MAX PLANCK PhDnet

The doctoral network of the Max Planck Society

Max Planck PhDnet

SURVEY REPORT 2022

PhDnet Report 2022

PhDnet Survey Group

26 September 2023

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Chapter 1

Introduction

The Max Planck Society (MPS) comprises 85 research institutions, most of which are located in Germany, across many different scientific fields. These fields are organized into three sections: Chemistry, Physics, & Technology (CPT); Biology & Medicine (BM); and Human Sciences (HS). Researchers from around the world flock to MPS for the opportunity to do excellent research with top-notch facilities, and unlike in universities, with minimal teaching requirements.

As of 2022, more than 5000 individuals were privileged enough to be working towards a PhD in a Max Planck Institute (MPI). These doctoral researchers (DRs) come together in the official network of the MPS known as the Max Planck PhDnet (or just "PhDnet"). PhDnet represents DRs' perspectives in conversations with the MPS General Administration. This work is organized into several working groups on topics of relevance to DRs and the necessary functioning of the network. PhDnet is also a member of the Network of Doctoral Research Networks known as N^2. As representatives for the largest group of non-university-based DRs in Germany, N^2 and PhDnet are frequently engaged by policymakers and advocates for reform of academic labor regulations. More information on PhDnet is available at phdnet.mpg.de.

One key function of PhDnet is to measure and gather opinions from all affiliated doctoral researchers. This is the primary responsibility of the Survey Working Group. This ambitious annual survey allows us to report on the demographics of who is doing a PhD in the MPS, DRs' working conditions, the quality of PhD supervision, satisfaction with support structures, levels of conflict and discrimination, and the state of DRs' mental and physical health. The data gathered anonymously in this survey has previously been used to advocate for improvements that benefited all DRs in the MPS, such as ending the use of internal stipends in favor of employment contracts, then increasing the standard contract rate, and increasing the number of holidays offered in doctoral support contracts. Additionally, anonymized reports of only the respondents within each institute allow for local PhDnet representatives to identify problems specific to that institute, and the report can then be used to advocate with directors on the local level. We are grateful to all members of PhDnet who take the time to participate in this survey, as it is an incredibly valuable tool when speaking with administrators and policymakers about what doctoral researchers need to flourish during their PhD period.

This report is arranged into chapters reflecting the key topics of our analysis. Here we will summarize the key findings of each chapter, which are further detailed below.

- **Demographics**
  - 2323 DRs participated in the survey in 2022, a decrease from the previous year's participation rate
  - Respondents included slightly more women relative to men than the previous year, but the gender balance differs by section, with CPT being the most male-dominated section
  - Only 41.6% of respondents are German citizens, reflecting a significant population of international researchers
- **Working Conditions**
  - Base salary has improved for most DRs since the 2020 increase of the doctoral support contract to TVöD E-13 65% level, but some DRs still do not receive this
  - Despite a recommendation of "3+1" contracts (3 years with up to 1 year of extension), most DRs receive several contracts or other types of funding (including stipends and unpaid periods) throughout their PhD
  - The average expected time to completion of PhD is 4 years
  - DRs continue to work more hours than required by their contract and fail to use all of their holidays, mainly due to a fear of not completing their PhD in time
  - A significant number of DRs in the MPS are involved in teaching during their PhD, even though MPIs are not generally considered teaching institutions
  - More than half of DRs have considered quitting their PhD
- **Supervision**
  - 44% of DRs have both a supervision agreement and a Thesis Advisory Committee (TAC), the two items specified in MPS doctoral researcher training guideline
  - Most DRs with formal/direct dual supervisor arrangement would like to meet more frequently with their formal supervisor
  - Many DRs receive little supervision from non-early career researchers
  - DRs stated that their supervisors do not have clear and strict requirements for their work
- **Available Support Structures**
  - Most DRs feel well supported with their arrival in Germany, though more support would be appreciated with university enrollment and finding accommodation
  - German language is not a significant problem
  - Most DRs hope to continue working in science, either in academia or a non-academic research institution, though evaluations of preparedness for their next career step vary
  - Most DRs do not have children or plan to have children during their PhD, but most DRs also don't believe that their institute provides sufficient support with childcare
  - Satisfaction with some support structures has dropped in the last few years, particularly psychological support, support for international DRs, bureaucracy and administration, and family
  - DRs who participated in courses

offered by Planck Academy are satisfied with them, but 74.5% of DRs have nor participated in Planck Academy and 29% were not familiar with the program

- **Conflicts and Discrimination**
  - 8.9% of respondents reported experiencing some form of sexual harassment, which is almost double the rate from 2019. 84% of those who were sexually harassed are women.
  - 22.6% of respondents reported being bullied. The most common reason for the bullying was the respondent's position of power in the hierarchy.
  - We evaluate the levels of identity-based discrimination related to:
    * nationality: 16.2% among non-EU citizens
    * gender: 13.6% among women and 24% among gender diverse people
    * LGBTQI+ identity: 7.2% based on sexual orientation and 13.8% based on gender identity
    * disability: 22.2% of those with Schwerbehindertenausweis ("disability identification card") legal status
    * parenthood: 15% of parents
  - Satisfaction with conflict reporting mechanisms of the MPS remain similar over the past few years, but many DRs who have experienced conflicts still choose not to formally report them
- **Mental and Physical Health**
  - The majority of DRs who reported mental health issues that bothered them also indicated that their work was affected: 17.6% stated that it was extremely or very difficult to perform their work, while an additional 56.3% found it somewhat difficult
  - For the first time in this yearly survey, the work-related physical health of doctoral researchers was assessed: most DRs have no significant physical representations of stress
  - Awareness of the Employee and Manager Assistance Program among DRs is low, with 65.7% of respondents indicating that they have not heard about the program

Data such as that gathered in the PhDnet survey is rather unique, and it is crucial for understanding the wellbeing of DRs and what they need to thrive and succeed as early career researchers. We appreciate the time and dedication of all of the survey participants, the representatives at MPIs who helped us reach their colleagues, and the oversight and collaboration of other members working in PhDnet to help make this survey a success.

Chapter 2

Demographics

In this chapter, we will discuss the demographics of doctoral researchers (DRs) that participated in PhDnet Survey 2022 in terms of participation rate, gender distribution, citizenship, family status, age at the start of their PhD and participants year of PhD.. The responses given by participants serve as a valuable resource, providing representative insights into various aspects of being a DR in the Max Planck Society (MPS).

In the PhDnet survey of 2022, a total of 5455 eligible Doctoral Researchers (DRs) were invited to participate, from which 2323 (42.6%) complete and valid responses were collected. It is worth noting that the overall response rate of 42.6% is lower than the 47.2% response rate in the 2020 survey. We can only speculate that this difference is due to the different time periods in which the surveys were conducted. The PhDnet survey of 2021 was conducted in November of that year, while the survey of 2022 was conducted in December.

The gender distribution of DRs is an important aspect of the demographics. According to the PhDnet Survey 2022, the gender distribution of DRs is fairly balanced, with 51.1% men, 46.1% women, 1.7% gender diverse people, and 1.4% who did not provide their gender identity. The proportion of gender identities has slightly changed compared to the year before (53.3% men and 44.1% women in 2021 [1]). Because of the limited number of participants who identified as gender diverse or declined to disclose their gender, we chose to focus on exploring gender-based correlations exclusively between women and men in most of our analyses in order to protect individual respondents' privacy. The gender distribution varies across different sections and fields of study: in BM and HS, the gender distribution is skewed towards women, with 56.4% women and 41.1% men in BM, and 53.7% women and 41.7% men in HS. On the other hand, in CPT, women represent only 34.2%, while men make up 63.2% (Figure 2.1).

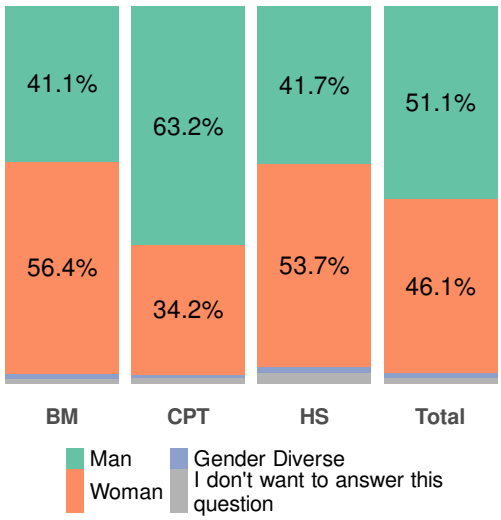

Figure 2.1: Gender Distribution per Section and in Total.

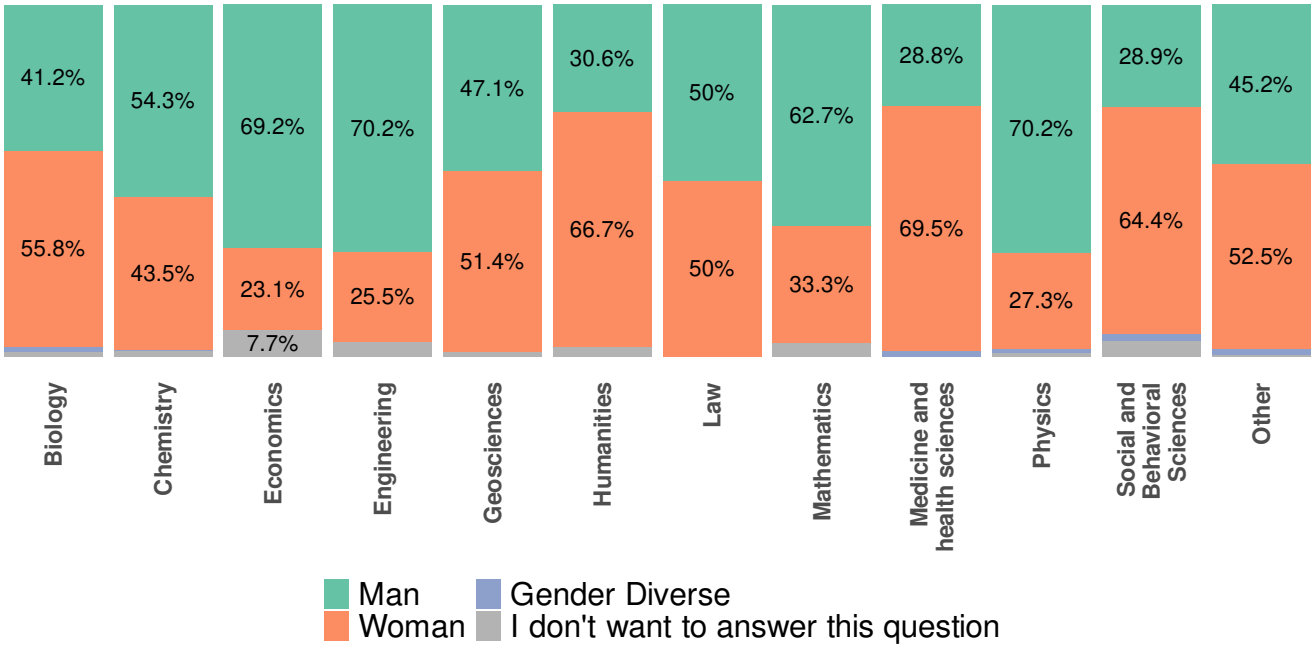

Figure 2.2: Gender Distribution per field of study.

Additionally, the survey revealed that the gender distribution varies among different fields of study, similarly to how it varies among different sections. For example, in the fields of Humanities and Social and Behavioral Science, the gender distribution is 66.7% women and 30.6% men, and 64.4% women and 28.9% men, respectively. In contrast, in the field of Engineering, Mathematics, and Physics, women represent 25.5%, 33.3%, and 27.3%, while men make up the majority with 70.2%, 62.7%, and 70.2% (Figure 2.2).

Citizenship is another important aspect of DRs' demographics. In the 2022 PhDnet survey, the majority of DRs hold a citizenship from the European Union. Specifically, around 41.6% of DRs are German citizens, 19.3% hold citizenship from other countries within the European Union, while 38.0% of DRs hold citizenship from countries outside the European Union. Citizenship distribution per section does not vary significantly from the general distribution. However, in the BM and CTP sections, there are slightly more German and European citizens than in the HS section: only 26.5% in HS compared to 38.5% in CPT and 42.5% in BM. (Figure 2.3.)

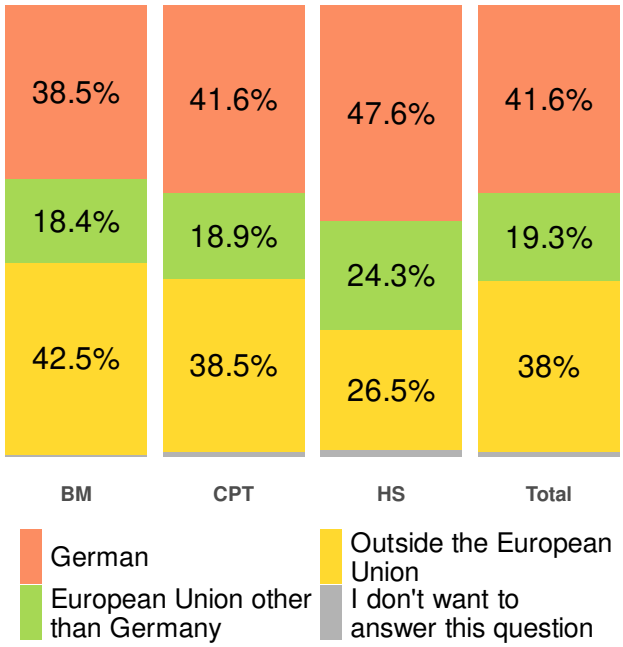

Figure 2.3: Citizenship of DR per Section and in Total

The PhDnet survey of 2022 indicates that the overall percentage of DRs who have or are expecting children is 8.2%, which is similar to the 8.1% reported in the 2021 PhDnet survey [1].

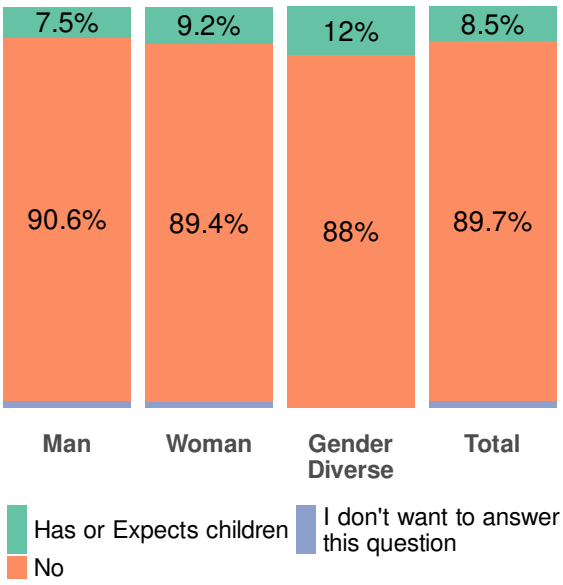

Figure 2.4: DRs that currently have and expect children or children status.

At the start of their PhD, the average age of DRs is around 26 years old. The overall age distribution of DRs is shown in Figure 2.5. Additionally, we categorized all survey participants based on their current year of PhD (Figure 2.6). The majority of participants were in their second, third, and fourth years of their PhD, accounting for over 21% each. Approximately 13.9% of DRs were in their first year, while 16.7% were in their fourth year or beyond. This is an important consideration to keep in mind throughout our analyses, as we have collected data from respondents at different stages of their PhD equally distributed across the years.

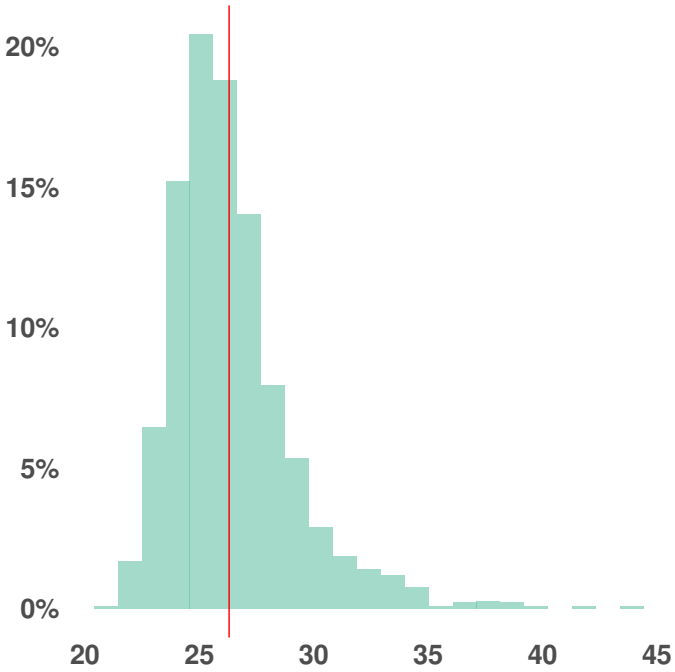

Figure 2.5: Age of DRs.

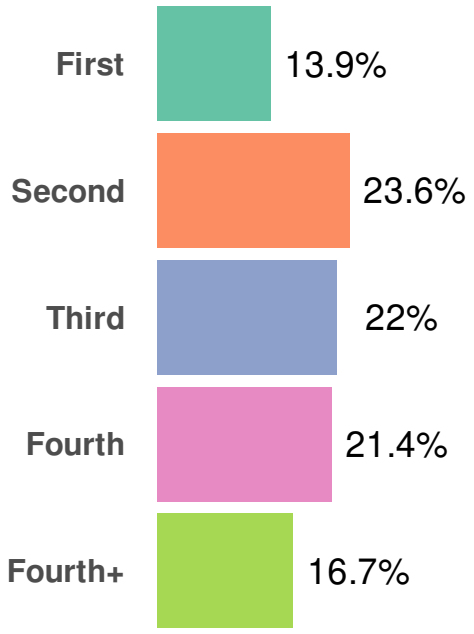

Figure 2.6: Participants and year of PhD.

In this report, we present the demographic information of the DR survey participants who volunteered to take part. Based on this data, readers can deduce the specific conditions of these individuals within MPS. It is important to acknowledge that certain variables, such as the will-

ingness of certain demographics to respond to surveys, cannot be controlled for in this survey. To estimate the experiences of all DRs across MPS by demographics and fields of study, we make the assumption that all demographics have an equal likelihood of participating in our survey.

Chapter 3

Working Conditions

Working conditions refer to the environment and circumstances in which work is carried out. It is important to evaluate working conditions because they can affect employees' health, both physical and mental, and can influence their retention [2]. Additionally, it can impact the organization's ability to attract new talent and create a positive work environment. Identifying areas where working conditions need improvement is essential to ensure a basic safety net for the well-being and financial stability of doctoral researchers. This chapter will cover several aspects related to working conditions, including employment situation and funding, duration and number of employment types, unpaid DRs, income, working hours and holidays, teaching as part of PhD-related work, and satisfaction with various aspects of working conditions.

3.1 Employment situation and funding

The objective of this section is to provide an overview of the employment situation of DRs in the MPS and to identify any noticeable trends. To achieve this, we classified DRs based on their sections, fields of study, gender and citizenship. Additionally, we sought to compare the distribution of employment types with the chronological order of contracts received and the current year of the PhD. To ensure the financial security and well-being of DRs, we also looked in more detail at commonly problematic employment situations, such as receiving no pay at all and usage of stipends instead of contracts.

Employment can be categorize into one of five types including:

- Contract-based employment
- External stipend/funding received within Germany
- External stipend/funding received from abroad
- Internal stipend/funding received within the MPS
- Unpaid employment.

Contracts are a form of payment that is agreed upon for typically the entire duration of the DRs employment by DR and supervisor, which contains benefits such as a pension plan, social insurance, and health insurance. A contract is sometimes subject to collective bargaining agreements or tariffs. The MPS offers "Doktoranden Fördervertrag" (support contracts) which are modelled on 65% of level E-13 of the TVöD tariff [3]. With a contract, the doctoral researcher is legally bound to their workplace and pays into the social security system. On the other

hand, stipends could be similar in terms of pay, but usually do not come with additional benefits and are typically not based on hours worked. Stipends take the form of external funding from within Germany, international funding, and internal funding from the MPS. With a stipend, the doctoral researcher is not legally bound to their workplace and have to arrange their social security themself rather than the employer. While internal stipends have been abolished from the MPS and are being phased out, we kept this as a category due to other forms of stipends still being handed out within the MPS [4].

Initially, we classified DRs based on their respective sections: Biology and Medicine (BM), Chemistry, Physics and Technology (CPT), or Human Sciences (HS). The primary type of funding across all categories was found to be contracts, with approximately 78-89% of DRs employed by them in each section. In line with the 2021 survey results [1] , the CPT section has the highest percentage of DRs with contracts, followed by the BM section, with the lowest percentage of contract holders observed among DRs in the HS section. The findings revealed that over 14% of DRs employed in the HS section receive funding internal stipend (6.1%) and external stipend / scholarship paid by a different institution in Germany (8.4%). Furthermore, it was found that 3.1% of DRs in the HS section reported being unpaid, which is five times higher than the rate in the BM section and ten times higher than in the CPT section (Figure 3.1).

When categorizing DRs into specific fields, similar tendencies were observed in their employment situations. Physics, Engineering and Geosciences were the top three fields with the highest percentage of contract holders among DRs. On the other hand, Humanities, Social and Behavioral

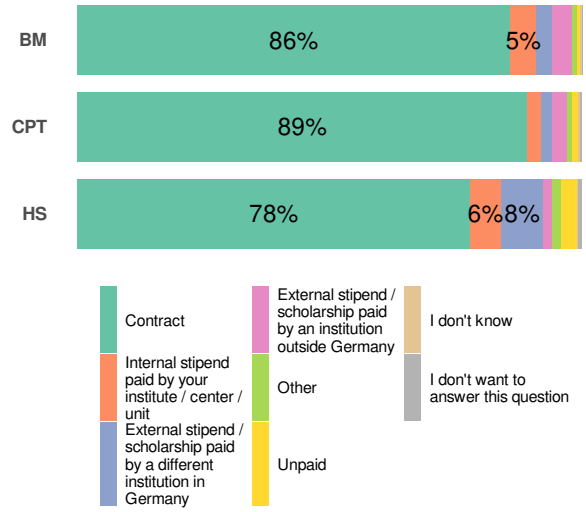

Figure 3.1: Distribution of DRs by employment situation and section.

Sciences had the lowest number of contract holders. Notably, the highest percentage of unpaid doctoral students belonged to the field of Humanities (6.9%). The fields that show a higher percentage of Internal stipend are Economics (7.7%), Humanities (6.9%) and Biology (5.8%) as shown in Supplementary Figure A.1.

The distribution of employment situation based on gender does not vary much between DRs who identified themselves as women, men or gender diverse (Figure 3.2).

In terms of employment type by citizenship, contracts are equally prevalent for German and European Union doctoral researchers. However, for doctoral researchers with citizenship outside the European Union, other forms of employment, particularly external stipends and scholarships from Germany and abroad, are more frequent (Figure 3.3). This could be due to a tendency among international researchers to first look for internationally recognized scholarship opportunities in their home country before applying for research positions abroad.

In addition, we were interested in comparing the distribution of employment

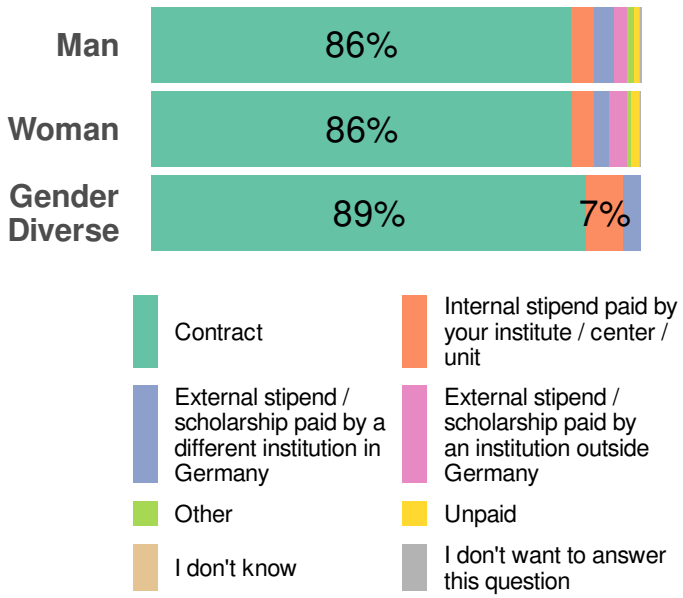

Figure 3.2: Distribution of DRs by employment situation and gender.

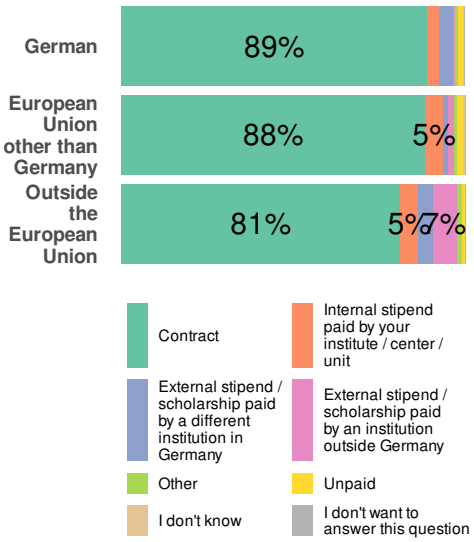

Figure 3.3: Distribution of DRs by employment situation and citizenship.

types with the chronological order of contracts received and the year of the PhD. The majority (84-88%) of DRs had contracts throughout their PhD, from the first to the fourth year and beyond. Notably, 12% of respondents in their first year reported receiving an internal stipend, although this type of employment has been abolished within the MPS [4]. Additionally, approximately 5% of DRs received external stipends during their second and third year of the PhD (Figure 3.4).

