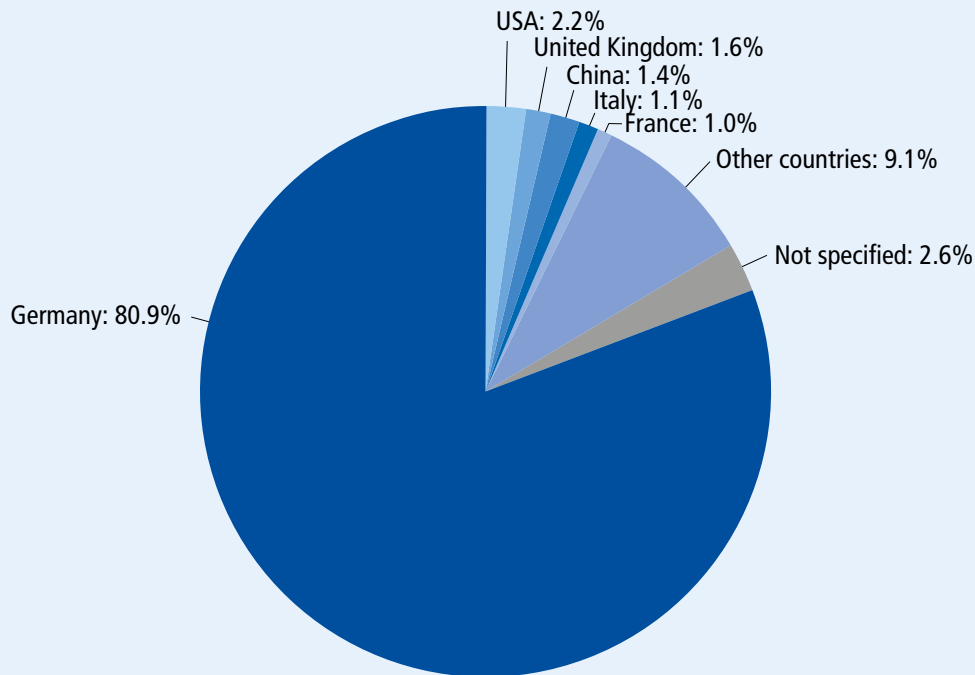
One reason for this lower proportion is the previous history of the clusters: ExStra clusters with an ExIn predecessor were better able than new consortia to build on existing staff already working in Germany. As such, Germany is automatically counted as the country in which these researchers were working prior to joining the consortium. Accordingly, ExStra clusters with an ExIn predecessor have a lower share of staff who have joined from abroad (15 percent) than clusters without an ExIn predecessor (18 percent). Although recruitment from abroad is also lower in this second group than in the clusters of the Excellence Initiative (2018), these clusters without ExIn predecessors also build on previous research activities – as already shown above (cf. Section 3). The extent to which the lower proportion of researchers coming from abroad remains limited to the start-up phase and international recruitment increases in subsequent years can

be observed based on upcoming Coordinated Programme Surveys.

The three most common countries from which academics come to Germany are the USA, the UK and China. Clusters of excellence attract researchers with different levels of experience from abroad, and there are differences between countries, too. The largest group within the researchers from the USA is made up of postdoctoral researchers (N=91), followed by professors (N=43) and doctoral researchers (N=38). Recruits from the UK are also predominantly postdoctoral researchers (N=61), followed immediately by doctoral researchers (N=56). Researchers recruited from China are mostly doctoral students (N=72). Here, postdoctoral researchers are only the second largest group (N=54).

Returnees form a group of their own: one in five (N=347 persons) researchers who worked abroad before joining the cluster of excellence has German citizenship. These researchers previously worked in 39 different countries, with

Figure 7:
Country in which the researchers involved in ExStra clusters worked before joining the cluster (in percent)



Data basis and source:
Annual Coordinated Programme Survey 2020 (N=10,159 persons in ExStra clusters, excluding visiting researchers).

the USA accounting for just under a quarter and the UK just under a fifth.

5 Summary and look ahead

This Infobrief presents the development of personnel in the 57 clusters of excellence from January 2019 to August 2020. After a swift start with significant waves of recruitment initially, growth continued in 2020 at a slower rate. International recruitment of researchers was hampered by the coronavirus pandemic but proceeded nonetheless, as reflected in the increasing number of researchers who worked abroad before joining the cluster.

At least half of the clusters build on a predecessor project under the Excellence Initiative. These clusters started off at a larger size and have involved more doctoral students and postdocs – in both absolute and proportional terms. The clusters with and without prede-

cessor clusters also differ significantly in terms of subject orientation. In future it will be possible to see whether there is any levelling process between the differing initial staff sizes of clusters with and without ExIn predecessors and if so, how quickly this happens.

The clusters of the Excellence Strategy differ from those of the Excellence Initiative in terms of the distribution of the subject specialisms of participating researchers, for example, as well as participant numbers. The latter has to be seen in the context of the “life cycle” of the consortia: the ExIn clusters were in their last year of funding in 2018, while the ExStra clusters did not start work until 2019.

The shift in gender distribution at the various career levels is striking: on the one hand, the proportion of female professors in ExStra clusters is higher than in the clusters of the Excellence Initiative, regardless of academic discipline. On the other hand, this contrasts with a lower proportion of female doctoral and postdoctoral researchers in the humani-

ties, social sciences and natural sciences. So in general it is true to say that in all academic disciplines, the stronger presence of women at the professor level is not (yet) reflected in a higher proportion of female researchers at earlier career stages. It remains to be seen to what extent this will change over time.

In conclusion, the initial question of this Infobrief “From zero to full capacity?” can be answered in the negative. Firstly, clusters did not start from zero: principal investigators recruited a large proportion of the academic staff in the very first month, and the vast majority of doctoral students joined the cluster with their doctoral studies already in progress. Secondly, team-building remains an ongoing process: the number of participants continues to increase – especially doctoral students and postdoctoral researchers. It will be possible to draw on future Coordinated Programme Surveys to monitor whether the slow-down in growth caused by the coronavirus pandemic is made up for in the coming years. The same applies to the issues of international mobility and the participation of female researchers in clusters of excellence. There is still potential for development in both areas.

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