When looking at the first employment situation of DRs, 84% of DRs began their PhD receiving a contract, but also 8% of DRs first received internal stipends. When looking later employment situations, it is important to highlight that some survey participants stated their employment situation as unpaid as third (7%), fourth (12%) and fifth (6%) type of employment (Figure 3.5), suggesting that later in the PhD process, some DRs may run out of funding opportunities. These findings provide insights into the employment patterns and transitions experienced by DRs during different stages of their doctoral research.

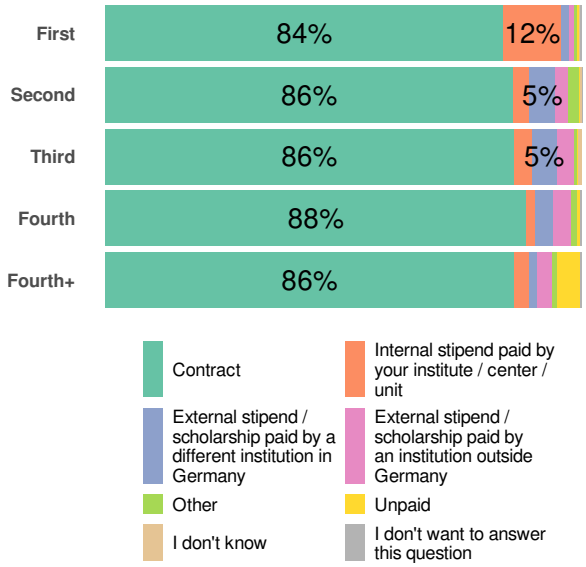

Figure 3.4: Distribution of DRs by employment situation and year of PhD.

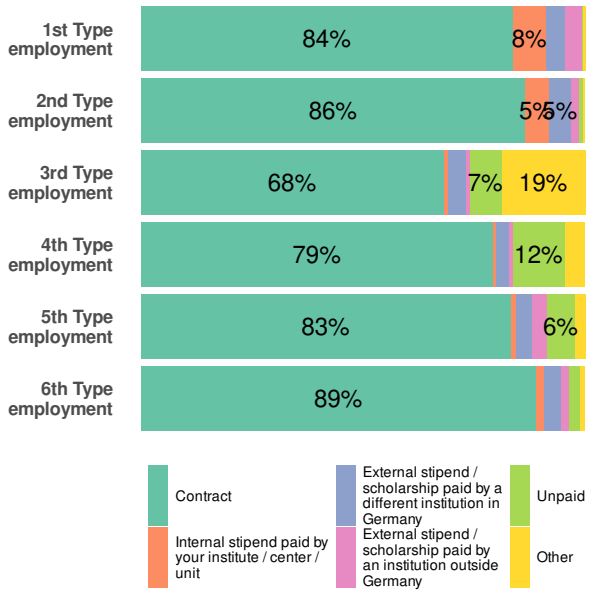

Figure 3.5: Distribution of DRs by employment situation and the chronological order of contracts.

3.2 Duration and number of contracts

The Max Planck Society's official policy on doctoral support contracts is that they should follow the "3+1" rule: an initial contract lasting three years, with the opportunity to extend that contract by 6-12 more months as needed [3]. In this year's survey, we calculated the expected time to completion of the PhD project by combining information about the starting point of doctoral research and the time when DRs expect to submit their doctoral thesis. In Figure 3.6, the Kaplan-Meir curve shows that the average time to PhD completion is 4.0 years for the BM section, 3.9 for CPT, and 4.1 years for HS. Additionally, we looked into the expected time of completion of doctorate and year of PhD (Figure 3.7). Not surprisingly, the later the respondent was in their PhD studies, the longer they expected their PhD to take in total. Similarly, past PhDnet surveys have demonstrated that almost all DRs in the MPS require more than three years to finish their PhDs [1, 5] and other surveys that include university-based DRs show an average duration of 5.7 years [6].

We therefore investigated the correlations between duration and number of our members' employment types in more detail, to better understand conditions under which researchers need to complete a PhD in 2022. We asked respondents to report what kind of employment type they received and for how long at different stages of their PhD, allowing us to construct a timeline of all employment situations that they have had during their PhD so far. For ease of readability of this report, we will use the word "contract" in this discussion to broadly refer to any period of work on the PhD including stipends and unpaid periods.

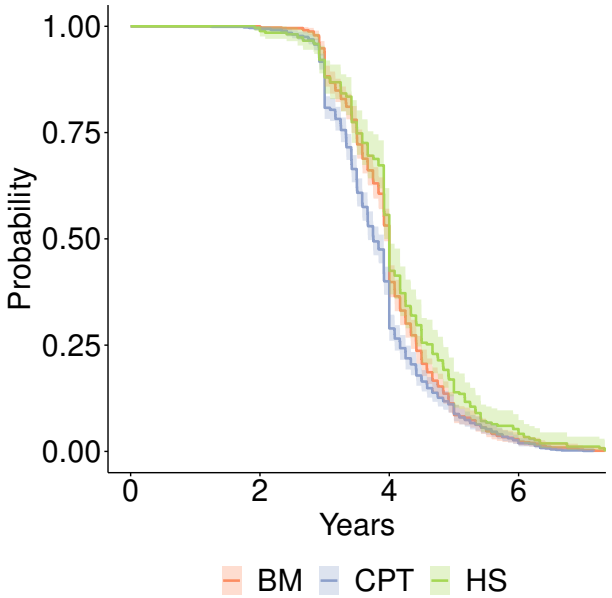

Figure 3.6: Kaplan-Meir curve for the expected time to completion of PhD project by section.

Our survey is taken by current doctoral researchers, so we do not necessarily know how many contracts they will receive throughout their entire PhD, though this information would be very useful to collect from alumni if possible. Naturally, the earlier in their PhD that someone is, the fewer contracts they will have had.

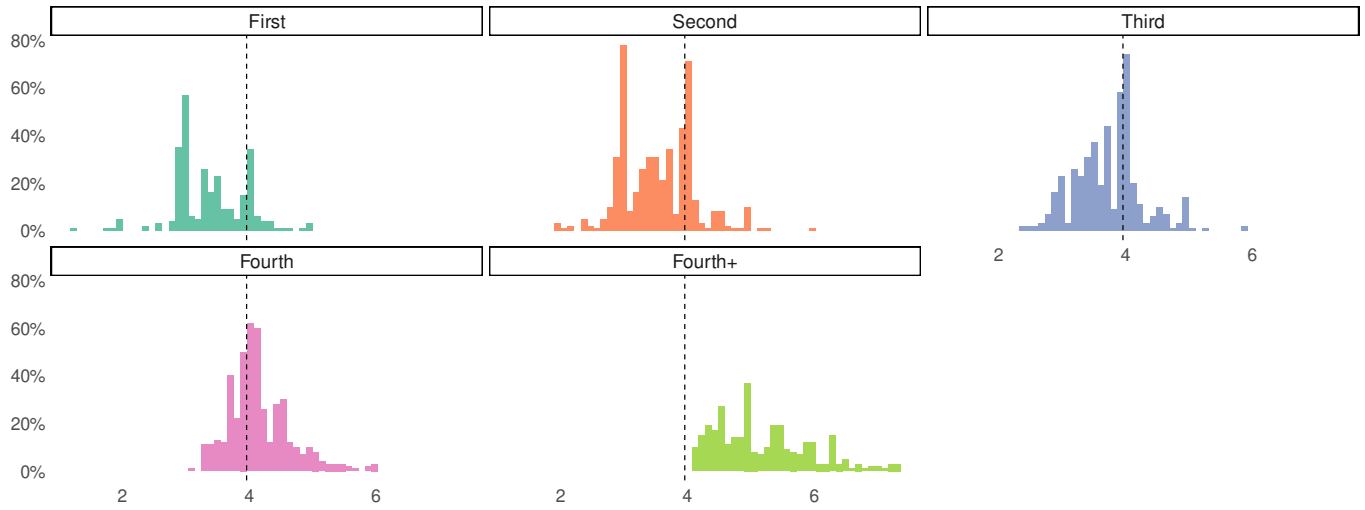

Figure 3.7: Expected time to completion of PhD project per DR's year of PhD. The dotted vertical line marks 3.96 years as the average across all years.

Figure 3.8 summarizes our findings concerning number of contracts received in different years of PhD. In the first year of PhD, 84% of DRs have received one contract meaning that already 16% of survey participants received two or more contract which goes against "3+1" rule. By the time DRs reach their third year, only 64% of them are still funded by the first contract they received. 28% are on their second contract, leaving 8% with three or more contracts. This ratio shifts dramatically in the fourth year though. In year 4, 31% of DRs are on their 3rd or more contract, and beyond year 4, 69% have received at least three contracts.

Next we examined the duration of different contracts received in chronological order of contracts (first, second, third, fourth, fifth and sixth contract). 58% of respondents received a first contract with a duration between 25-36 months. 25.3% of respondents began their PhDs with a contract that lasted less than two years, and the remaining 16.7% received an initial contract that lasted more than three years (Figure 3.9). The results show that second contracts tends to be in duration of 6-12 months for 53% of case and less then 6 month for 9%

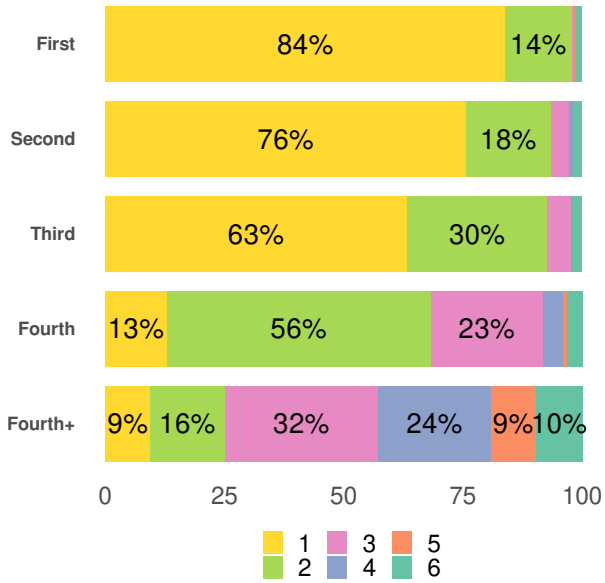

Figure 3.8: Contract number per DR's years of PhD.

of DRs. Significant numbers of MPS DRs are beginning their doctoral research with short term contracts. This is somewhat offset by the fact that 22.2% of respondents received a second contract that lasted at least 2 years. This describes considerable variation across the MPS in terms of contract duration, including many DRs who are not offered a "3+1" contract.

A more in-depth view of contract duration by section can be found in Supplementary Figure A.2, where we notice a difference between sections. The CPT section has the highest rate of compliance with the 3+1 policy: 77.5% of DRs received an initial contract that lasted longer than two years, while the HS section had the lowest compliance rate: only 68.5% begin with a contract of this length. The BM section has a high rate of very short initial contracts: 10.3% of all first contracts in this section last for less than six months.

In total, the average number of contracts a DR receives is 1.92 (Supplementary Figure A.3), suggesting that almost everyone who does their PhD in the Max Planck Society receives at least one extension.

The variation in contract duration and different number of contracts can have several consequences for DRs. Firstly, shorter contract duration may create a sense of instability and uncertainty regarding their future employment and concerns about the financial stability. Moreover, shorter contract duration can limit the time available for DRs to complete their research projects and meet their academic goals. It may lead to increased pressure and stress to achieve significant milestones within a limited time frame, potentially impacting the quality of their work and overall research outcomes.

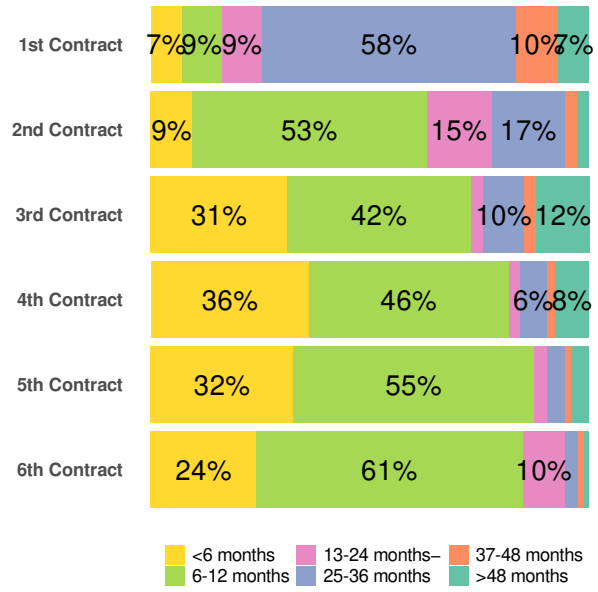

Figure 3.9: Distribution of contract duration by chronological order of contracts.

3.3 Unpaid doctoral researchers

In the overall analysis, we found that 1.2% of the respondents reported being unpaid while still working on their PhD (Supplementary Figure A.4). The majority of the DRs working without pay were in an advanced stage of their PhD, specifically in year 4 or beyond, as shown in Figure 3.4, accounting for 5.3% of DRs compared to all DRs at 4+ year of PhD.

The duration of unpaid work varied, with most cases lasting less than 6 months (42.9% for 0-3 months and 17.9% for 3-6 months). However, it is concerning that 21.4% of unpaid DRs were without pay for over one year (Figure 3.10). The reasons for being unpaid were categorized into three groups: funding running out, contract not being extended, and other reasons (Supplementary Figure A.5). Since very low number of respondents answered this question, we do not want to generalize these results. Nevertheless, these findings provide valu-

able insights into the prevalence and duration of unpaid work among doctoral researchers.

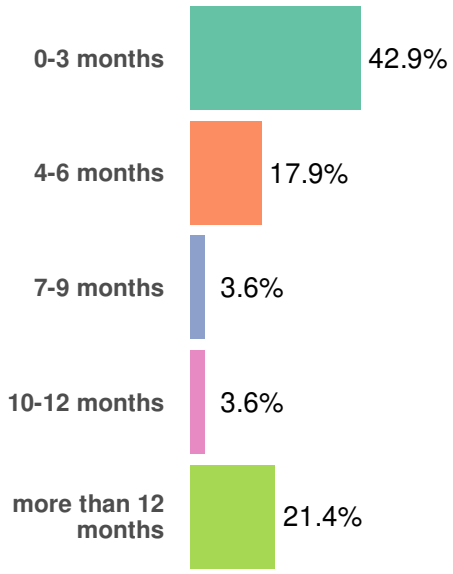

Figure 3.10: Duration of work without pay.

3.4 Income

The objective of this section is to enhance our understanding of the salary, as primary source of income, and its distribution among doctoral researchers in the MPS. We examined the distribution of salaries based on various factors, including section, specific field of study, gender and citizenship. By exploring these categories, we aim to identify any pay gaps between fields and evaluate previous improvements of support contracts.

An overview of the income distribution among doctoral researchers categorized by their respective sections is presented in Figure 3.11. The income ranges varied from less than 500 euros per month to above 2500 euros. Notably, the median net income for all three sections fell within the range of 1901-2000 euros per month.

Further, we looked into the salary distribution per field of study (Supplementary Figure A.6). No differences in median net income were observed between the different fields of study. Despite this apparent similarity, distribution in terms of proportion of DRs in certain salary range varies between fields. For example, while in Biology field almost 50% DRs received 1901-2000 euros per month, in Economics and Engineering around 20% of DRs had the same month salary. In fields of Engineering and Mathematics, there were more DRs with higher net income per month compared to the overall median.

The income distribution among DRs also revealed some variations based on gender (Figure 3.12). On average, there was a slight difference in income between men and women compared to gender diverse survey participants, with gender diverse DRs tending to be distributed in lower salary ranges.

Next, we conducted an analysis of monthly income based on the citizenship of survey participants (Supplementary Figure A.7). The findings showed no variations in income based on citizenship (German, European Union other than Germany and Outside the European Union).

These findings are consistent with the previous year's data, indicating a significant improvement in reducing salary disparities. This positive trend can be attributed to the implementation of a minimum salary of 65% of the TvöD standard for all DRs' support contracts within the MPS, marking a substantial improvement in the income situation of DRs.

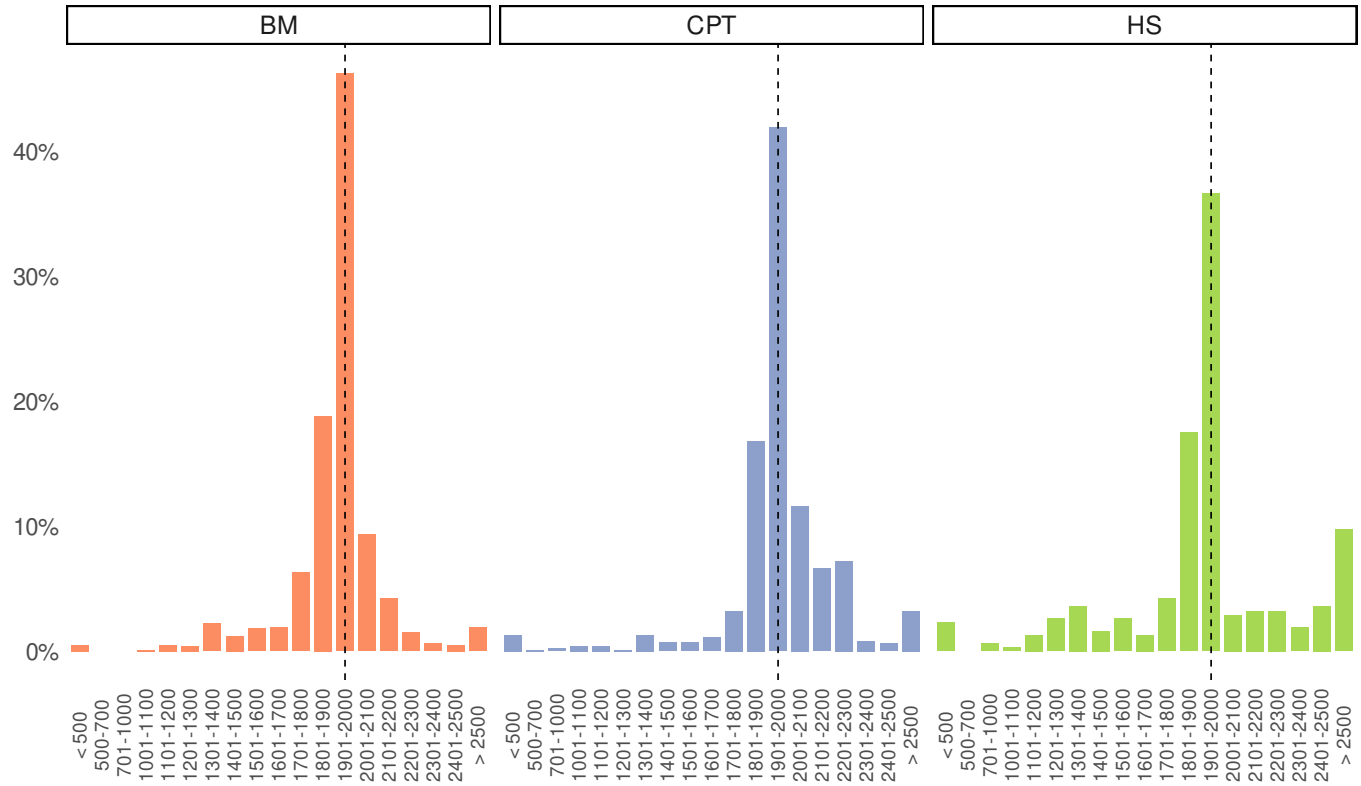

Figure 3.11: Distribution of income section.

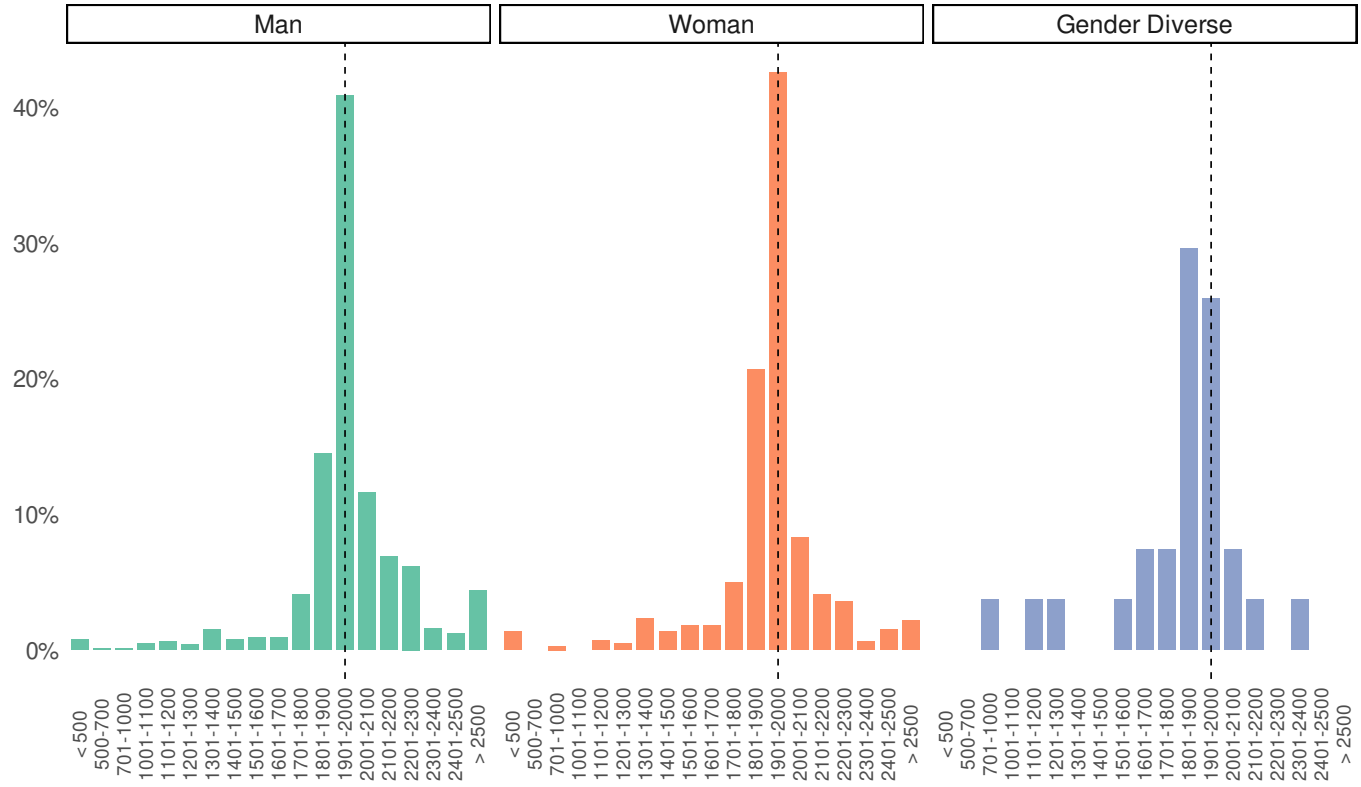

Figure 3.12: Distribution of income per gender.

3.5 Working hours and holidays

Working hours and holidays are crucial aspects of working conditions for doctoral researchers [7, 8] . While the standard working hours for DRs in the MPS typically range between 38 to 41 hours per week, the provision of 30 days of holiday per year offers DRs the opportunity to maintain a healthy work-life balance. In order to gain insights into the working conditions of doctoral researchers, we conducted an investigation on their actual working hours and the tasks they engage in during their working time. We examined whether there are variations based on employment type and explored the reasons behind overtime work. Additionally, we examined whether DRs work on weekends and public holidays.

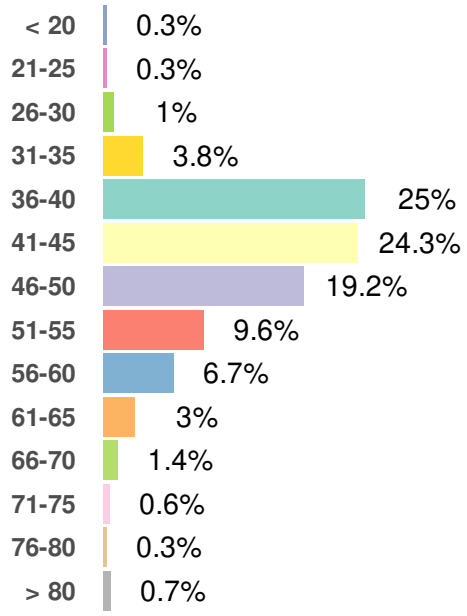

Figure 3.13: Number of hours worked per week.

Working hours

As expected, 78.1% survey participants reported that expected working hours per week based on their contract is 36-40 hours, while interestingly 6.5% do not know this information (Supplementary Figure A.8). When we asked DRs how many hours they typically work per week in total, 29.8% responds answered 26-40 hours, while 65.8% DRs work more then 40 hours per week as shown in Figure 3.13. If we further analyze average number of hours worked with the number of hours required per week, we can estimate that 74.5% of DRs are overworking (Figure 3.14).

We conducted an analysis to examine the correlation between weekly working hours and different employment situations. Our findings indicate that among people that work more than 61 hours, there was a higher proportion of stipend holders, regardless of whether they have an internal

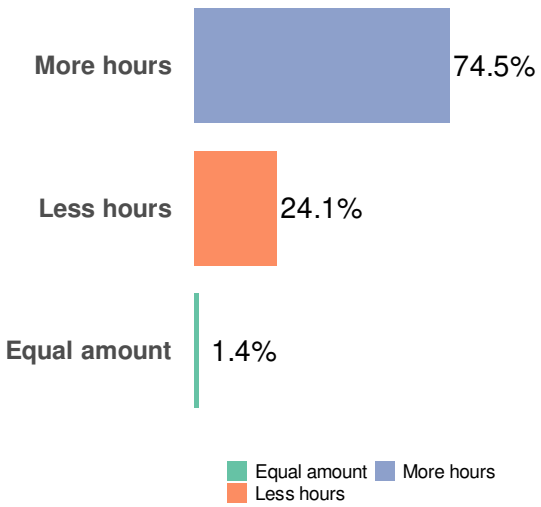

Figure 3.14: Comparison of average number of hours worked per week with the number of hours required per week.

or external stipend (Figure 3.15). This observation leads us to speculate that possible reasons for this overworking are that stipend contracts often do not specify working hours or holidays or that stipend holders want to finish their PhD as soon as possible because they have less assurance regarding employment extensions.

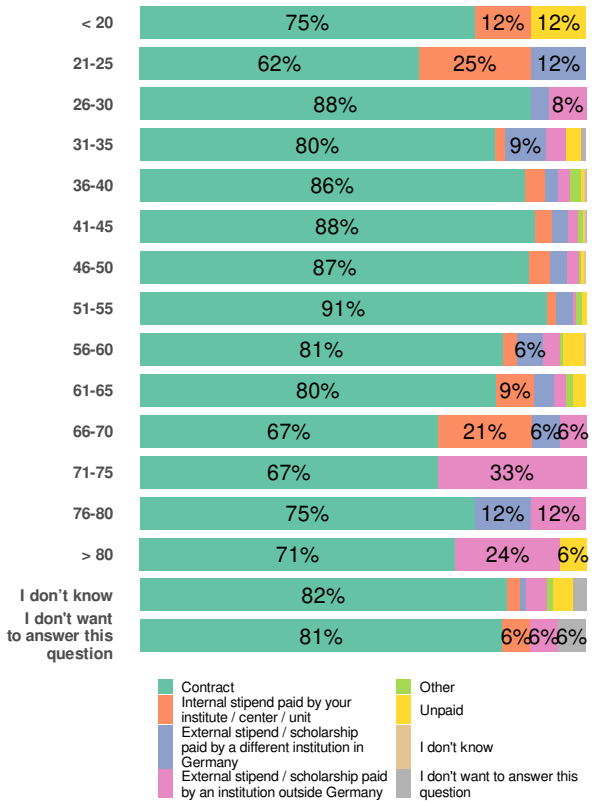

Figure 3.15: Hours worked per week by employment type.

Furthermore, our analysis reveals that a significant portion of DRs often work during weekends and public holidays. Specifically, 32.3% of respondents reported working twice per month, 16.6% reported working three times per month, and 8.5% reported working every weekend (Figure 3.16). It is noteworthy that these findings are consistent with the 2020 survey results [5], indicating a persistent trend in the work habits of DRs in this regard.

The primary reasons cited by DRs for working overtime include concerns about

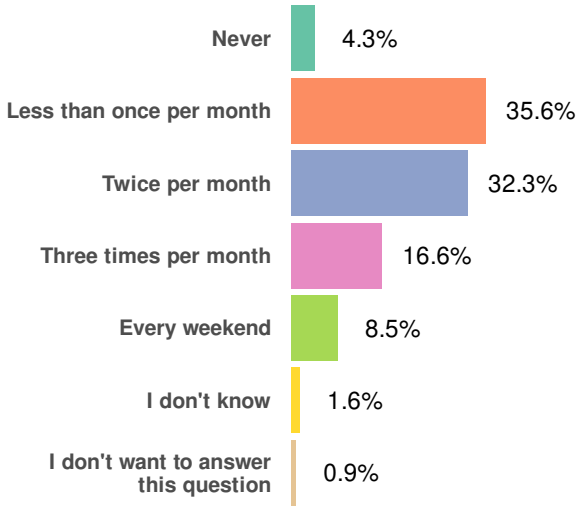

Figure 3.16: Number of weekends / public holidays worked in past year.

not completing their PhD before their contract/stipend expires (54.1%) and having an excessive workload with additional projects and tasks alongside their PhD work (41%). Interestingly, only 15.8% of DRs reported feeling pressure from their supervisors to work more than 40 hours per week (Figure 3.17). These findings suggest that self-imposed expectations, pressure related to employment termination and workload management are significant factors contributing to overtime work among DRs.

Finally, we sought to understand how DRs allocate their working time to various tasks. The results, depicted in Figure 3.18, indicate that the majority of DRs dedicate their working time to scientific work directly related to their doctoral research. This is followed by time spent on scientific work not directly related to their doctoral research, as well as attending courses and seminars. These findings highlight the primary focus of DRs on their research work, while also engaging in other scientific activities to enhance their knowledge and skills.

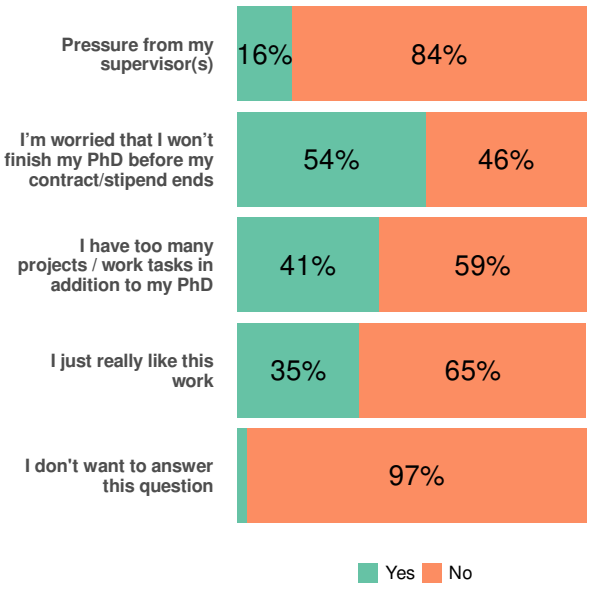

Figure 3.17: Why do you work more than 40 hours per week.

Holidays

It is widely recognized that extended periods of work-free relaxation are important for long-term happiness, productivity, and resilience, as highlighted in related publications [9, 10]. As of 2019, DRs holding a doctoral support contract in the MPS are granted 30 days of holiday per year, with the majority of these days being flexible and adaptable to individual preferences and needs. It is indeed encouraging to find that a significant majority of survey participants (84.2%) confirmed that their current employment situation includes 26-30 days of holidays per year, as reflected in the survey results (Supplementary Figure A.9). However, when we asked "How many days did you take off (holiday) in the past year?", we find that only 22.3% DRs used all their holidays (26+ days) in previous year. While the majority took 16-25 days (41.9%), still 52.6% did not take more than 15 days of vacation (Figure 3.19). Here we see a positive trend toward increasing number of holidays used compared to 2020 [5] and 2021 [1]. The majority of DRs (58%) reported feeling free to take holidays during the year. However, among those who feel the opposite, the major reasons include a high workload, pressure to complete work within a given time frame, and a desire to achieve high performance with their projects (Supplementary Figure A.10).

3.6 Teaching as part of PhD-related work

In 2022, our survey included questions about our members' teaching responsibilities for the first time. The official guidelines for doctoral training in the MPS state that DRs' main contract responsibilities should be "tasks that directly serve the purposes of their own doctoral project," but we anecdotally knew that some DRs had significant teaching responsibilities as well [11]. Respondents were prompted to consider all activities related to teaching and supervision, such as giving lectures, supervising exams and theses, and grading assignments. In addition to quantifying how many DRs teach, we wanted to understand why they teach, how they are compensated for it, and how satisfied they are with the amount of teaching they do during their PhDs.

The majority of DRs (67.0%) either have taught or would like the opportunity to teach during their PhD. 29.5% of DRs have not taught and do not expect to do so (Figure 3.20). The most common reason why DRs in the Max Planck Society teach is because it is required by their university (42.2%) (Supplementary Figure A.11). This highlights the interesting positions DRs in a non-university research institute face. We know that many more DRs who work in universities fund their research by teaching [12], and it is often assumed that MPS members are freer to focus on their research

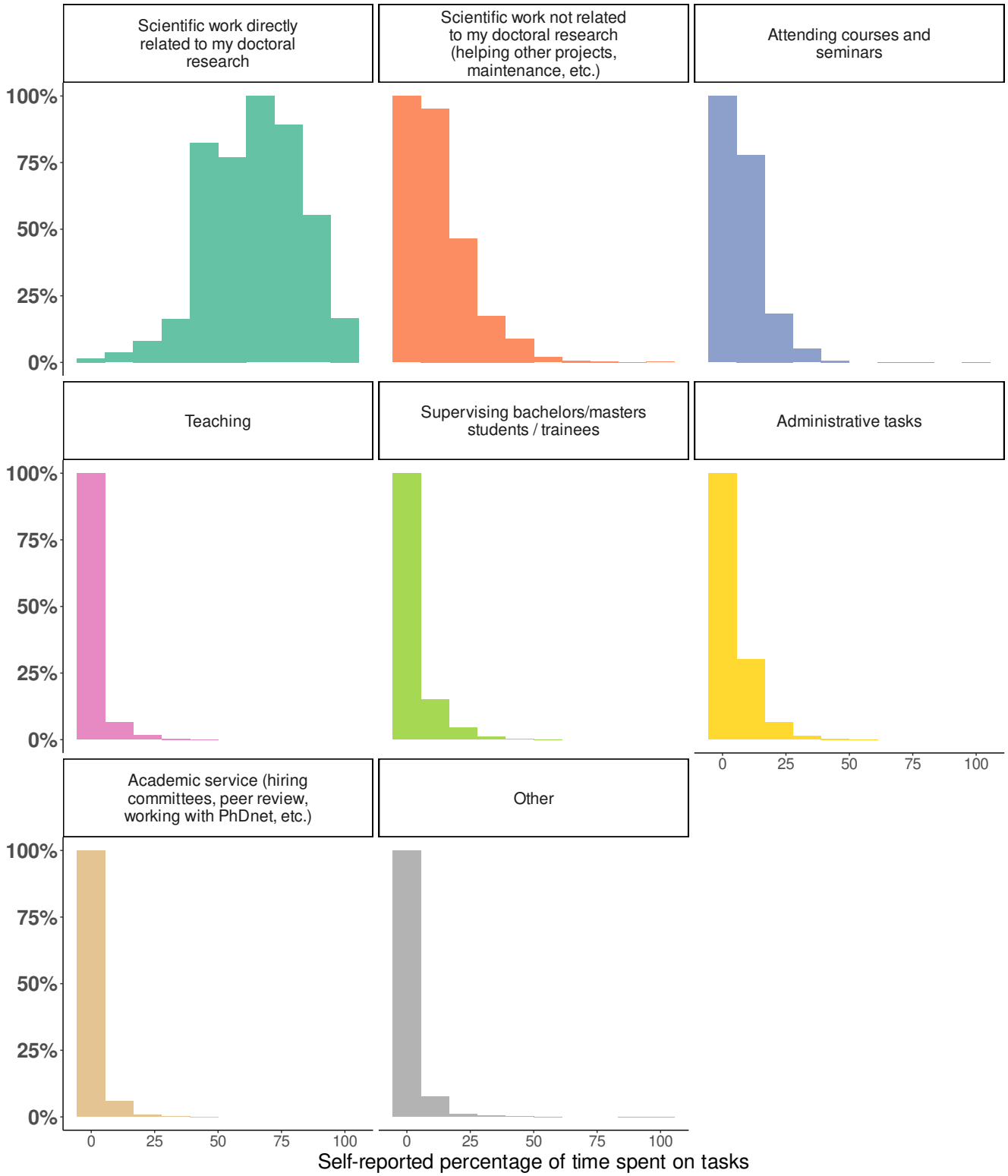

Figure 3.18: Working time and tasks.

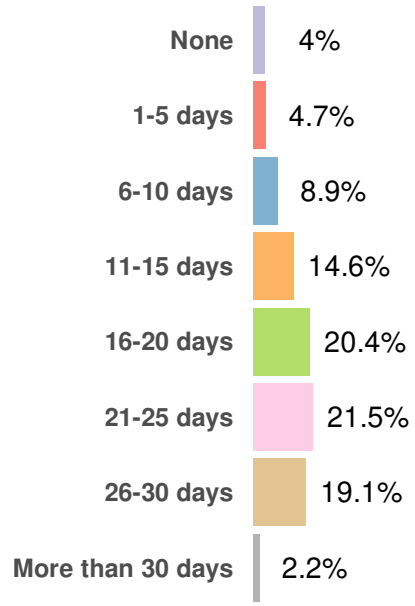

Figure 3.19: Holidays taken off in the last year.

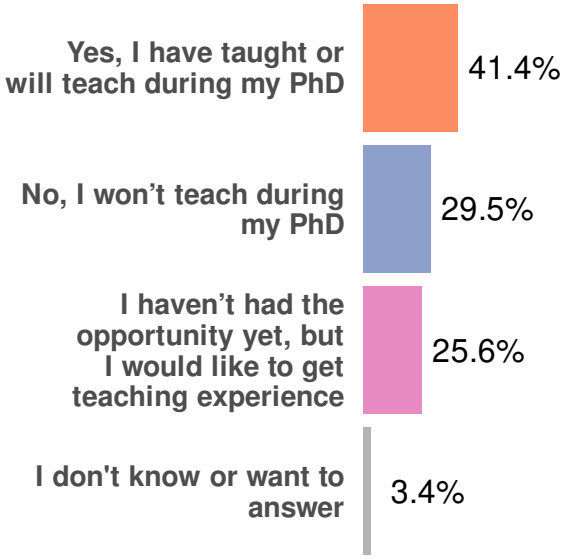

Figure 3.20: Teaching during the PhD

because they do not have this obligation. These results demonstrate, however, that many universities consider teaching experience essential to awarding a doctoral degree, meaning that our DRs are also gaining teaching experience. It would be interesting to know in a future survey how much teaching is required, to be able to compare this to the teaching obligations of TVöD contracts.

About one third (33.4%) of DRs who teach do so either because their funding source requires it or because their supervisor asked them to. An additional 19.4% teach by their own choice (Supplementary Figure A.11).

Most DRs who teach are not compensated for this beyond their doctoral support contract (Supplementary Figure A.12). This may be because of the university requirements for teaching, but we did not explicitly ask about this in the survey. Only 8% of teachers receive an additional contract to compensate them for teaching, but a further 13.2% report that their other responsibilities in the lab or center in which they work are reduced when they are teaching. A non-negligible number – 7.3% – answered that they do not know whether they are compensated for teaching work (Supplementary Figure A.12). In the HS section, additional contracts for teaching are much more common than in the other two sections (Figure 3.21). This aligns with the finding that teachers report slightly more contracts than non-teachers (Supplementary Figure A.13).

We do not see significant differences in the income of DRs who teach versus those who do not teach (Supplementary Figure A.14). Teachers also report working similar numbers of hours to their non-teaching colleagues (Figure 3.22).

Most respondents are relatively happy with the amount of teaching they do now (Supplementary Figure A.15). 30.0% would

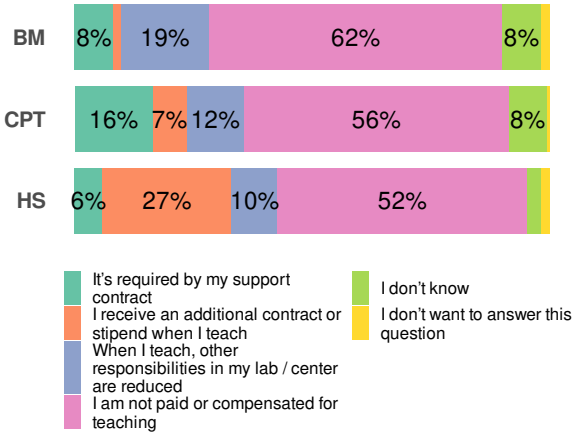

Figure 3.21: Compensation for teaching by section.

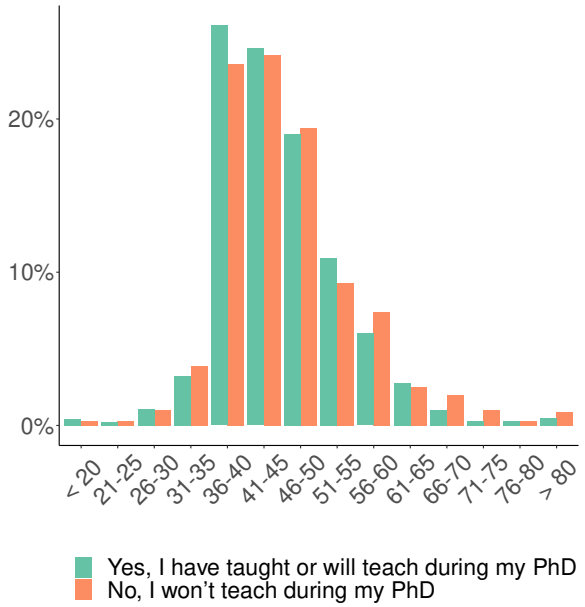

Figure 3.22: Distribution of DRs' working hours based on whether or not they teach.

like more opportunities to teach, with only 8.1% reporting that they would like to teach less. A sizable group did not offer an opinion on this question, suggesting that 22.1% of DRs are uncertain about the value that teaching experience would add to their PhD.

When we break down satisfaction with the amount of teaching by section however, we see that more members of the CPT section would prefer less teaching responsibility, whereas more HS section members would prefer more teaching opportunities (Supplementary Figure A.16), suggesting that perhaps teaching is a more valuable experience in the HS section than the CPT section. It also aligns with findings that future career plans differ by section: 44% of HS respondents are strongly considering a career in academia (Supplementary Figure A.17, but only 35% in CPT (Supplementary Figure A.18) and 29% in BM (Supplementary Figure A.19), with more respondents in CPT and BM indicating a desire to work in non-academic research. Thus it follows that teaching experience is more valuable in HS, where more respondents expect to teach in their future careers.

3.7 Satisfaction with various aspects of working conditions

Analyzing satisfaction with working conditions among DRs provides insights into the quality of the working environment and helps identify areas of improvement. Satisfaction with working conditions directly impacts the well-being and productivity of DRs. When DRs are satisfied with their working conditions, they are more likely to be motivated, engaged, and productive in their research. On the other

hand, dissatisfaction can lead to increased stress, burnout, and decreased job satisfaction, which can have negative consequences on the mental health and overall research outcomes of DRs.

Global satisfaction of DRs reaches 65% (Figure 3.23) which is lower than the 72% of 2020 [5] and the 67% of 2019 [13].

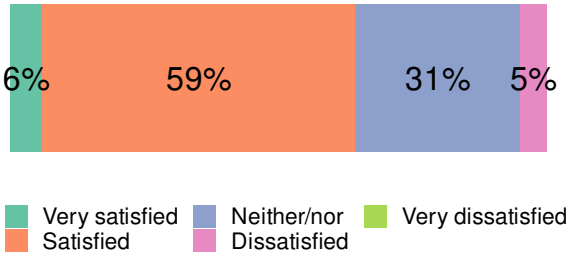

Figure 3.23: Overall satisfaction of DRs

Figure 3.24 summarizes DRs satisfaction levels with various aspects of their working conditions. DRs are overall very satisfied with their laboratory equipment, office equipment and vacation days, with respectively 87%, 83% and 84% reporting satisfaction. They are also very satisfied with the overall research ethos, with 77% satisfied with the adherence to good scientific practices, 73% satisfied with their work environment and atmosphere, and 68% satisfied of their contribution to science. 52% of DRs were satisfied with their workload while 20% of them were dissatisfied with it. Those numbers are similar to our data from 2019 [13] and 2021[1].

However, DRs are generally less satisfied with their salaries and benefits, with only 52% of them satisfied with these while 26% are dissatisfied. Those numbers were respectively 63% and 18% in 2021. This gap may be explained by a higher cost of living in 2022 due to higher inflation rates. Therefore, 65% of them would like an improvement of their salaries and benefits, 45% would like an improvement of their workload. 38% of them would like an improvement of their contribution to science and 37% would like to have a better work environment and atmosphere (Supplementary Figure A.20). Those numbers are much lower than in 2019 [13] and 2021[1], but this likely due to a difference in scaling: "Rather not" was replaced by "A little", which have different meaning in this situation. If we take in account the people who answered "A little" to improvements, all numbers then get higher than the previous surveys.

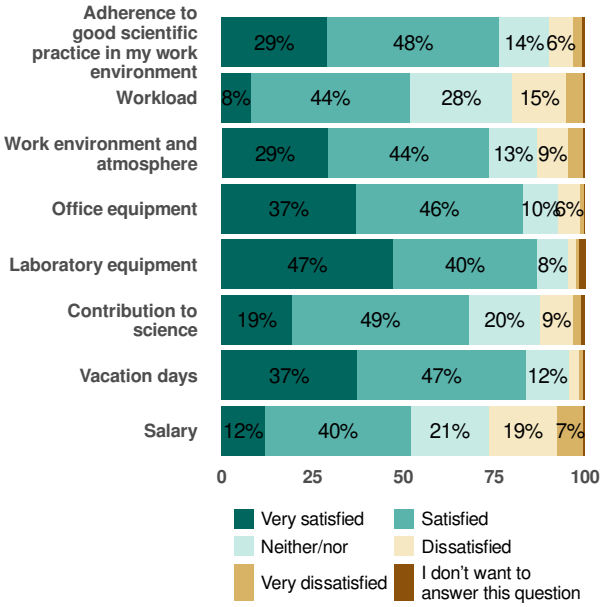

Figure 3.24: Satisfaction levels with various aspects of working conditions.

Satisfaction on salary per employment type revealed that people with contracts or internal stipends were more satisfied about salary: 54% and 53% (Supplementary figure A.21) than people with external stipends regardless of the origin of funding (external stipend from Germany: 38% and external stipend from outside of Germany: 26% (Supplementary figure A.21).

3.8 Considering quitting the PhD track

The PhD track in general is known to be extremely difficult and demanding, at the point that through its process, people can question themselves about the purpose of continuing it. 58.6% DRs have already considered quitting their PhDs, and 33.7% are considering it at least occasionally (Figure 3.25). These numbers are similar to those reported since 2019[13]. The main reasons for these consideration were the feeling of not being qualified enough, (41% of those who considered quitting), the unattractive career prospective (33%), the lack of academic results (31%), the high workload (25%), their health (24%) and due to work-related difficulties with their supervisors (21%) (Figure 3.26). Those numbers are overall higher than those of 2021[1].

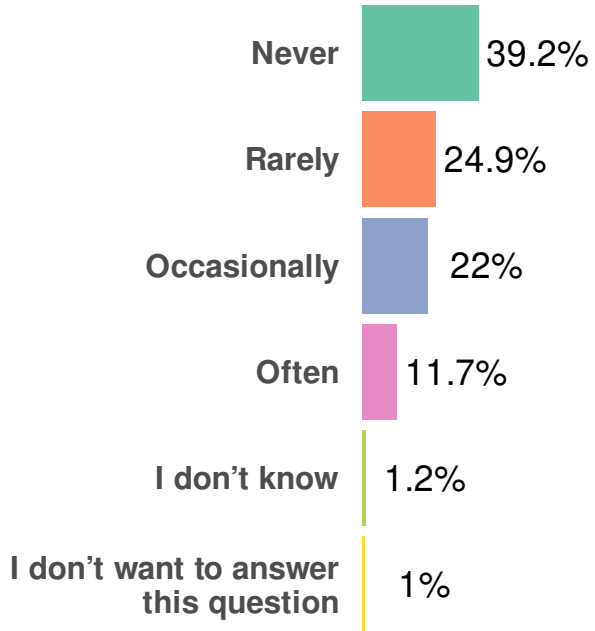

Figure 3.25: Have you previously considered quitting your PhD?

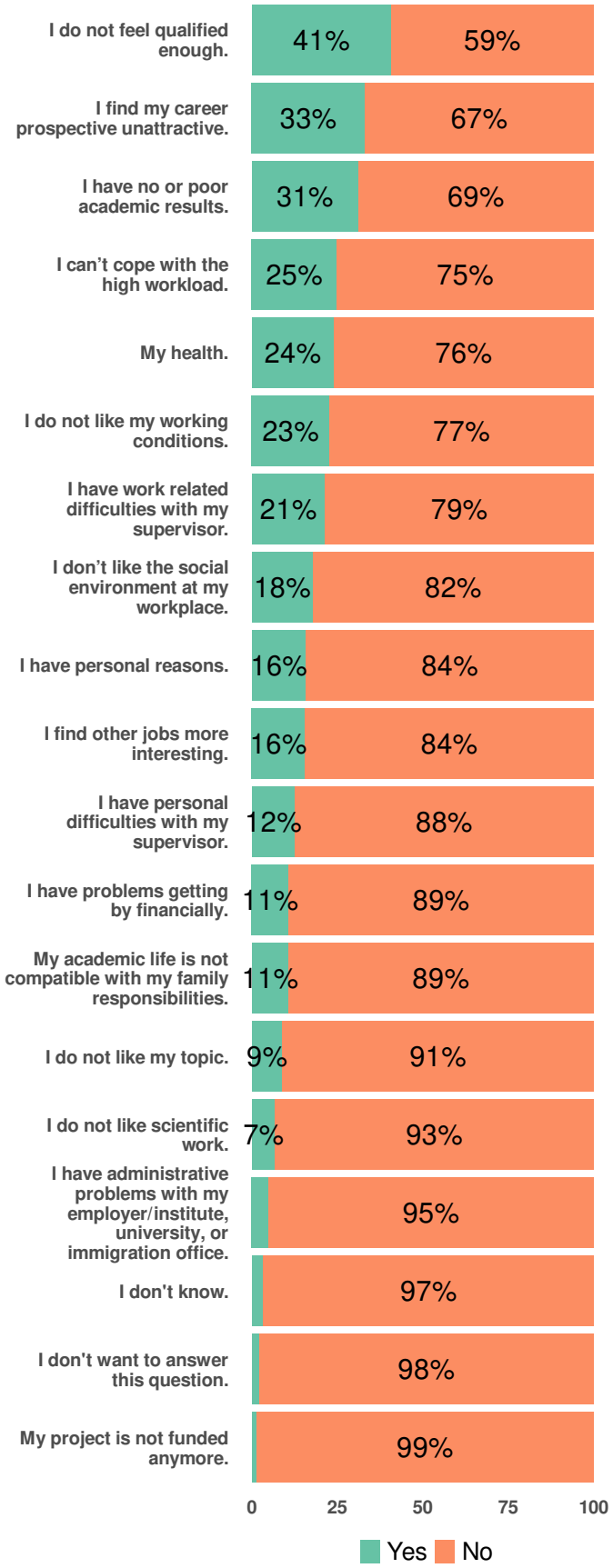

Figure 3.26: Why did you consider quitting your PhD?

A higher share of gender diverse people and women already considered quitting their PhD compared to men: 85% of the gender diverse people already considered quitting their PhDs, 64% of the women already considered quitting their PhDs while 54% of the men already considered quitting their PhD (Figure 3.27). We could see a similar tendency for considering quitting the PhD at least occasionally: 55% of the gender diverse people already considered it at least occasionally, 40% of the women and 28% for the men (Figure 3.27). In general, the reasons to consider quitting the PhD were distributed quite evenly across genders (Supplementary figure A.22).

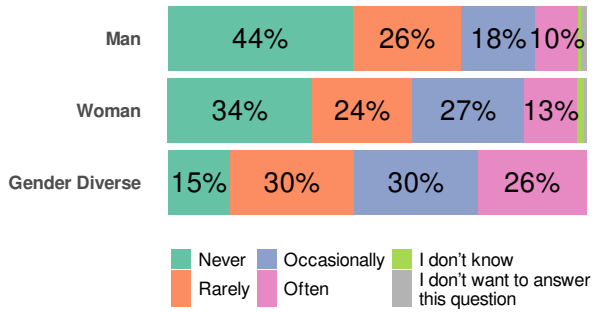

Figure 3.27: Considering quitting the PhD - by Gender identity

Chapter 4

Supervision

The interaction between DRs and PhD advisors is at the core of PhD careers. Supervisors should guide DRs to develop their full potential as junior scientists, and prepare them for future professional goals. To assess the current condition of supervision, we surveyed the existence of official structural components, the amount of advisory meeting time, and DRs' satisfaction with the supervision quality.

4.1 Official structures

MPS doctoral researcher training guideline[11] specifies the following components for each doctoral researcher to obtain to support their academic success:

- A written agreement specifying the rights and obligations of the doctoral researcher and supervisor.
- A Thesis Advisory Committee (TAC), whose members are independent of one another; documented meetings of this Committee should be held at least once a year.

Despite this guideline, we found that less than half (44%) DRs have both components. 63% of DRs have a written agreement and 65% have a TAC (Figure 4.1). Among those that have a TAC, 76% meet once per year as recommended (Figure 4.2).

Encouragingly, we also find that many groups implemented additional structure for DRs: 47% have a written project outline and 12% have a written training plan. In addition, 67% of DRs are in a graduate school (e.g. IMPRS) and 49% have PhD guidelines (Figure 4.1) .

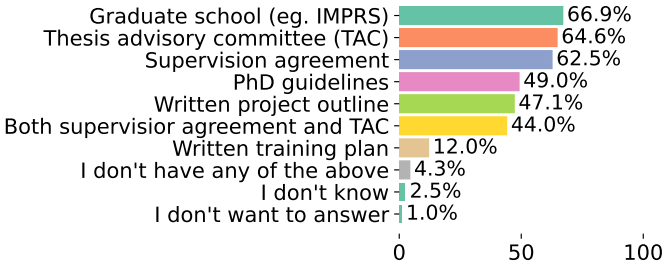

Figure 4.1: Percentage of DRs with official structures.

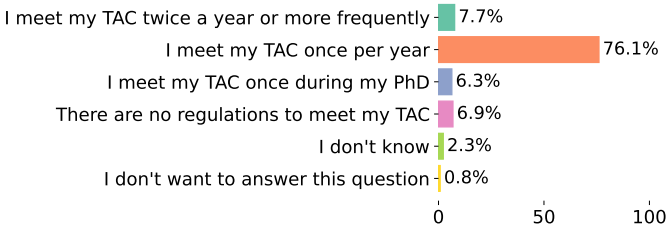

Figure 4.2: Thesis advisory committee (TAC) meeting frequency.

4.2 Supervisor personnel

Due to the structure of MPIs and some subject fields, dual supervision with a "formal"

and a "direct" supervisor is often arranged as part of supervision agreement. We use the following definition in survey:

- formal supervisor: the main advisor of the thesis
- direct supervisor: the person who actually consults and discusses the thesis project with on a more regular basis.

Figure 4.3 shows DRs' supervision status across fields. Overall, around 60% of DRs have a sole supervisor, while 36% have dual-supervisors (Figure B.1).

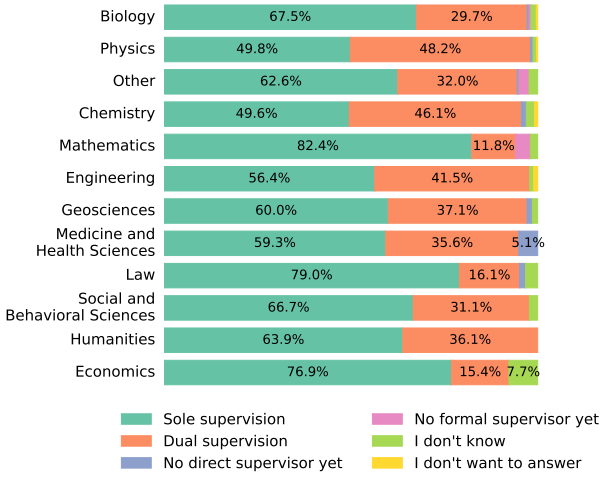

Figure 4.3: Distribution of supervision status across fields of study.

4.2.1 Sole supervision

We further looked into the position and stage, citizenship and gender of supervisors. Sole supervisors are typically group leaders(61%), followed by directors (37%) (Figure 4.4). Surprisingly, 19 DRs (1.6%) said that their single supervisor is a Postdoc researcher, and four (0.33%) said that their single supervisor is another DR. The majority of supervisors (either formal or direct) are from Germany and identified as men (Supplementary Figures B.2 and B.3).

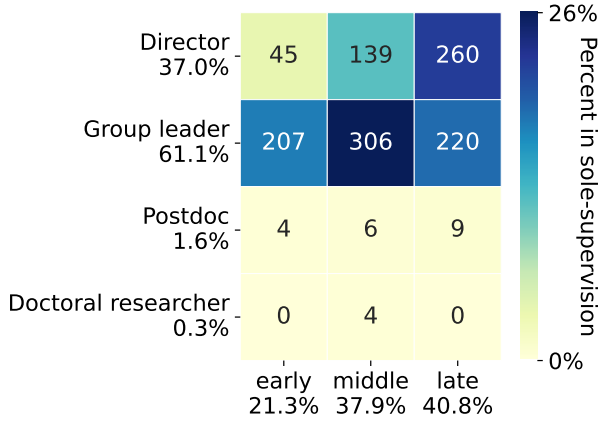

Figure 4.4: Sole supervisor's title and stage in current position. (Color is scaled by the maximum in table, whose percentage is displayed on top of color bar; numbers in table are counts; same applies for figures below).

4.2.2 Dual supervision

In the case of dual supervision, most formal supervisors are directors (73%) or group leaders (26%) (Figure 4.5). While direct supervisors are group leaders (69%) or postdocs (26%) (Figure 4.6). Additionally, 23% of formal supervisors are described as "only serves bureaucratic purpose" (Supplementary Figure B.4). In these cases, the effectively sole supervisor is most commonly a group leader (Figure B.5).

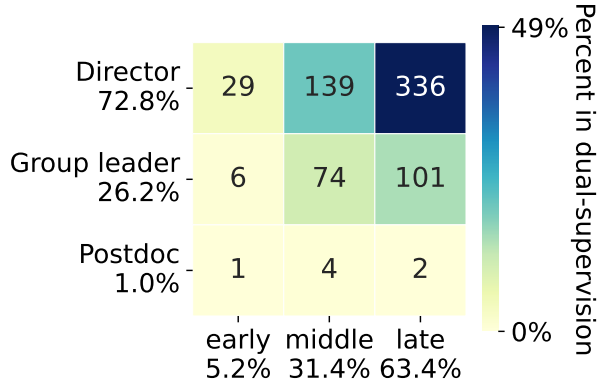

Figure 4.5: Formal (within dual) supervisor's title and stage in current position.

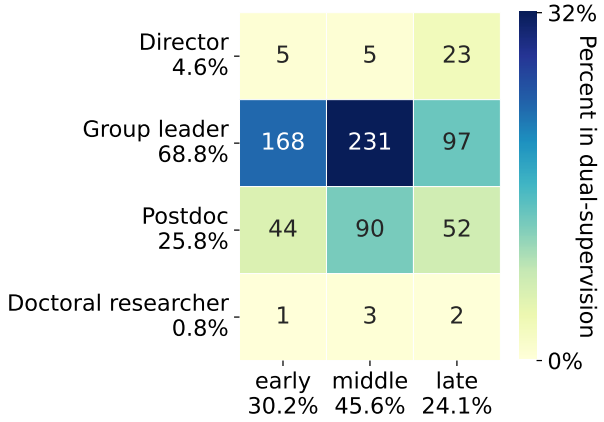

Figure 4.6: Direct (within dual) supervisor's title and stage in current position.

4.3 Supervision availability

Communication frequency is a key indicator of how involved is a supervisor in the training of DR. We asked how often DRs communicate with their advisors on their thesis project, and how often the DRs would like to communicate. We compared the DRs' preferred vs. actual communication frequency with their supervisors in Figure 4.7 (sole), Figure 4.8 (formal within dual) and Figure 4.9 (direct within dual). Additionally, we converted the frequency categories to fold differences (e.g. Almost daily = 3x Weekly, Weekly= 4x Monthly) to explore the magnitude of discrepancy between DRs' preferred and received supervisory frequency.

Figure 4.7 shows the most popular communication frequency with sole supervisor is weekly (44%), and a close 35% achieved that. Typical actual meeting frequency ranges from almost daily to monthly. Encouragingly, most (61%) DRs with a sole supervisor are satisfied with their frequency; other 23% would like to double or triple it, and 8% would like to meet half or a third as frequently (Figure 4.10). There are also in total 13% of DRs that meet quarterly or less, all of whom would prefer to meet more (often much more).

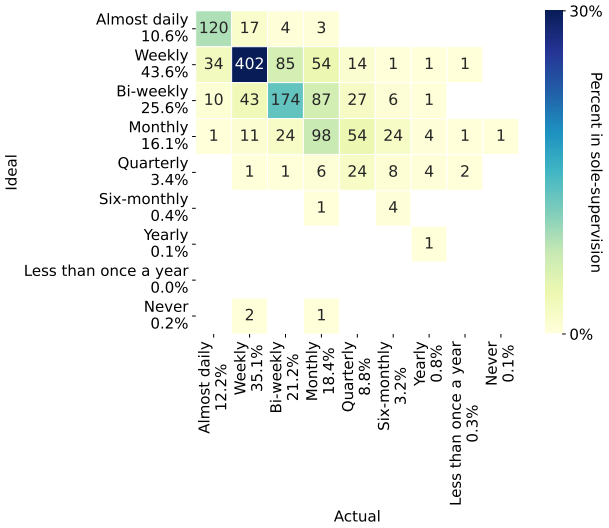

Figure 4.7: Ideal and actual communication frequency with sole supervisor.

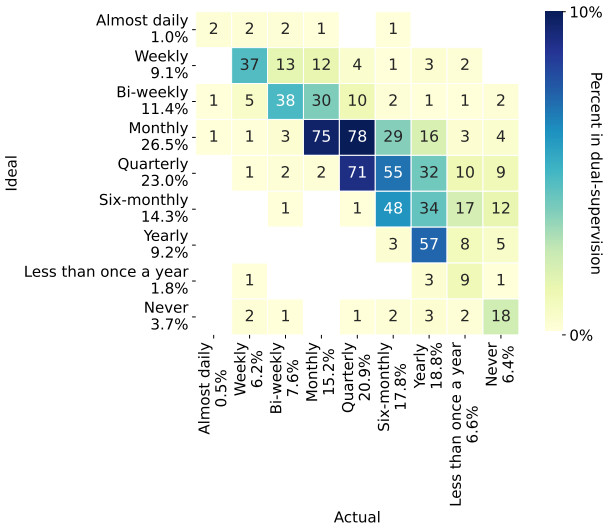

Figure 4.8: Ideal and actual communication frequency with formal supervisor in dual-supervision.

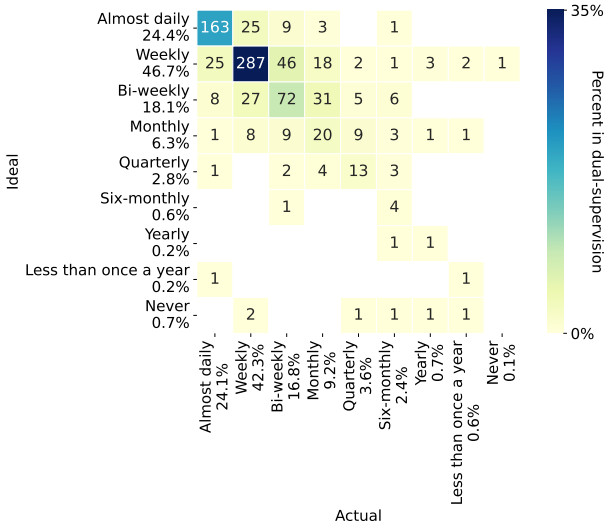

Figure 4.9: Ideal and actual communication frequency with direct supervisor in dual-supervision.

Looking into the meeting frequency within dual supervision, we found that the majority of DRs there prefer to meet much more frequently with their formal supervisor (Figure 4.11). Less than half (45%) are satisfied with their current frequency, 28% would like to meet double or triple as frequent, a notable 17% would like to meet 4-10 times as frequently, and even 5% would like to meet 10 times or more frequently, indicating a vast discrepancy between the DRs' need and the advisors' involvement.

With direct supervisors in dual-supervision, DRs are overall (68%) satisfied about the communication frequency (Figure 4.12). Still, 14% would like to meet double or thrice as frequently, and 8% would like to meet a half or a third as frequently.

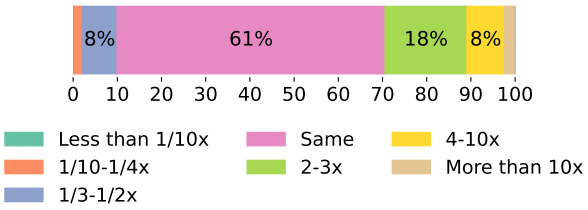

Figure 4.10: How many times as frequent do DRs want to communicate with sole supervisor.

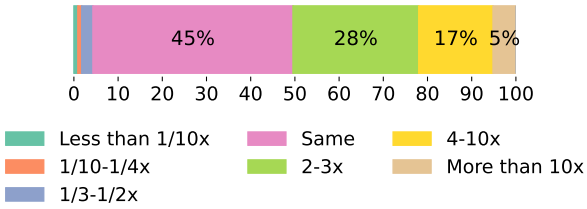

Figure 4.11: How many times as frequent do DRs want to communicate with formal supervisor in dual-supervision.

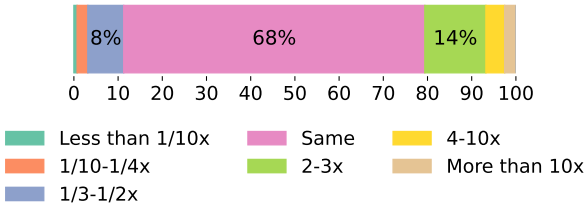

Figure 4.12: How many times as frequent do DRs want to communicate with direct supervisor in dual-supervision.

4.4 DRs supervised by another DR, a Postdoc or an absent supervisor

Since many DRs in dual-supervision meet extremely infrequently with the main thesis advisor (formal supervisor), we explored whether the DRs are advised by an experienced scientist as intended by the MPS guideline [1] [3] . Figure 4.13 shows that a notable number of DRs who communicate with the main thesis advisor only quarterly or less are supervised by another DR or an early-stage postdoc.

Together with the doctoral researchers whose sole supervisor communicates quarterly or less (Figure 4.7), and those who are reported to be officially supervised by a

[1]The MPS guideline specifies that "no more than 8 students should share one main supervisor, unless more experienced scientists are incorporated into daily supervision".

postdoc or another DR (Figure 4.4), these cases warrant further investigation and regulation of doctoral advisorship.

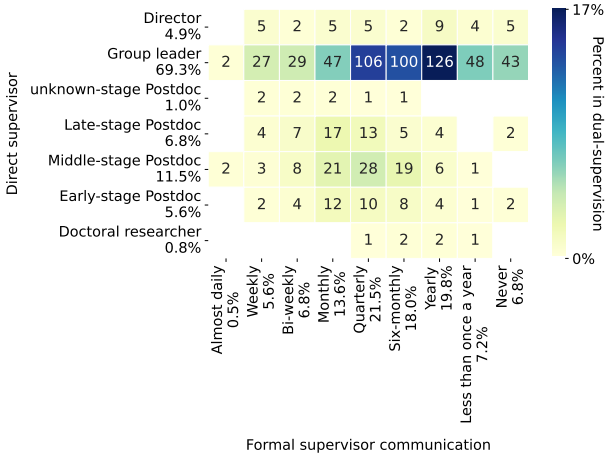

Figure 4.13: Communication frequency with formal supervisor for categories of direct supervisor.

4.5 General satisfaction with supervision

Figure 4.14 shows an overall satisfaction of DRs with their direct supervisor, especially DRs fully agree that the supervisors treat them politely (76%) and professionally (72%), adhere to good scientific practise (73%), are well informed about current state of their PhD project (71%) and they are available for giving advice (70%). Areas for improvement are leadership skills with only 39% of DRs fully satisfied, clear (35%) and strict (24%) requirement, and support of professional development (52%).

Regarding formal supervisors (Figure 4.15), DRs are not fully satisfied with: timely feedback (33%), clear (19%) and strict (11%) requirements, being informed about the state of project (20%), and supervisor's availability (30%). On the other hand, workplace personal interaction are generally satisfactory. Separately we asked if DRs have problem with their supervisor(s) (Supplementary Figure B.10). 55% reported no problems with supervisors, while among most common problems were listed: not enough experts in the group (23%), not enough feedback (22%), meetings not regular enough (21%), not enough meeting (20%), not enough scientific discussion (19%) and not enough encouragement (19%).

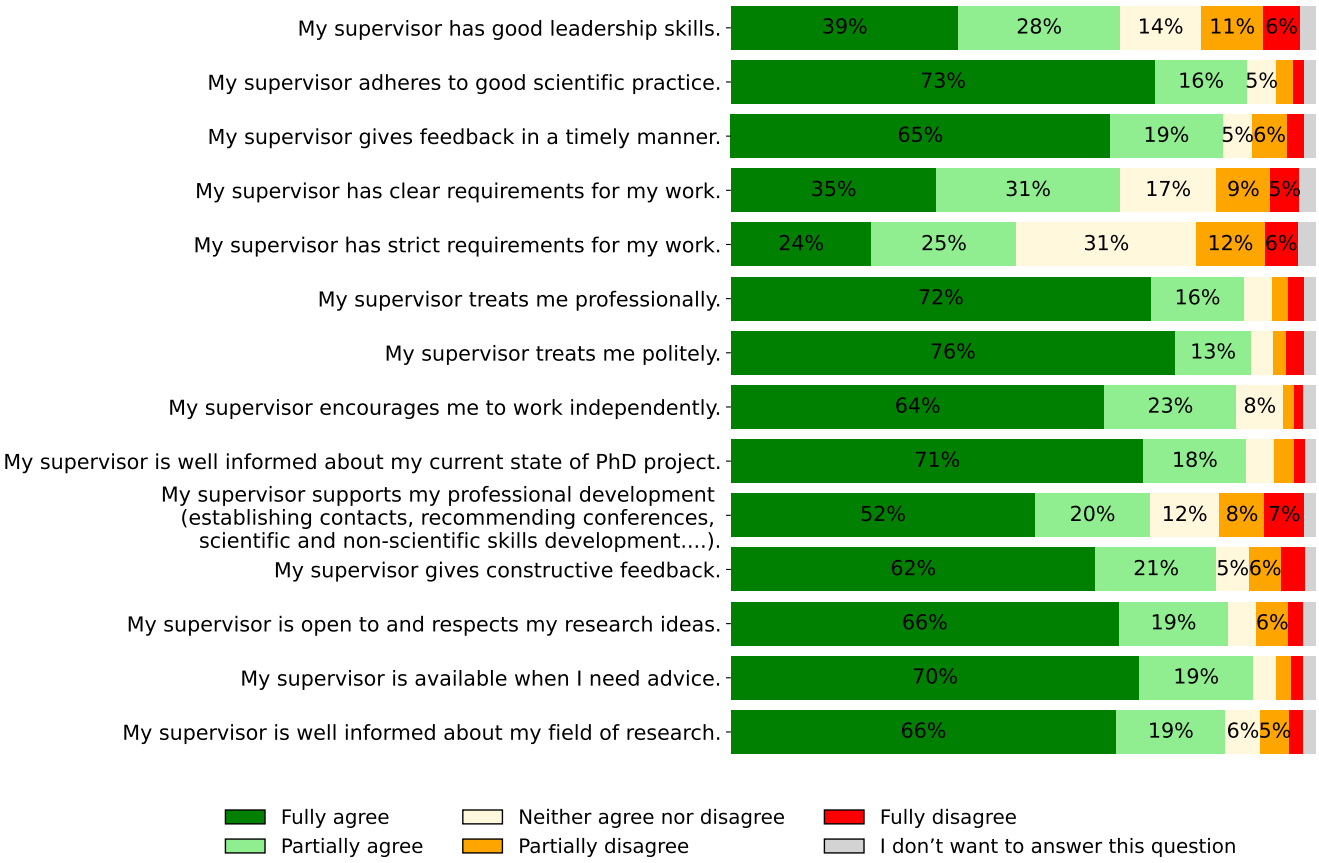

Figure 4.14: Satisfaction with direct supervisor.

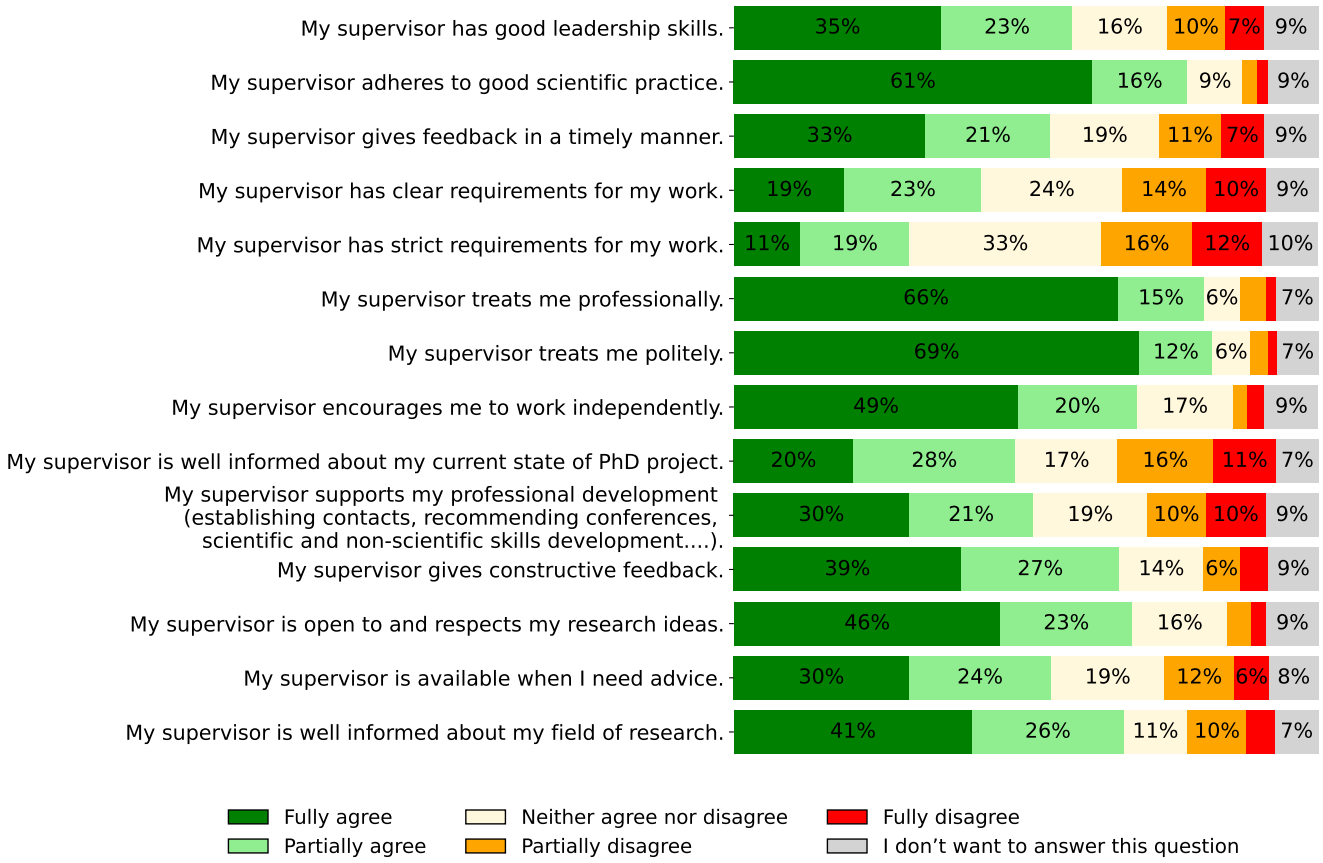

Figure 4.15: Satisfaction with formal supervisor.

Chapter 5

Available Support Structures

5.1 Integration

The Max Planck Society (MPS) is privileged to have attracted diverse DRs both locally and from abroad. Within the MPS, 57.3% of DRs are from outside of Germany (Figure 2.3), which suggests the necessity of offering support for international and domestic DRs to settle in Germany without too much disruption to their scientific work. We therefore asked all our DRs - especially international DRs - how integrated they feel regarding support with administrative tasks, legal documents, languages and accommodations.

From the survey, we observed that while 64.3% of all DRs received support from their institute for aspects regarding university enrollment, 52.1% felt that more support is needed, indicating that enrolling in university is more complicated than anticipated by our current support structures. Finding accommodation comes in second place, with 38.7% DRs receiving help but 49.1% DRs needing further support (Figure 5.1).

Language is another big part of integration. Therefore, we asked DRs whose German level are under C1 about their language levels (Supplementary Figure C.1). With 21.6% of DRs having no knowledge of the language and 41.9% only at beginner's level, we see that the MPS is fairly international. This further drives us to ask if language is

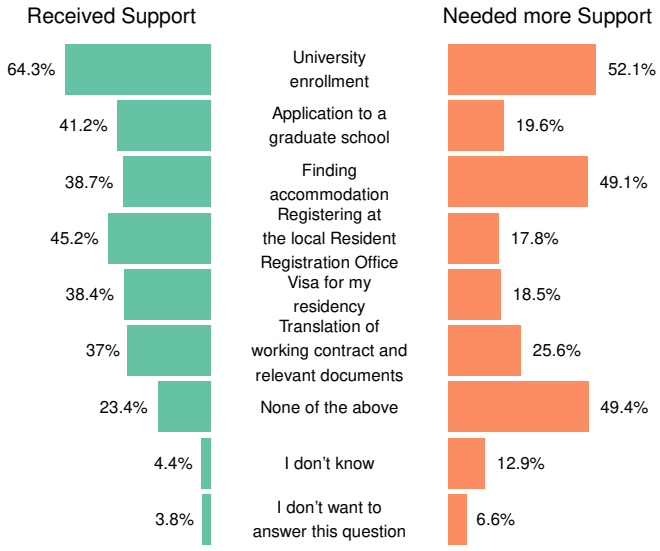

Figure 5.1: Percentage of DRs stating whether they received support and/or needed more support from their institute/center/unit.

an obstacle for DRs (Figure 5.2) and if all the information at their institute is available in a language that DRs understand (Figure 5.3). We observe that language is not an obstacle especially with the statistics that 41.6% of all DRs are German (Figure 2.3). Among DRs of the MPS whom German level are below C1, 78.2% DRs feel that German language is not at all or not much of an obstacle for them and that 97.9% of the information is relatively available in a language they understand.

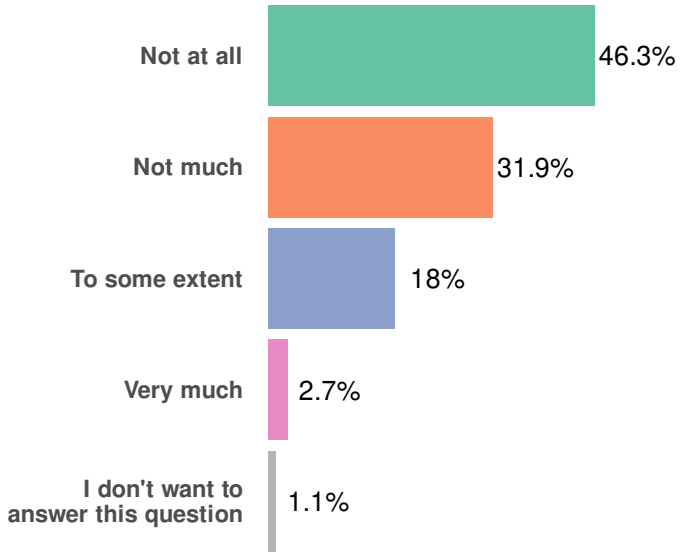

Figure 5.2: Opinion of DRs regarding German language as an obstacle.

Considering that 57% DRs are from outside of Germany (Figure 2.3) and 63.5% of them do not speak much German (Supplementary Figure C.1), we wonder if their workplace provides an inclusive and sociable environment to help them better integrate into the new place. Therefore, we asked how often do DRs have social gatherings, inside and outside of their institutes (Figure 5.4). From the survey, we learned that 51.5% of institutes hold social events on occasion, and 33.5% of institutes implement regular gathering every month or more frequently.

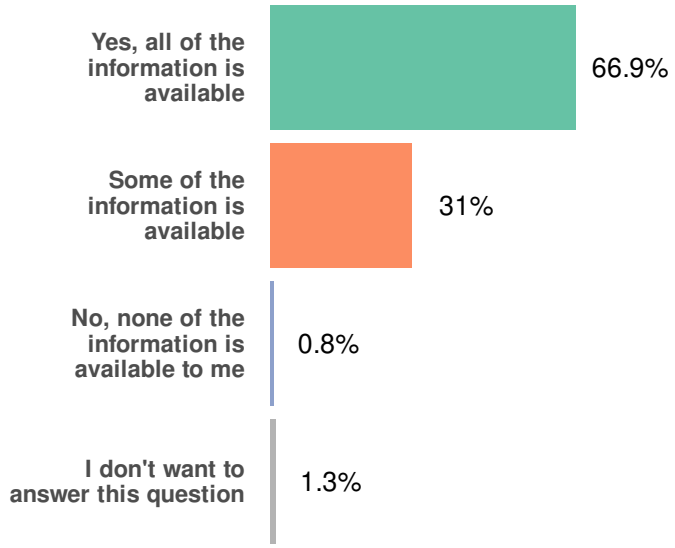

Figure 5.3: Percentage of information that is available in a language that DRs understand.

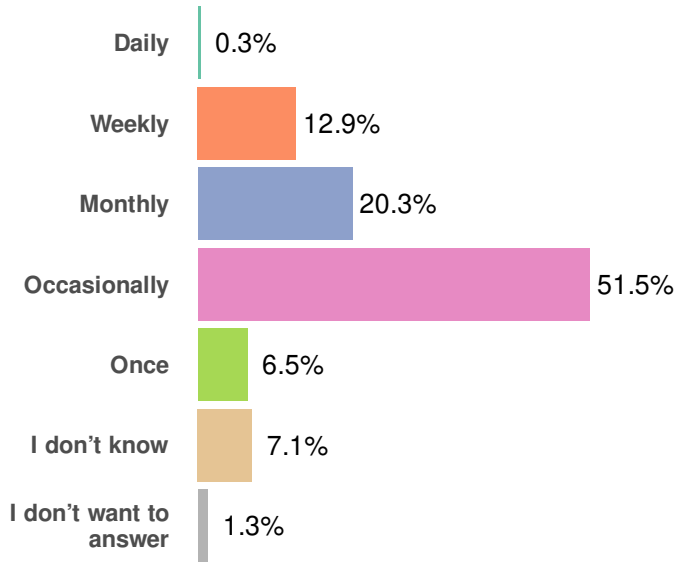

Figure 5.4: Frequency of social activities organized by the institute/center/unit.

5.2 Career development

Doctoral research is not an easy task to tackle. An essential part of the process is career development. Doctoral researchers need to receive diverse information and guidance towards future jobs inside or outside academia to plan their next steps after the PhD.

To better understand what the preferred fields of work for DRs after completing their PhDs are, we asked several questions regarding the direction of future career development (Figure 5.5). Our analysis shows that while 64% of DRs would prefer to stay in academia, 78% would like to work in a non-academic scientific research field. Overall, most DRs want to stay in a scientific environment and perform research. More HS people want an academic research job whereas BM and CPT want a non-academic research job, probably because there are more natural science non-academic research jobs available (for a more in-depth analysis see section 3.6). Nevertheless, 31% of DRs would prefer to choose a non science-related job.

Certain professional training such as internships / research stays, leadership, and soft skill courses are beneficial towards career development, since those are aspects that are valued by many employers. Therefore, we asked DRs whether their workplace offers support regarding the following measures of career development: language courses, mentoring training, practical courses, and transitioning to a non-academic career, etc. (Supplementary Figure C.2). Our result shows that the top three most valued career development programs are soft skill courses (73%), language classes (70%), and practical courses (65%).

Moreover, it is interesting to observe that while 78% of DRs would like to transition

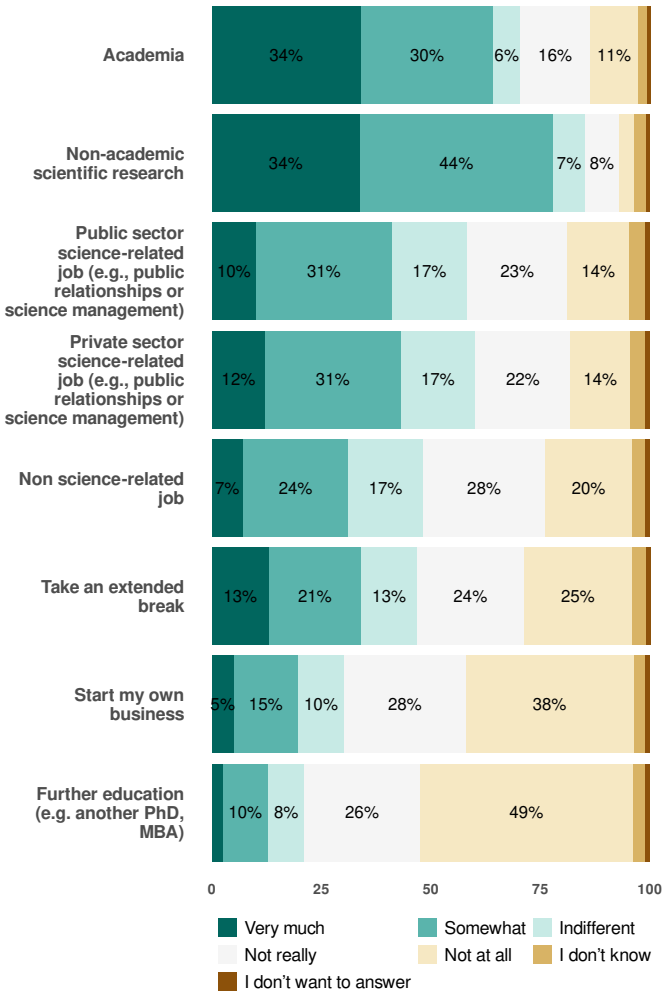

Figure 5.5: Percentage of different career preferences post-graduation.

to a non-academic job, only 51% of DRs claim that their institute provides support for transition to a non-academic career including career fairs and networking possibilities (Supplementary Figure C.2). Thus we further focused on whether our DRs feel prepared or not for a job outside of academia (Figure 5.6). Analyzed result show that 35.7% of DRs feel prepared while 45.3% state that they are not prepared. Moreover, 18% of DRs do not know / cannot evaluate this aspect.

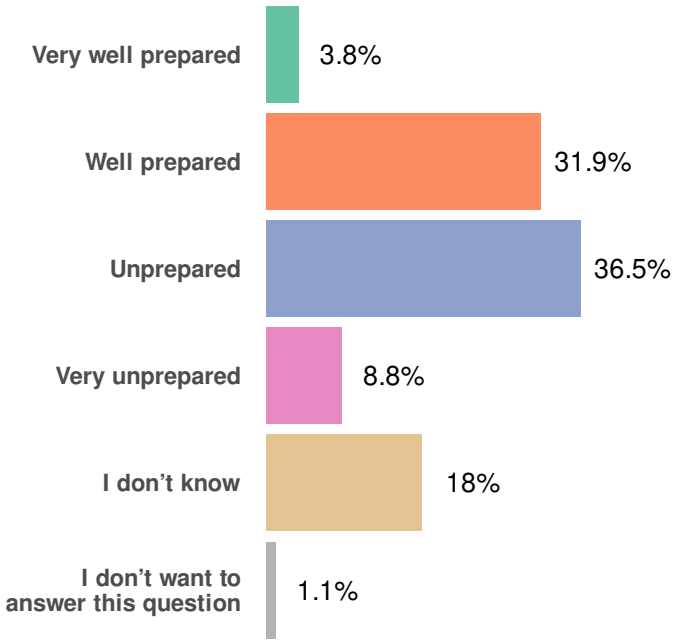

Figure 5.6: DRs stating whether or not they feel prepared for a non academic career.

Finally, to better understand the future career choice of DRs and to learn the reasons / motivations behind these choices, we asked DRs to evaluate various aspects of an academic job (Figure 5.7). We observed that DRs find academic careers attractive for the following top three aspects: interesting work (91%), skill development (80%), and diversity of work (77%). However, we also observed a lower evaluation regarding certain aspects of an academic job, with the bottom three aspects being: salaries in academia (13%), availability of permanent positions (14%), and compatibility of one's own career plans with having children (14%). These results are very similar to year before [1].

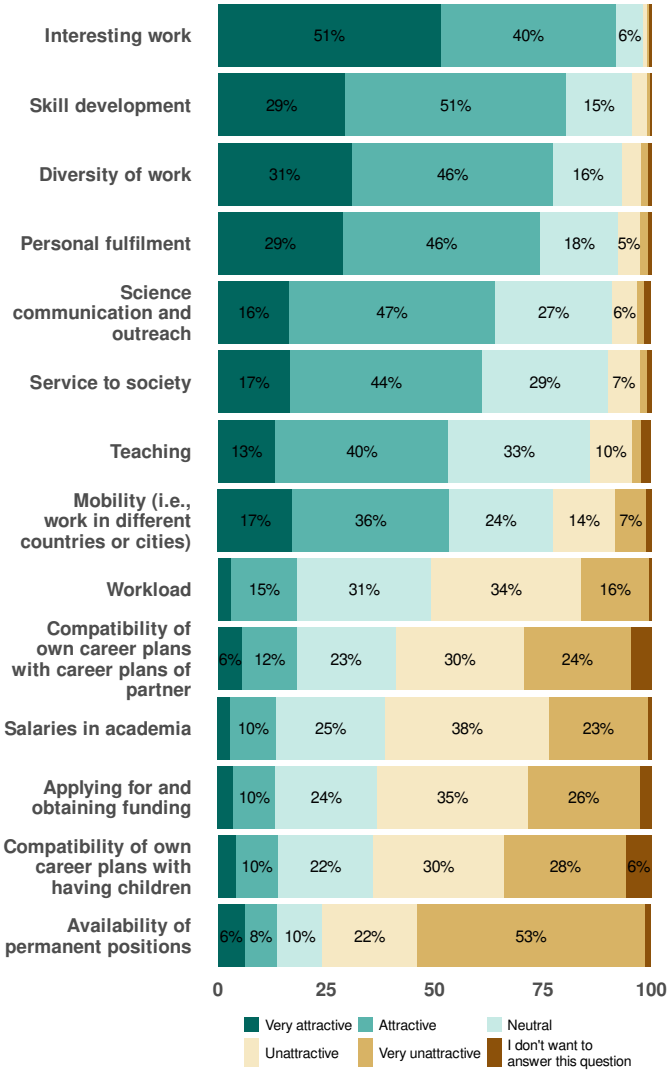

Figure 5.7: Evaluation of an academic career.

5.3 Family

Family serves as a crucial aspect for a person's integrity and well-being. Therefore, in addition to the perspective of DRs on their career development, in this section we wanted to know how DRs feel about the compatibility of their own career plans with

having children; how the career trajectory affects their choice of having children, and the other way around.

As our analysis shows in Figure 2.4, 8.1% of DRs have or plan to have children during their PhD period, while 85.8% state that they do not want to have children at this time.

Having sufficient support from the workplace for childcare serves as an essential factor for DRs who have children to be committed to their researches without excessive stress. Thus, we asked DRs if they feel that there is sufficient support in childcare services in their institute, including daycare accessibility, financial support, parent- / child-friendly environment, and flexibility of home office (Figure 5.8 and 5.9). From the analysis, 22.1% of DRs state that there is support, while 34.7% do not know. Moreover, we observed 41.1% of DRs who have children are not satisfied with childcare support, mainly because of reimbursements for daycare during business travel (91%), lacking financial support for daycare (90%), and a lack of a child-friendly working environment (87%) (Figure 5.9).

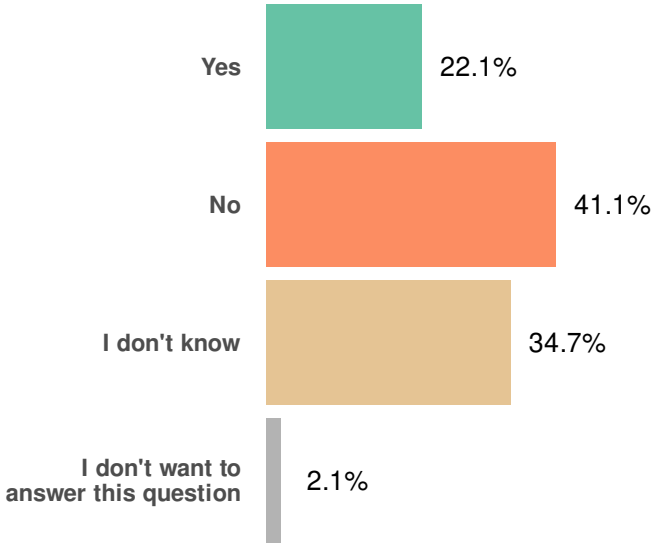

Figure 5.8: Satisfaction towards childcare support from the institute.

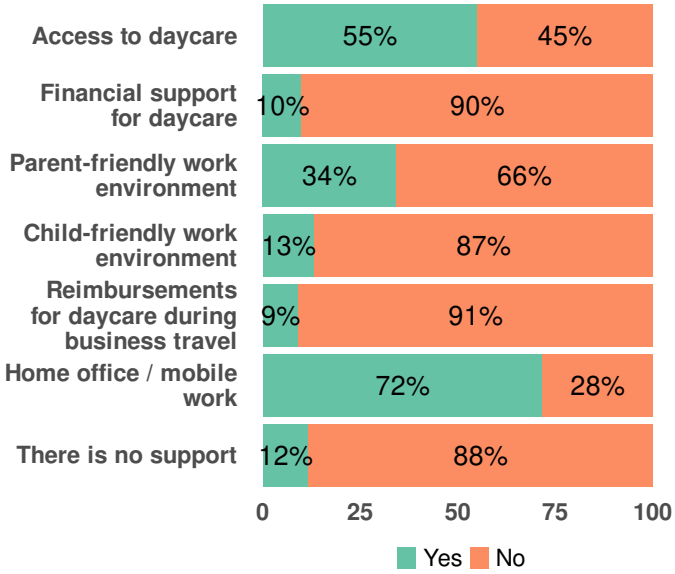

Figure 5.9: Aspect of childcare services that are offered by the institute.

Based on analysis showed in Figure 5.7, with "compatibility of own career plans with having children" being one of the aspects with the lowest satisfaction, we cannot help but wonder – are we losing scientists because of insufficient family-friendly policies?

5.4 Satisfaction with available support structures

The general satisfaction for support for international DRs and for bureaucracy and administrative support have gotten lower since 2019 (Figure 5.10) (Support for international DRs: 55% in 2022, 62% in 2019 [13], 61% in 2020 [5] and 62% in 2021 [1]; Bureaucracy and administrative support: (57% in 2022, 60% in 2019 [13], 65% in 2020[5], 64% in 2021 [1] and this score was at 74% in 2018 [14]). We can see a similar trend for family support as well: 48% were satisfied of it in 2022, while this number was at 57% in 2019 [13], 52% in 2020 [5] and 55% in 2021[1]. This corroborates the observations expressed in section 5.3.

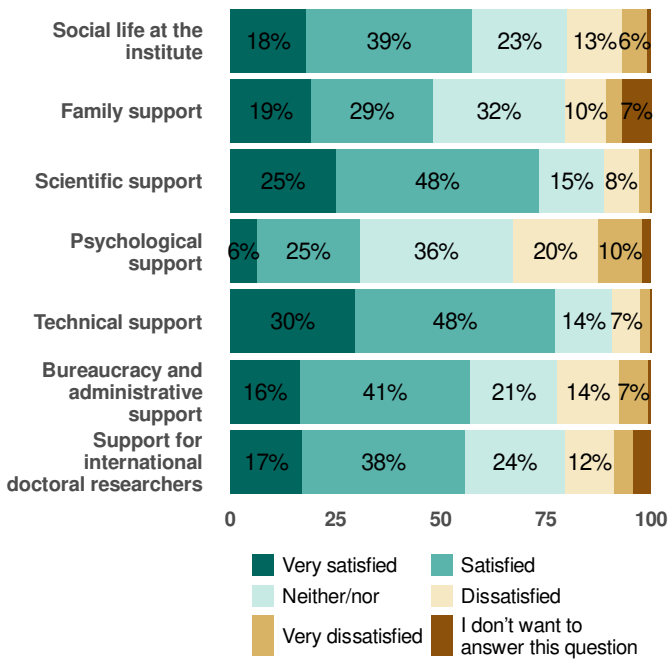

Figure 5.10: Satisfaction with aspects of Support

Psychological support gets by far the lowest satisfaction rates, with 30% of DRs satisfied and 30% dissatisfied. These numbers are similar to those reported since 2019, reflecting minimal progress over three years on this measure[1, 5, 13].

It is therefore not a surprise to see that 73% of DRs would like to see improvements on bureaucracy and administrative support, 72% would like improvement on psychological support, and 74% would like a better support for international researchers (Supplementary Figure C.3) - if we exclude the "I don't know" answers (which represent 25% of respondents). 69% of the respondents desired better family support, again excluding "I don't know" answers (36% of answers). For bureaucracy and administrative support and family, the desire for improvement is higher than in previous years, and it is in a similar range for psychological support and support for international DRs.

Satisfaction with career development reaches 61% (Figure 5.11), which is higher than previous years (48% in 2021 [1], 46% in 2020[5], 44% in 2019[13]). On the other hand, satisfaction with science communication and outreach is worse than previous years: 42% in 2022 and 26% of dissatisfied people (Figure 5.11), compared to the respective 53% and 15% in 2021 [1] and 50% and 16% in 2019[13]. A similar trend is to be observed for satisfaction with workshops and skills trainings: 45% in 2022, 58% in 2021[1], 62% in 2020 [5], and 61% in 2019[13].

This can seem counter-intuitive since the Planck Academy – a platform of various online and in-presence learning modules specific to the employees of the MPS – was founded in 2020 to solve this problem. Looking at the Supplementary Figure C.4, the majority of participants in the Planck Academy courses (85% of the 22% who took part, accounting for 18.8% of all survey respondents) found the courses to be useful. However, it is noteworthy that 74.5% did not partake in any course, and a substantial 29% of doctoral researchers have not even heard of them.

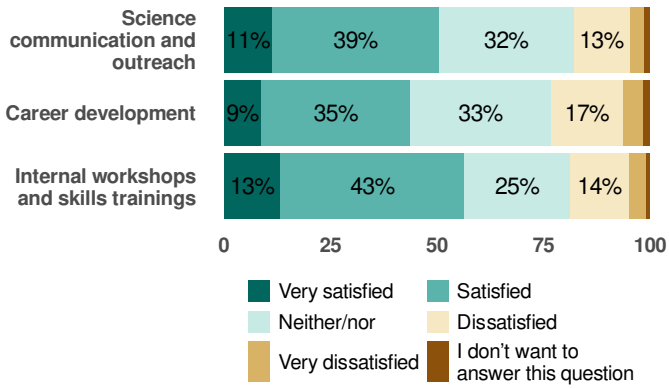

Figure 5.11: Satisfaction with aspects of Career development

Hence, 86% of DRs would like to improve their career development opportunities, 79% would like improvements to workshops and skills training, and 72% would like more science communication and outreach (Supplementary Figure C.5). All those numbers are higher than the previous years, which may partially be due to the change in rating scale, and the observations made above.

Chapter 6

Conflicts and Discrimination

Doing a PhD can be a precarious moment in an early career researcher's life. The world of academia is as-yet unknown to us, and we rely heavily on our supervisors and other support personnel to guide us through the experience of the PhD. This informational asymmetry has been known to lead to cases of power abuse and bullying, which has effects on both the personal well-being of doctoral researchers and their scientific output. We therefore investigate this sensitive subject in our survey to evaluate the current status of power relations between doctoral researchers and their senior colleagues and inform solutions.

6.1 Conflicts

14.6% of respondents (339 people) declare having had a workplace conflict. 7.9% of respondents (184 people) had reported a conflict through formal reporting structures (Supplementary Figure D.1). Another 6.7% had experienced serious conflicts but did not report them (155 people) (Supplementary Figure D.1). Of those who had one or more serious conflicts, the plurality of 43.2% indicated a conflict with their direct supervisor (Supplementary Figure D.2. Among those who reported the conflict, 27.8% of respondents described being satisfied or very satisfied with the results of reporting, but 40.2% were dissatisfied or very dissatisfied (Figure 6.1). Compared to the 2019 PhDnet Survey [13], more conflicts were reported, but the satisfaction with the results of reports was similar. This suggests that willingness to report conflicts has increased, but that the conflict resolution mechanisms have not improved.

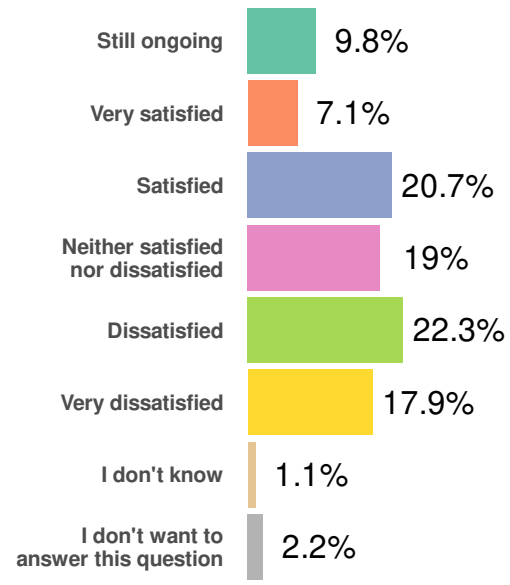

Figure 6.1: Satisfaction with consequences of reporting

6.2 Sexual harassment

Sexual harassment refers to unwelcome behaviors of a sexual nature, such as intrusive looks, catcalling, unwanted verbal remarks, spreading sexualized information,

unwanted touching, and requests for sexual favors. It involves making someone feel uncomfortable, intimidated, or pressured in a sexual context, causing emotional distress and negatively impacting their well-being. Sexual harassment was reported by 8.9% of all respondents (199 people) (Figure 6.2). This number is almost double the rate in the 2019 PhDnet Survey. 45.7% of these people had been harassed one time, with another 47.4% reporting occasional harassment (Supplementary Figure D.3). The most common perpetrators of sexual harassment were other doctoral researchers and other scientific staff who were not the respondent's supervisor or other superior (Supplementary Figure D.4).

84% of people who experienced sexual harassment are women, which corresponds to 16% of all women who participated in the survey (Figure 6.3). This is almost double the rate of the 2019 PhDnet Survey, despite men reporting a similar level of sexual harassment to the 2019 survey (2.5%)[13], along with 8% of gender diverse people (Figure 6.3).

Gender diverse people made up a disproportionate share of those reporting sexual harassment: only 1.2% of survey respondents are gender diverse, but they were on the receiving end of 20% of unwanted sexual advances, 14.3% of those reporting pressure to engage with someone sexually, and 12.5% of physical acts of sexual assault (Figure 6.4) These findings follow a similar trend to 2019. Among men who experienced sexual harassment, the most common forms were physical acts of violence and spreading of sexualized information or rumors.

Sexual harassment rates are quite similar across nationalities: 8.4% of German DRs reported it, 8.9% of DRs from outside the EU, and 9.4% of DRs from the EU excluding

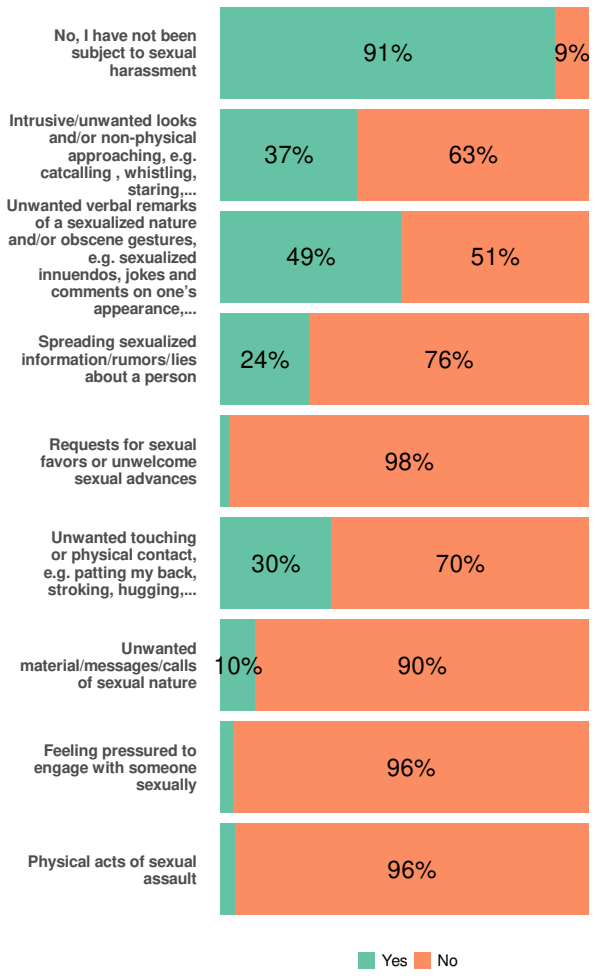

Figure 6.2: Types of sexual harassment of DRs.Lines 2-9 are the percentage of those who experienced some type of SH

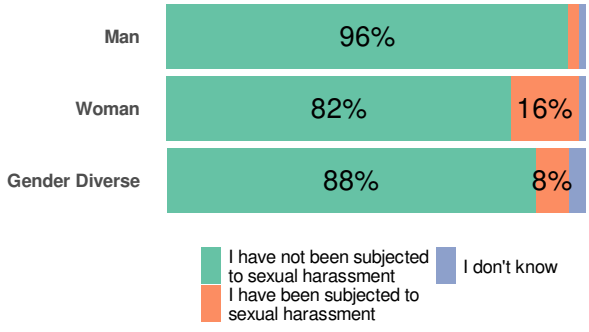

Figure 6.3: Sexual harassment by gender

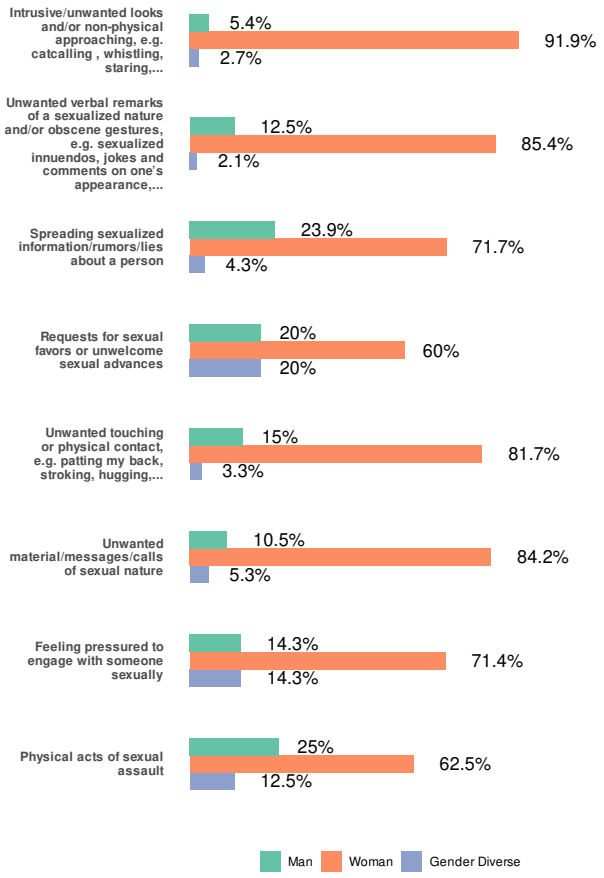

Figure 6.4: Sexual harassment by statement and gender

Germany (Supplementary Figure D.5). Notably, the share of DRs from outside the EU who did not know if they have been subject to sexual harassment (2.7%) was more than twice the share of DRs from Germany (1.3%) or from the EU excluding Germany (1.1%) who did not know (Supplementary Figure D.5). This may be explained by the difference of definition or knowledge of sexual harassment varying by continent/culture.

6.3 Bullying

Bullying is harmful behavior that includes spreading rumors, making fun of a person, withholding information, non-constructive criticism, verbal harassment, social isolation, threat to professional status, and even physical attacks. It aims to degrade and intimidate the target, causing emotional distress and negatively impacting their well-being and professional life. 22.6% of respondents report being subject to bullying (Supplementary Figure D.6).

58.9% of those who have been bullied say that this bullying occurs occasionally, and 17.0% report that it occurs at least once a month (Supplementary Figure D.7). The perpetrators of bullying are rather diverse, but 38.8% of those bullied identified another DR as the perpetrator, and 37% identified their direct supervisor (Supplementary Figure D.8).

The vast majority - 68% - report that the reason for the bullying was their position of power / hierarchy (Figure 6.5). This was particularly true for those reporting bullying by their direct or formal supervisor, but it holds true regardless of who the reported bully was: position of power and hierarchy was always the most common reason (Supplementary Figure D.13). This suggests that there are hierarchies at play beyond sim-

ply supervisor-supervisee, perhaps related to length of time working in the institute.

Nationality, gender identity, and mental health were also relatively common answers for the basis of the bullying, while age and ethnicity were a non-negligible share (Figure 6.5). Methods of bullying are similar across fields of research and gender (Supplementary Figures D.9 and D.10)

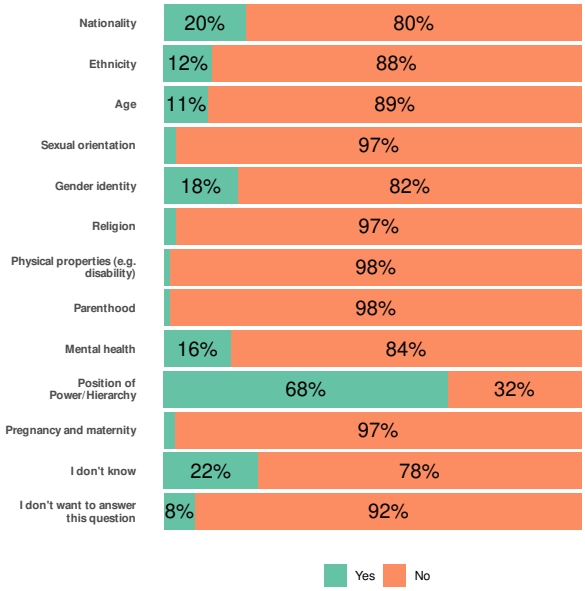

Figure 6.5: Reasons why respondents perceived that they were bullied

Respondents were also asked about bullying that they witnessed in their institute/center, and they reported similar trends to self-reported bullying (Supplementary Figures D.11 and D.12). Nationality and ethnicity were perceived as the basis for bullying more often when reporting other people who were bullied than in self-reported bullying (Supplementary Figure D.14). The witness data needs to be taken with a pinch of salt, since some cases may have been missed while other witnesses could also have reported the same bullying case, but the fact that these numbers are relatively similar suggests that respondents are not afraid to self-report bullying in this survey.

6.4 Discrimination based on identity

We asked respondents whether they had ever been discriminated against during their PhD, and if so, for what reasons (in their own assessment). 21.3% of respondents report one or more type of discrimination, with the largest shares being based on their nationality and/or their gender identity. We analyze the share of respondents belonging to a certain marginalized group who might feel discriminated against because of their marginalized identity.

Across the entire survey, individuals belonging to a wide variety of identities could report discrimination for many different reasons, but it is particularly important to evaluate the amount of discrimination felt by people of marginalized gender identities, nationalities, sexual orientation, disability, and parental status.

Discrimination based on nationality was highest among non-Europeans: 16.2% of non-EU citizens, 6.9% of non-German EU citizens, and only 1.2% of German citizens report feeling discriminated against based on nationality (Figure 6.6). Discrimination based on religion is not commonly reported among any subgroup, but non-Europeans were much more likely to decline to answer or say that they do not know whether they have experienced religious discrimination (Supplementary Figure D.15).

When considering gender, we see little gender identity-based discrimination among men, but 13.6% of women and 24% of gender diverse individuals report this (Supplementary Figure D.16). We also investigated gender identity-based discrimination among LGBTQI+ respondents, finding that 13.8% of them feel discriminated against based on their gender identity, com-

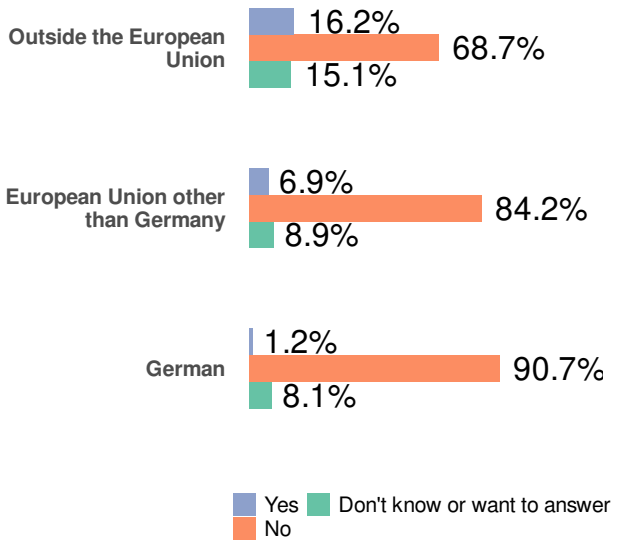

Figure 6.6: Discrimination based on nationality among non-European citizens, non-German Europeans, and Germans

pared to 6.1% of straight respondents (Supplementary Figure D.17). Of respondents who identify as members of the LGBTQI+ community, 7.2% report feeling discriminated against based on their sexual orientation, compared to 0.2% of straight respondents (Figure 6.7).

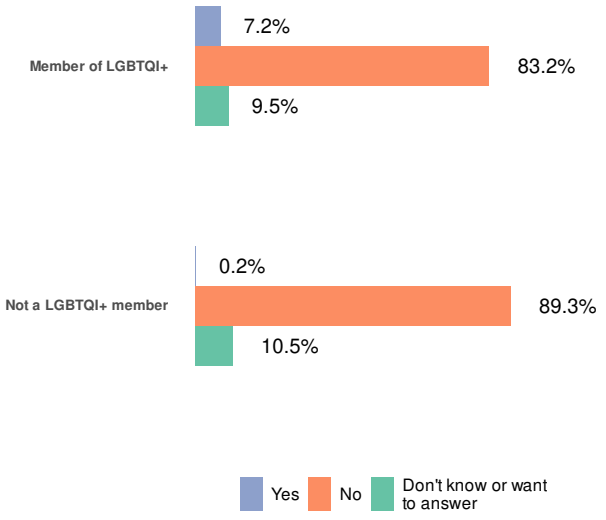

Figure 6.7: Discrimination based on sexual orientation among LGBTQI+ and non-LGBTQI+ respondents

Few respondents report having official "Schwerbehindertenausweis" legal status in Germany to recognize a disability, but of those who do, 22.2% felt that they had been discriminated against based on their disability (Figure 6.8). Among people who self-identify as disabled but do not have official recognition for it, 8% felt discriminated against for their disability, compared to only 0.3% of other respondents.

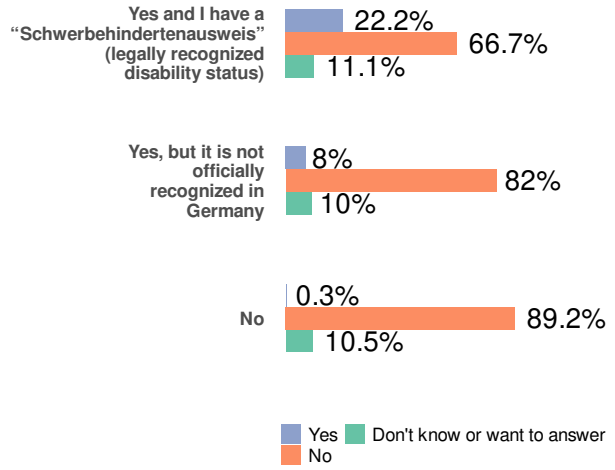

Figure 6.8: Discrimination based on disability among people with legally-recognized disability, self-identified disability, and no disability

Among doctoral researchers who have at least one child, 15% of them reported discrimination based on parenthood, with almost as many parents (13.3%) declining to answer or indicating that they do not know whether they were discriminated against (Supplementary Figure D.18).

The Max Planck Society has many resources for people experiencing workplace conflicts and harassment. For the latest up-to-date information on reporting a conflict, please refer to the "contact and reporting points" page on the MAX intranet. On the intranet you can also find more information about the Employee and Manager Assistance Program (EMAP) if you are in need of counseling and mental health support.

Chapter 7

Mental and Physical health

7.1 Mental health

Mental health is an essential aspect of overall well-being, and it plays a significant role in the lives of DRs. The demanding nature of the PhD journey, including high workloads, time pressures, and academic expectations, can have an impact on the mental health of DRs [2] . The 2021 PhDnet Survey did not include an in-depth discussion of mental health among our members, but we studied this in earlier years and have revived it in the 2022 Survey.

86.96% of survey participants agreed to answer questions about their mental health. Following the methodology from previous PhDnet surveys to facilitate comparison, we use the same definitions of three key concepts:

State anxiety: the current level of anxiety symptoms, determined by investigating how anxious people feel at the moment

Trait anxiety: the overall level of anxiety symptoms, determined by investigating how anxious people feel in general

Depression: the level of depression symptoms, determined by investigating which problems have bothered people over the last few weeks

Based on a standard known as the Spielberger State-Trait Anxiety Inventory [15], we calculate two anxiety scores, with depression scores calculated according to the Patient Health Questionnaire module PHQ-9 [16]. These standard practices from the psychology literature allow us to quantify the levels of anxiety and depression reported by our doctoral researchers.

Almost all respondents report at least some anxiety, both in the present moment and as a general trait. 63.5% have moderate to high state anxiety (at the time of taking the survey in November - December 2022), and 58.5% generally have moderate to high trait anxiety (Figure 7.1 and 7.2). These numbers are quite similar to those reported in the PhDnet 2020 survey [5] when we last discussed these measures.

When we looked into the depression score, 55.8% of respondents report symptoms over the last two weeks that indicate at least mild depression (Figure 7.3), a slight increase from the level reported in 2020 [5]. As noted in the 2020 report, it was possible that mental health conditions were worse that year due to the COVID-19 pandemic. The fact that we see sustained levels of anxiety and depression in 2022 suggests that the situation has not improved even though most pandemic restric-

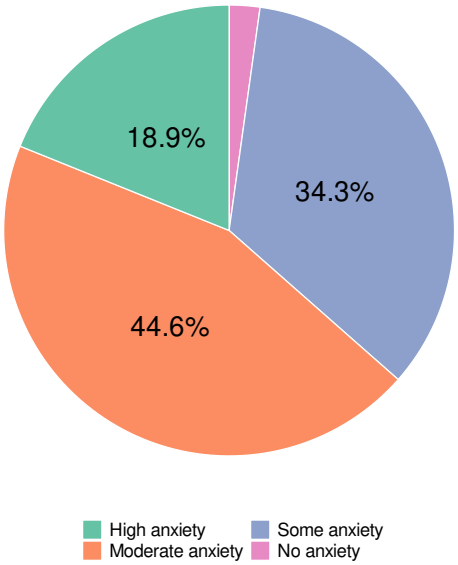

Figure 7.1: State Anxiety among respondents.

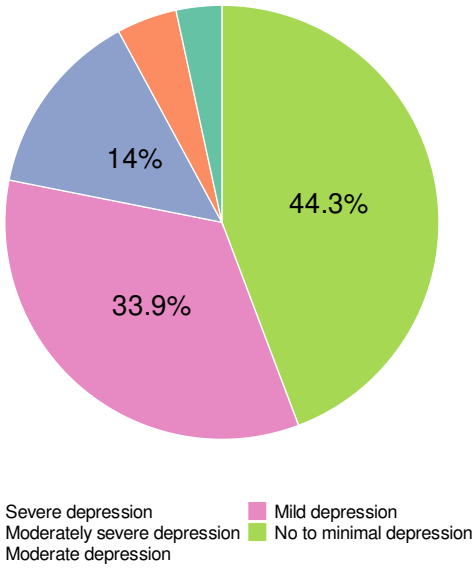

Figure 7.3: Levels of depression among respondents based on the PHQ-9 standard.

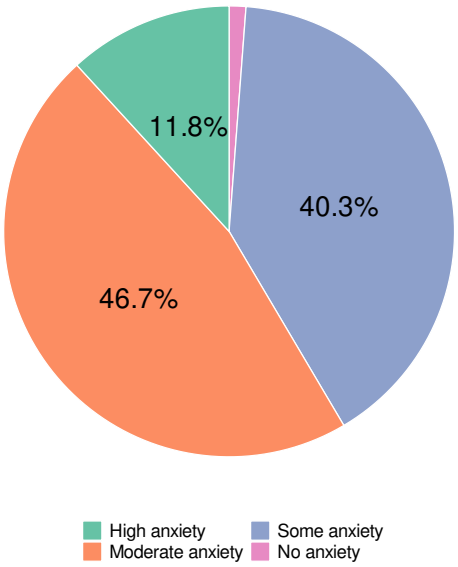

Figure 7.2: Trait Anxiety among respondents.

tions had been lifted at the time the survey was conducted. Most DRs who reported mental health issues that bothered them indicate that their work was affected: 17.6% say that it was extremely difficult or very difficult to do their work, with a further 56.3% saying work was somewhat difficult (Figure 7.4).

Mental health remains a challenge for doctoral researchers. Levels of state and trait anxiety as well as depression are alarmingly high, with majorities of respondents being affected. It is crucial that DRs receive more structural support to manage their mental health during the stressful time of their PhD work. It is important to prioritize mental health and create a supportive environment that promotes psychological well-being. Strategies such as providing access to mental health resources, fostering a culture of open communication, and offering support services can help address mental health challenges and promote the overall well-being of DRs.

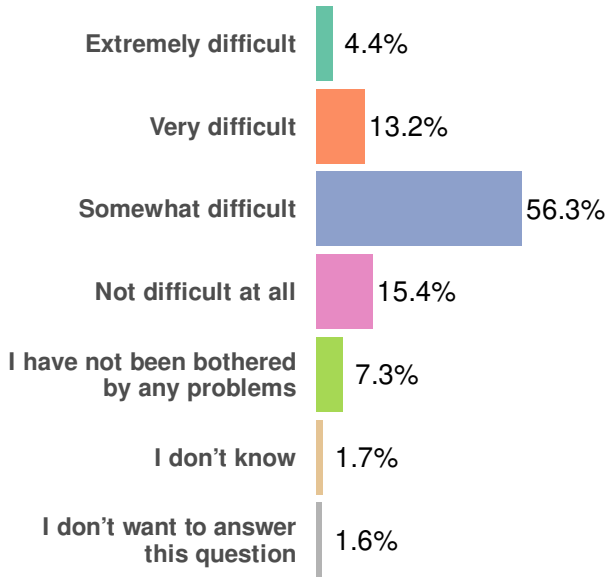

Figure 7.4: Difficulty of working due to mental health issues reported by DRs.

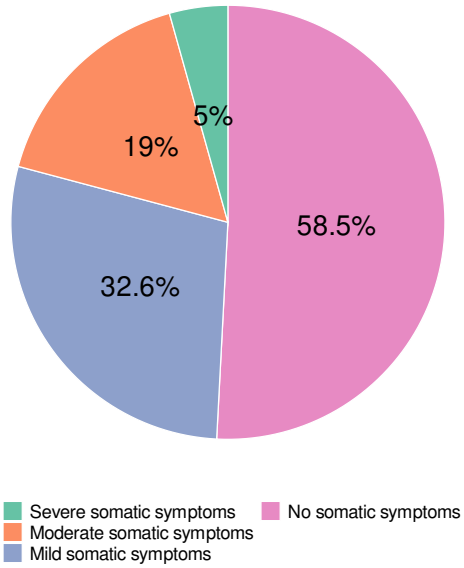

Figure 7.5: Levels of somatic symptoms among respondents based on the PHQ-15 standard.

7.2 Physical health

Physical health is also an important aspect of overall well-being, encompassing factors such as fitness, vitality, and freedom from illness or discomfort. Physical demonstrations of stress like burnout refers to a state of physical, mental, and emotional exhaustion that arises from chronic stress or prolonged exposure to demanding work or personal circumstances. Common physical manifestations of stress and burnout include fatigue, headaches, digestive issues, sleep disturbances, muscle tension and pain, weakened immune system, decreased libido, and increased susceptibility to illnesses. Physical demonstrations of stress can significantly impact various aspects of an individual's life, including their work performance, relationships, and overall quality of life [17]. With this in mind, our objective was to assess the work-related physical health of doctoral researchers.

To achieve this, we utilized the PHQ-15 (Patient Health Questionnaire-15) [16], a widely utilized tool in medical settings. The questionnaire consists of 15 specific questions that explore physical symptoms such as headaches, back pain, fatigue, and gastrointestinal problems. Its purpose is to evaluate the presence and severity of these symptoms and determine any potential associations with underlying medical conditions. Additionally, we sought to inquire whether DRs had experienced such symptoms prior to commencing their PhD.

The analysis of the results revealed that among the DRs surveyed, 5% reported severe somatic symptoms, while 19% reported moderate somatic symptoms. Additionally, 32.6% of participants reported mild somatic symptoms, and 58.5% reported no significant somatic symptoms. It should be noted that 33.1% of participants chose not to answer these questions (Figure 7.5).

The reluctance of some participants to disclose their symptoms suggests the sensitivity and personal nature of the topic and/or insufficient awareness of importance for asking this question. It is worth mentioning that 36% of the survey participants had already experienced such symp-

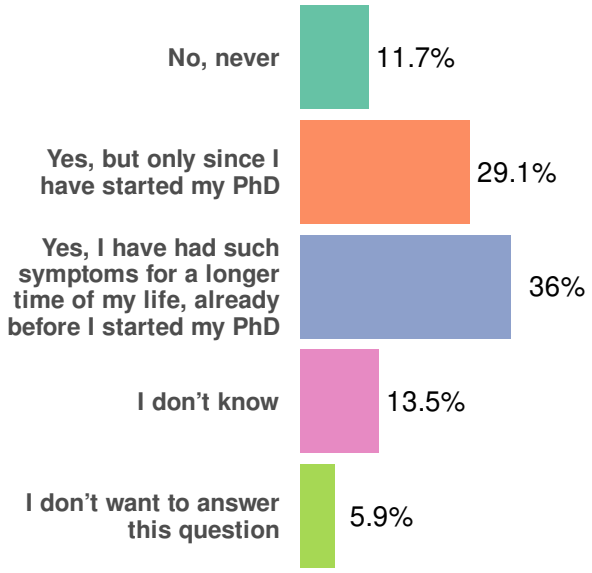

Figure 7.6: Time of the somatic symptoms appearances.

toms before starting their PhD studies and 40.8% survey participants have started having somatic symptoms during the PhD period (Figure 7.6). Further exploration and understanding of the underlying factors contributing to somatic symptoms among DRs can contribute to the development of targeted strategies aimed at promoting their well-being and mitigating the potential impact on their work and overall quality of life.

7.3 Employee and Manager Assistance Program

The Max Planck Society offers mental health support through the Employee and Manager Assistance Program (EMAP). This counseling service is free, anonymous, and available for all affiliates of the Society to discuss both professional and personal issues. Counseling can be extremely important to people navigating the stress of doing a PhD. Awareness of EMAP among DRs is unfortunately low, with 65.7% of

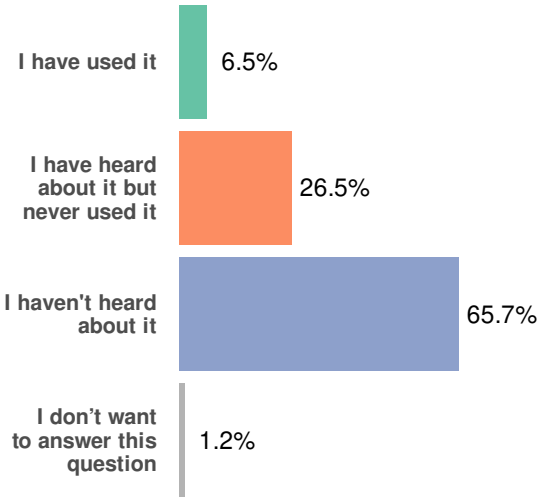

Figure 7.7: Awareness of EMAP

respondents saying that they have not heard about the program (Figure 7.7). Of the 6.5% of respondents who reported using EMAP services, 56.7% of them were either satisfied or very satisfied with the service (Figure 7.8). These numbers are quite similar to those reported in the 2021 PhDnet survey [1]. It is important to note that the MPS' service provider for the EMAP program has changed since the last survey, so respondents may be reflecting on experiences with two different providers.

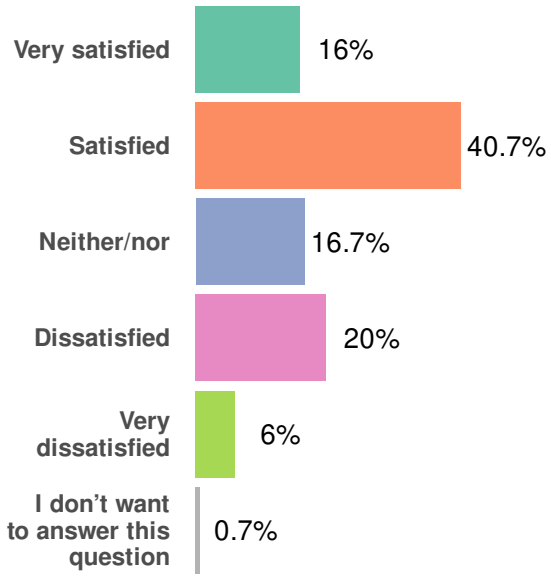

Figure 7.8: Satisfaction with EMAP

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Appendix A

Supplementary Figures: Working Conditions

A.1 Employment situation and funding

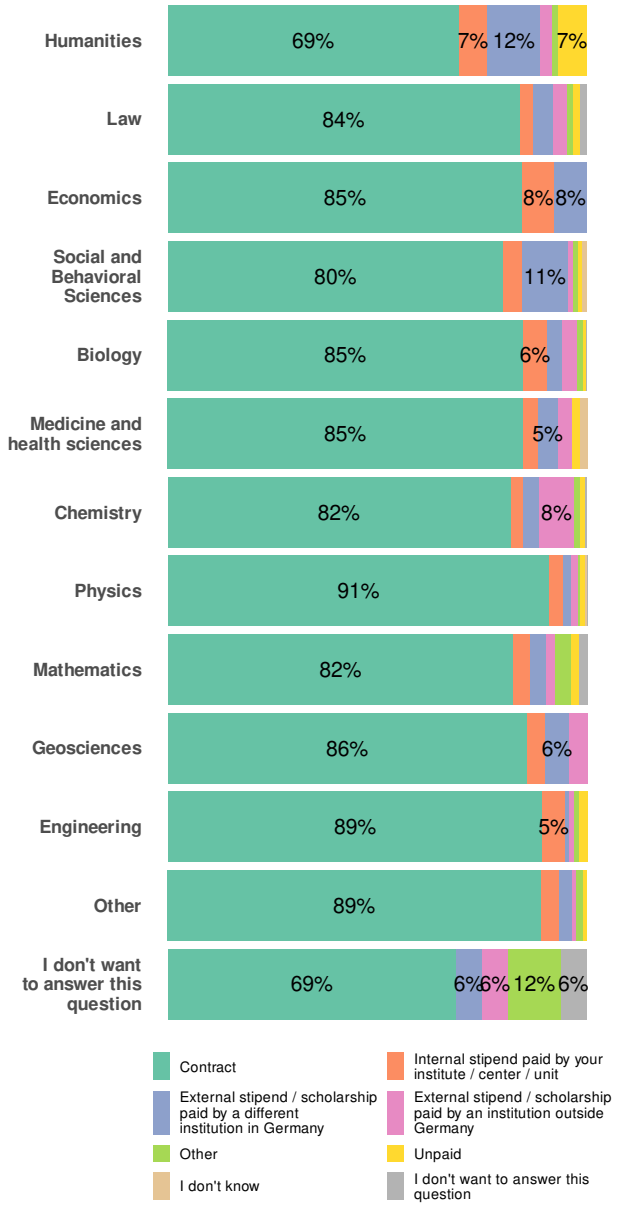

Figure A.1: Distribution of DRs by employment situation and field of study.

A.2 Duration and number of contracts

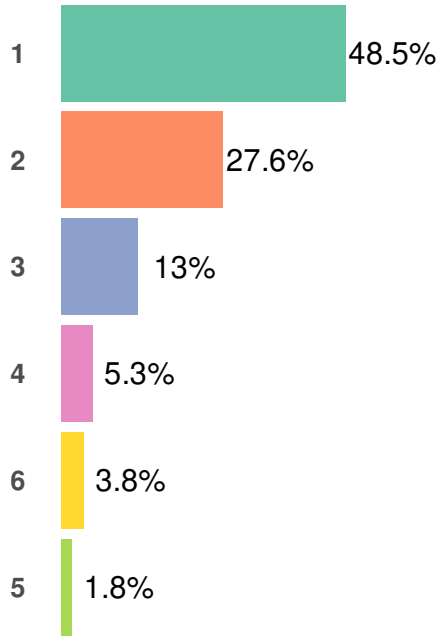

Figure A.3: The total number of described contracts per DRs.

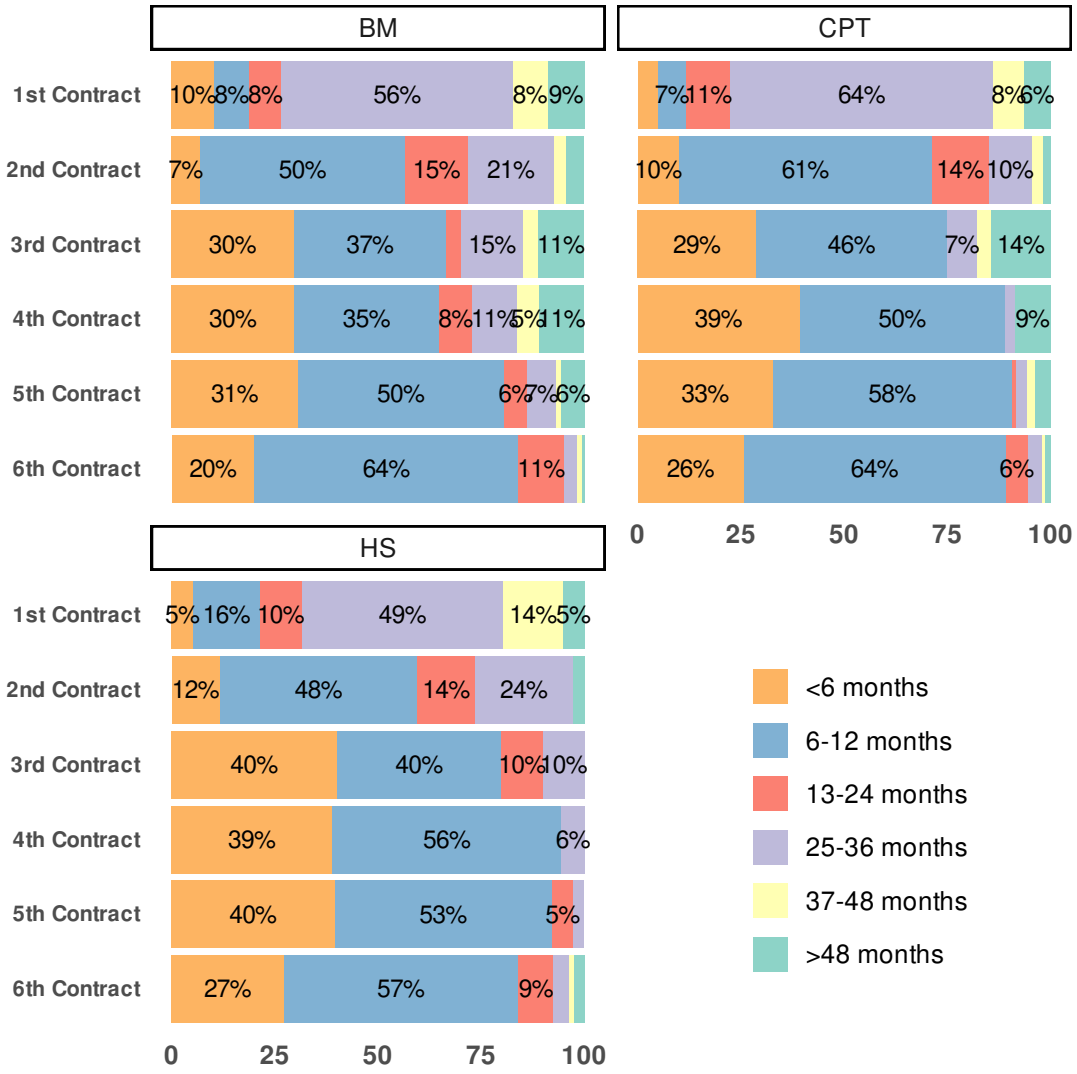

Figure A.2: Contract duration per PhD year per Section

A.3 Unpaid doctoral researchers

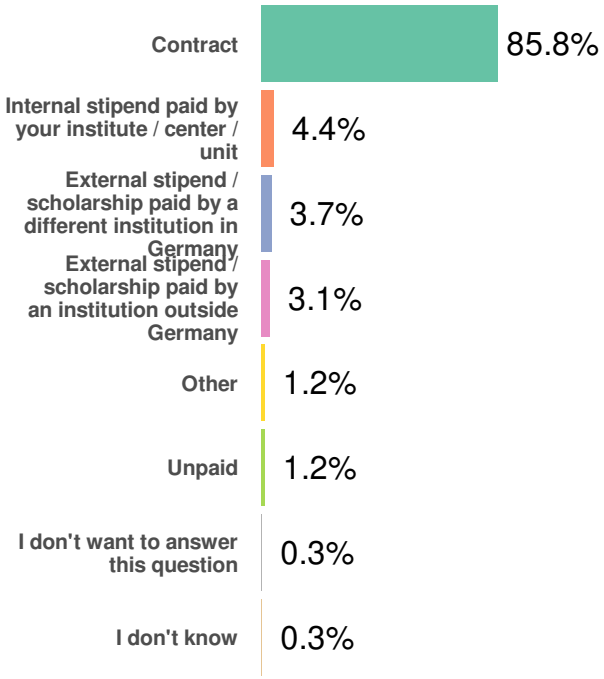

Figure A.4: Employment situation

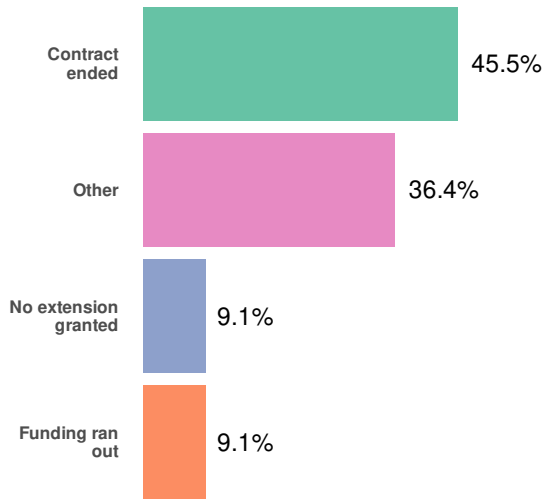

Figure A.5: Reasons for being unpaid

A.4 Income

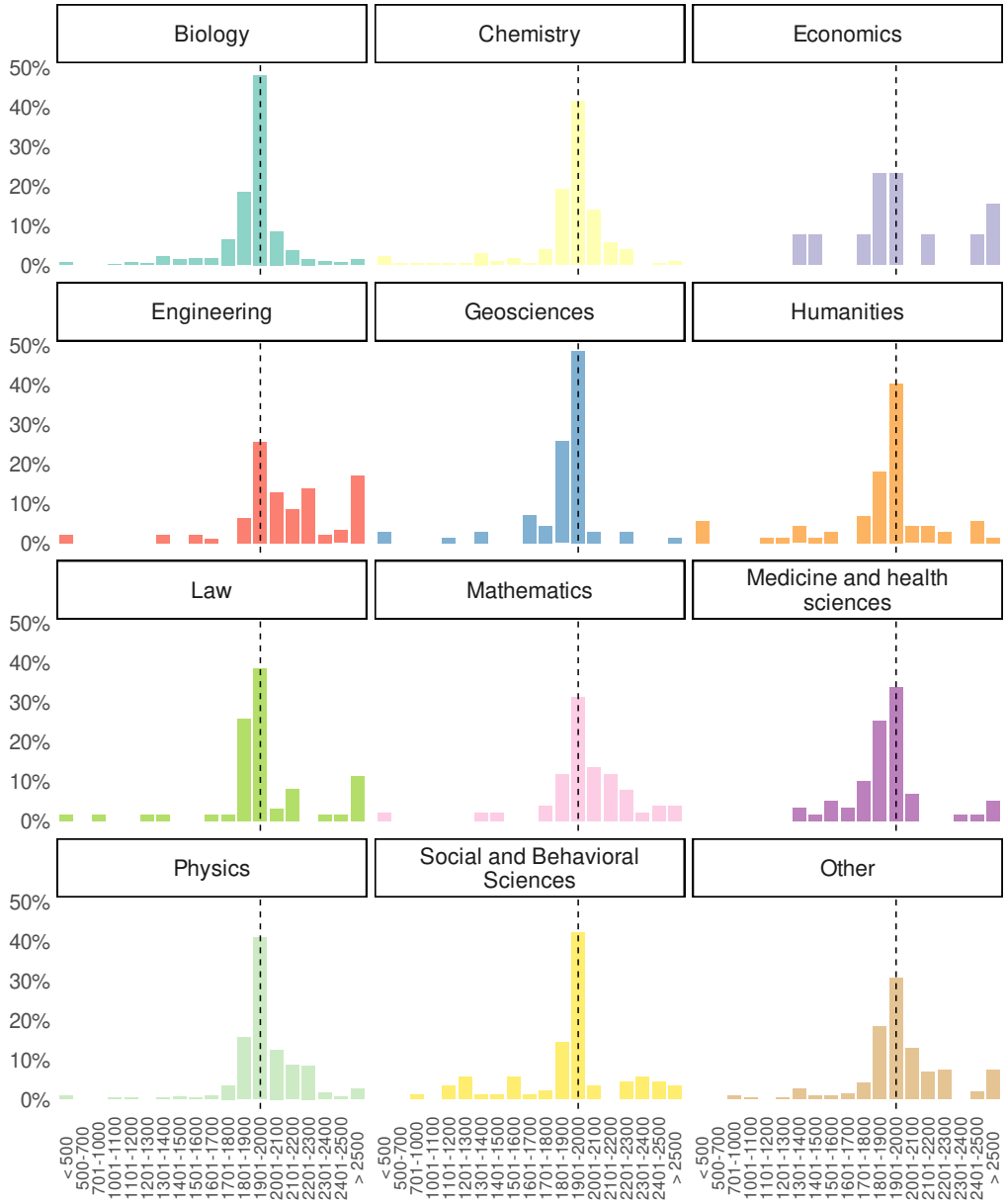

Figure A.6: Distribution of income per field of study.

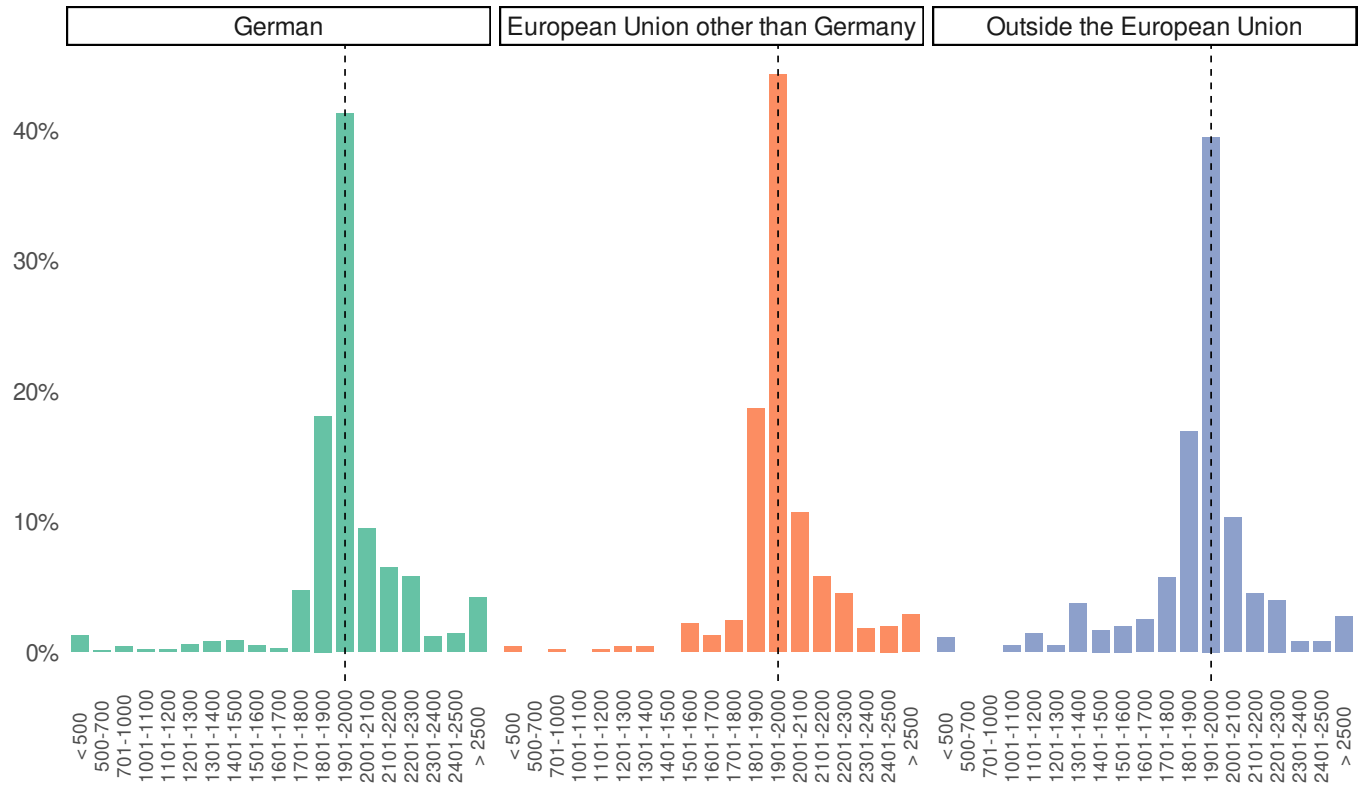

Figure A.7: Distribution of income per citizenship.

A.5 Working hours and holidays

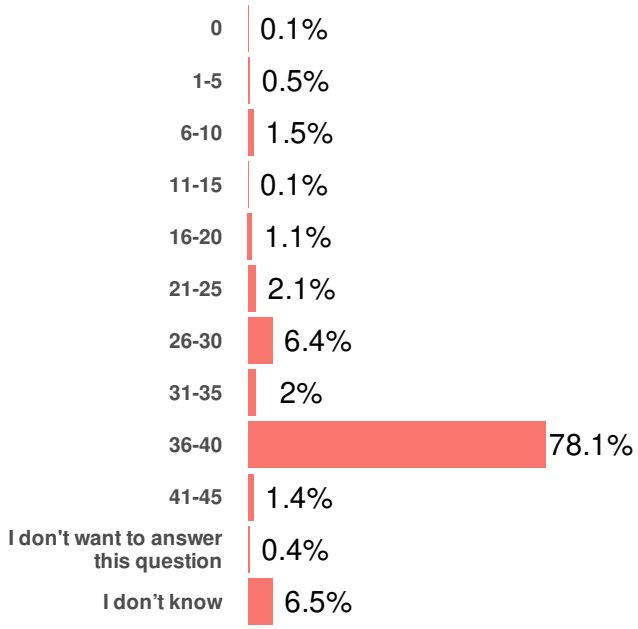

Figure A.8: Expected working hours per week based on the DR's contract.

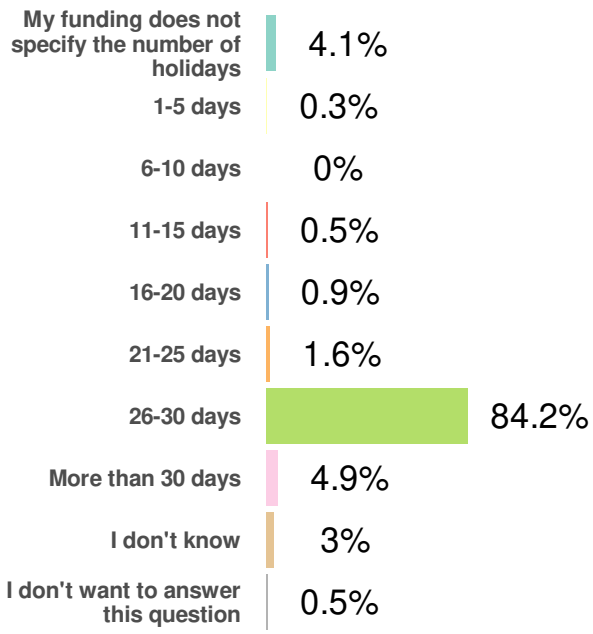

Figure A.9: Entitled number of holidays per year based on the DR's contract.

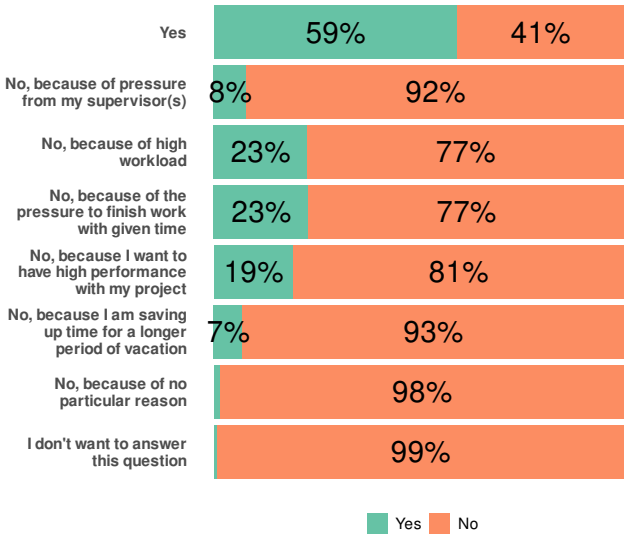

Figure A.10: Feeling able to take off holidays during the year.

A.6 Teaching as part of PhD-related work

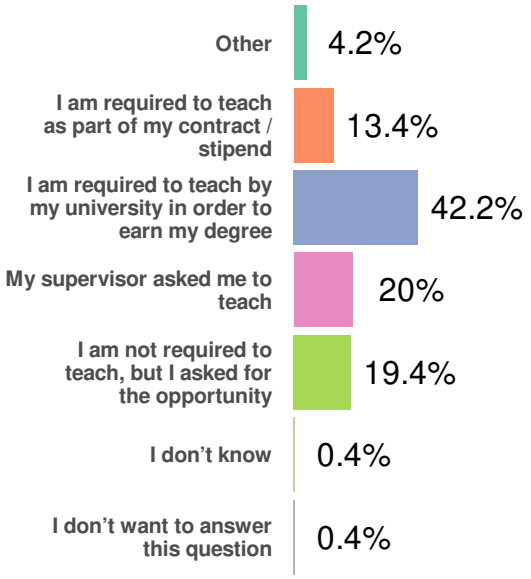

Figure A.11: Reasons why respondents are involved with teaching during their PhD

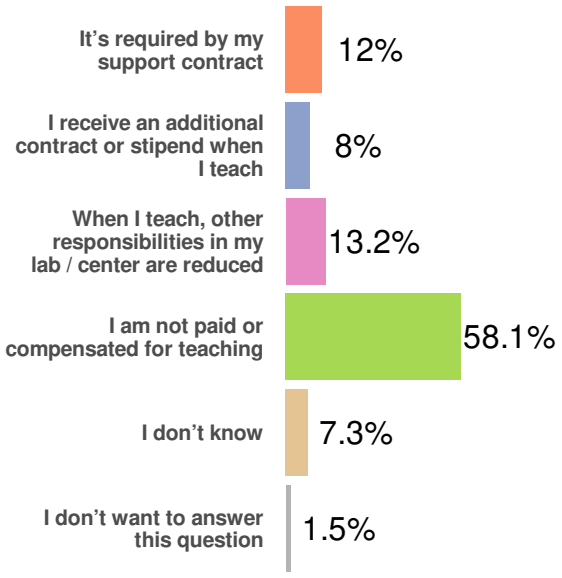

Figure A.12: Compensation for teaching during the PhD

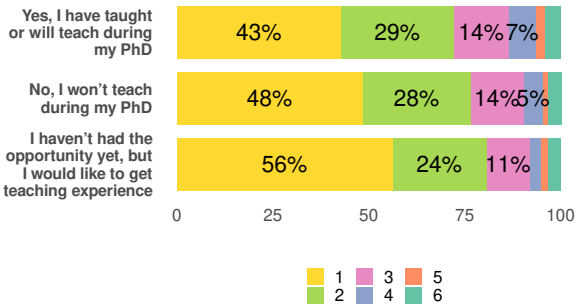

Figure A.13: Number of contracts/stipends during the PhD, broken down by whether the respondent is involved in teaching

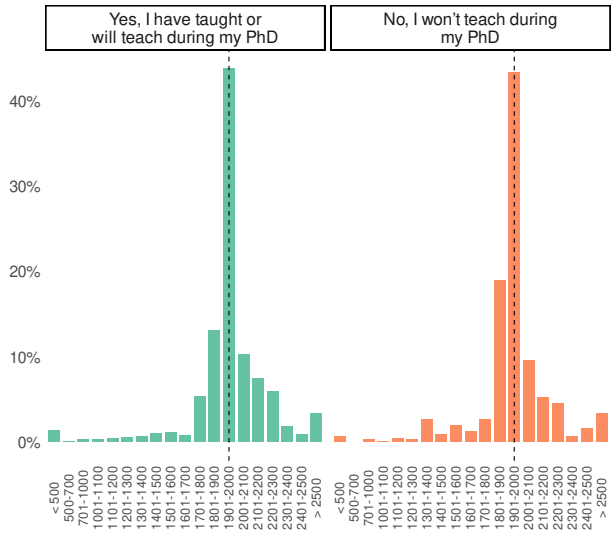

Figure A.14: Income distribution for teachers and non-teachers

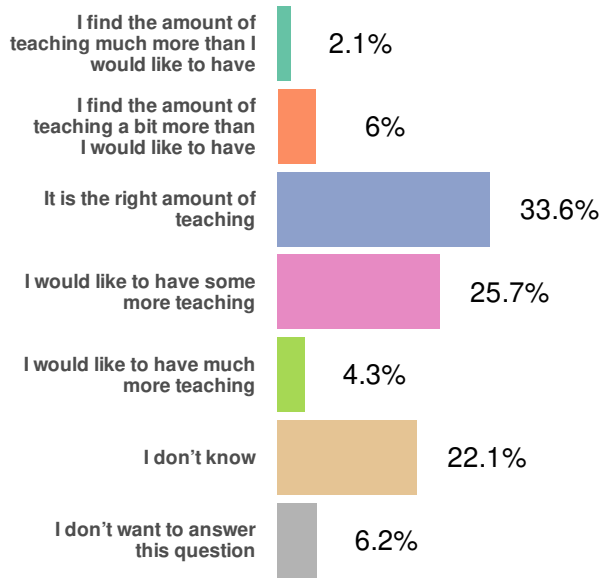

Figure A.15: How respondents feel about the amount of teaching that they do / will do during their PhD, aggregated

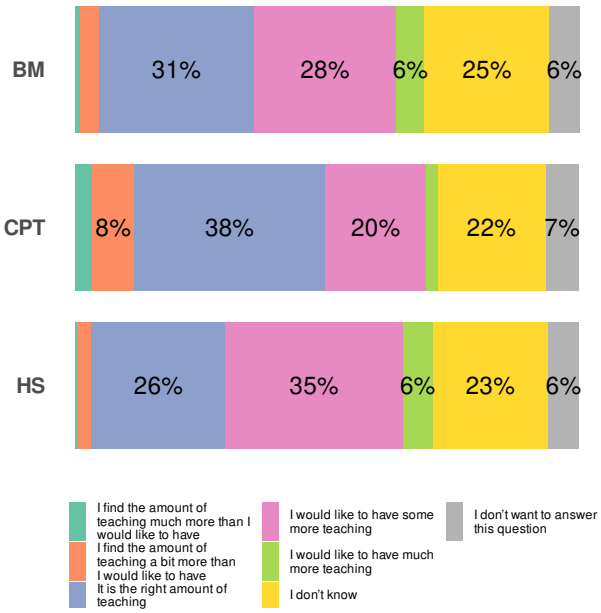

Figure A.16: How respondents feel about the amount of teaching that they do / will do during their PhD, broken down by section

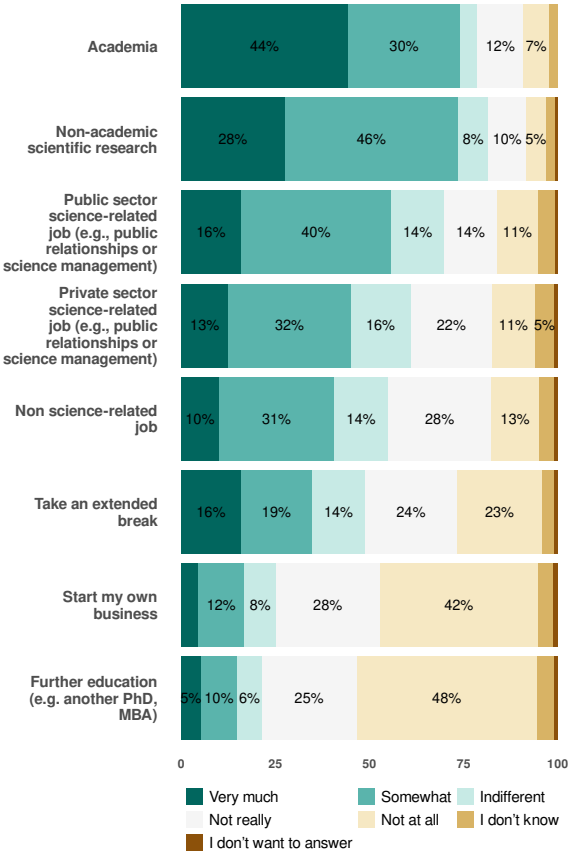

Figure A.17: Intended field of work after finishing PhD in HS Section

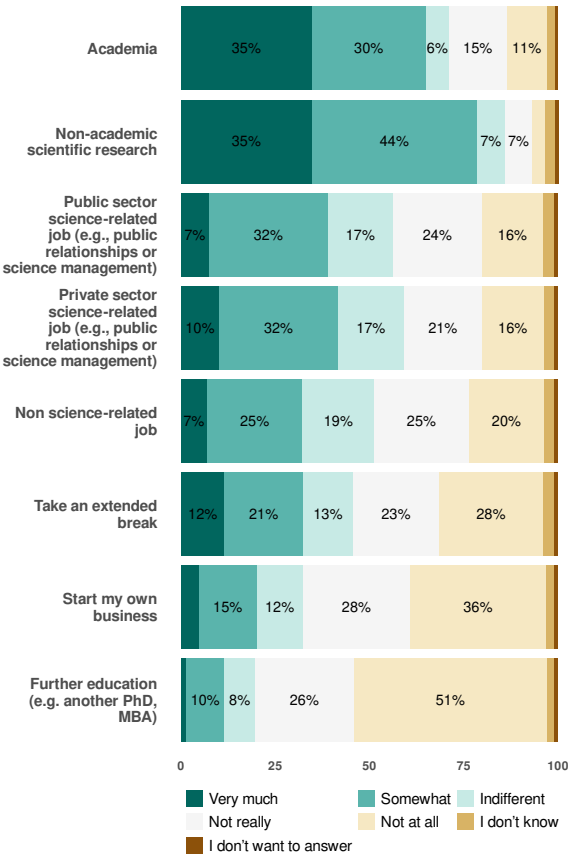

Figure A.18: Intended field of work after finishing PhD in CPT Section

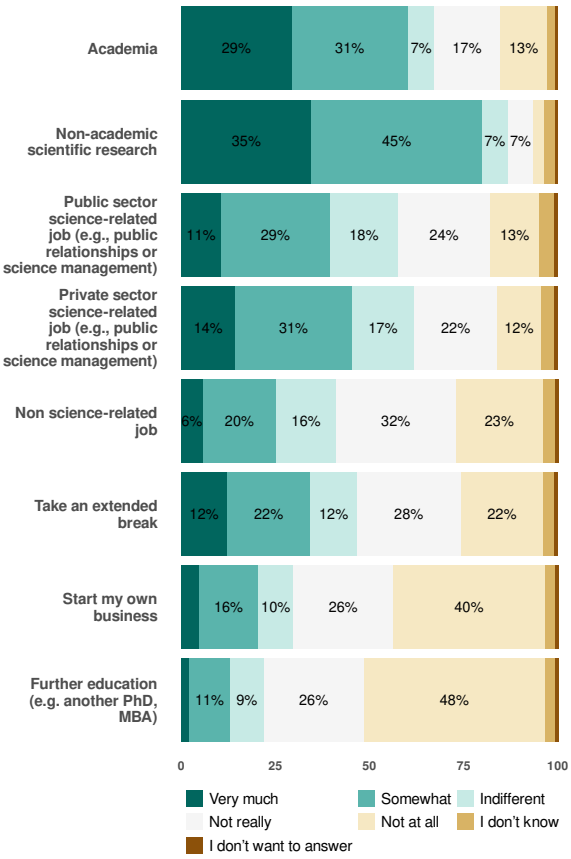

Figure A.19: Intended field of work after finishing PhD in BM Section

A.7 Satisfaction with various aspects of working conditions

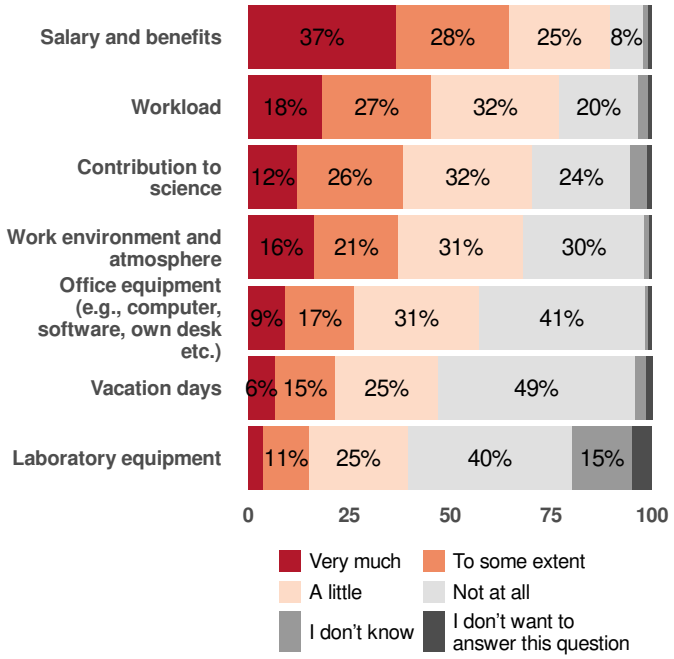

Figure A.20: Improvement desire with various aspects of working conditions.

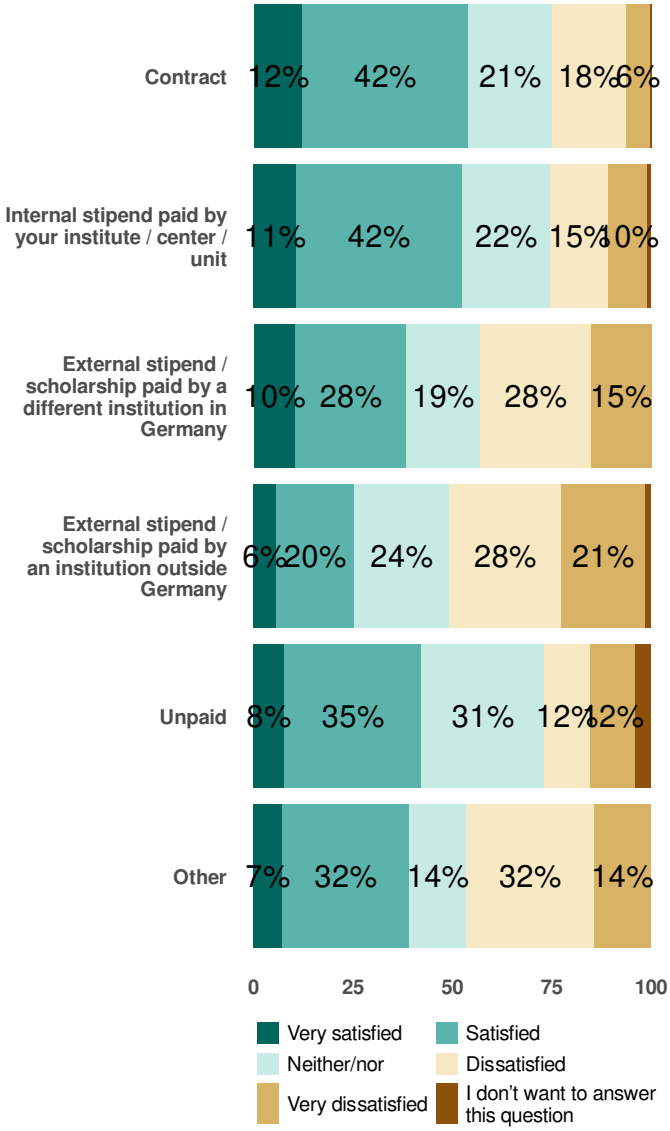

Figure A.21: Satisfaction with salary, divided per employment type.

A.8 Considering quitting the PhD track

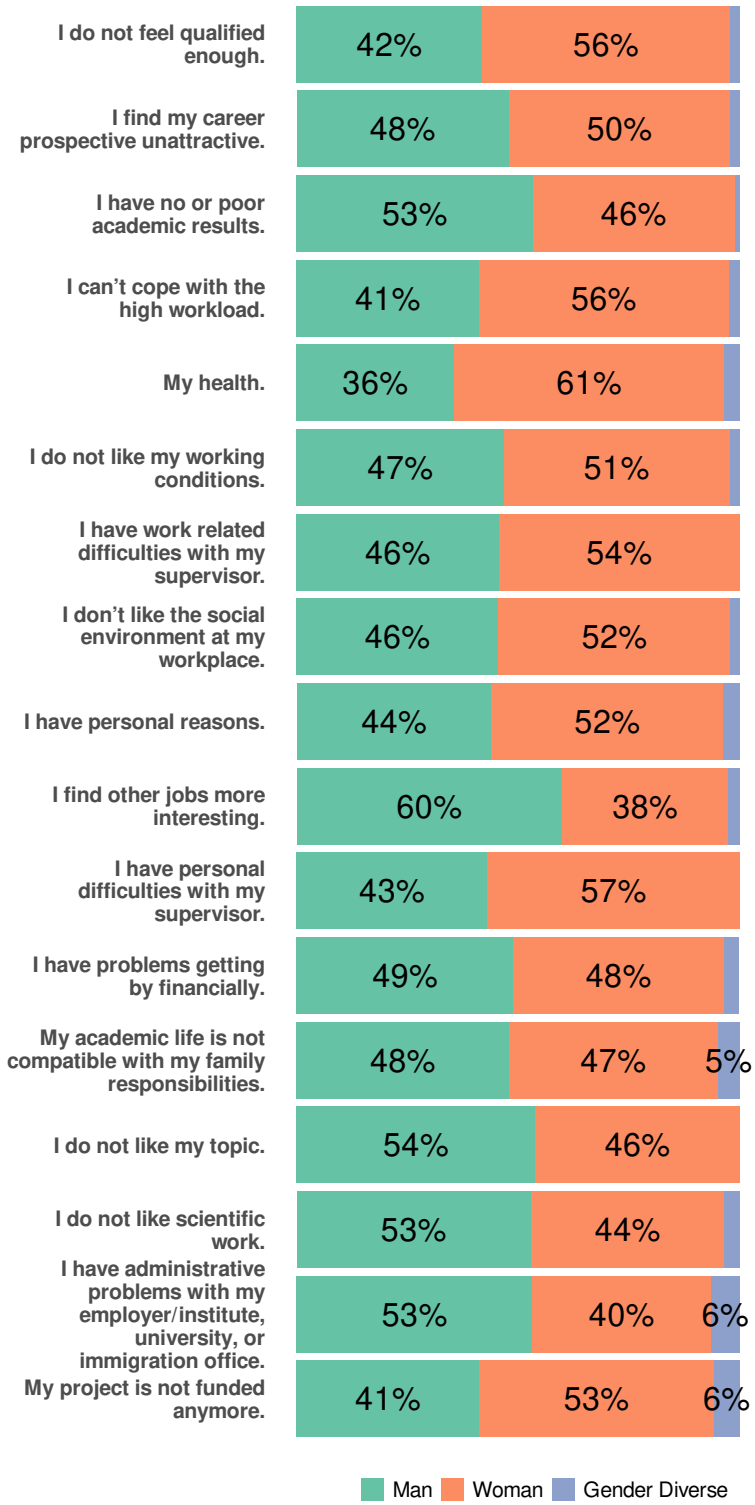

Figure A.22: Distribution of reasons to consider quitting their PhD by gender identity.

Appendix B

Supplementary Figures: Supervision

B.1 Supervisor personnel

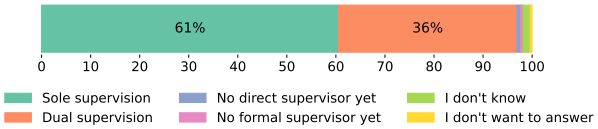

Figure B.1: Overall distribution of supervision status.

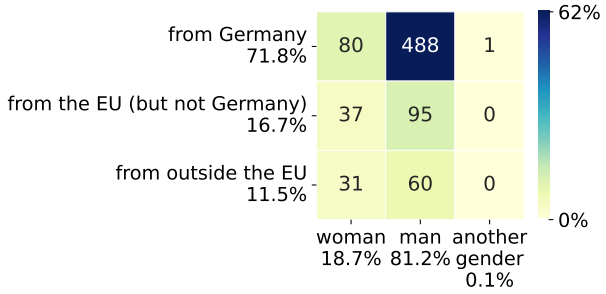

Figure B.2: Formal supervisor's citizenship and gender. Percentage within DRs with dual supervision.

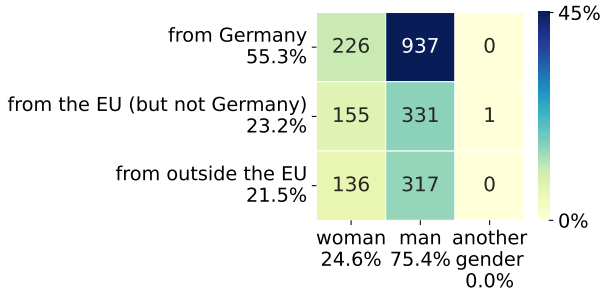

Figure B.3: Direct and sole supervisor's citizenship and gender. Percentage within all DRs.

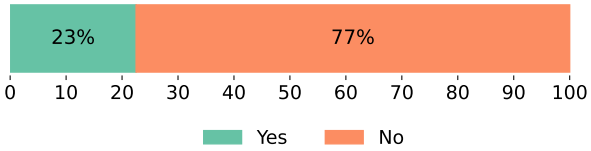

Figure B.4: Answer to "My formal supervisor only serves bureaucratic purpose". Percentage within DRs with dual supervision.

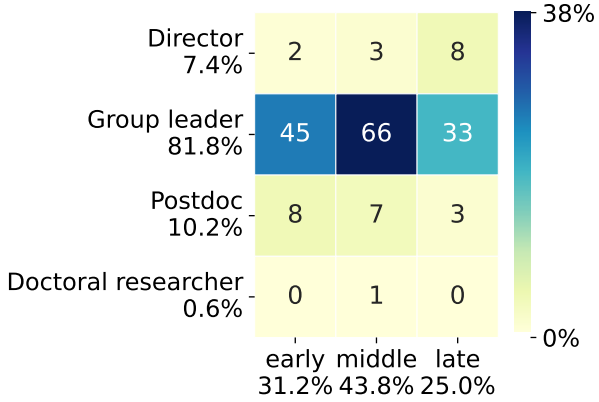

Figure B.5: Direct supervisor's title and stage in current position within dual supervision arrangement where DRs perceive the formal supervisor to only serve bureaucratic purpose. Percentage within DRs answering "Yes" in Figure B.4.

B.2 Supervision availability

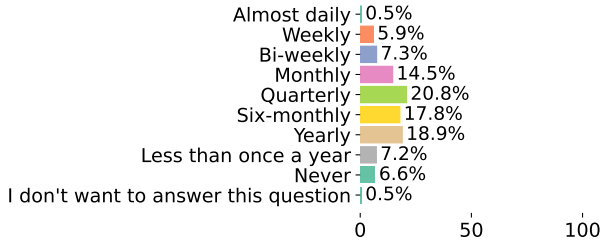

Figure B.6: Communication frequency with formal supervisor.

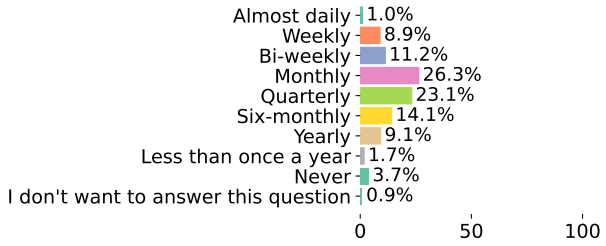

Figure B.7: Ideal communication frequency with formal supervisor.

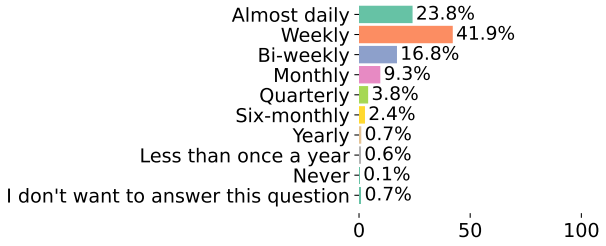

Figure B.8: Communication frequency with direct supervisor in duo-supervision.

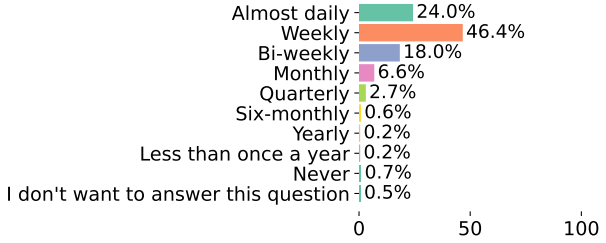

Figure B.9: Ideal communication frequency with direct supervisor in duo-supervision.

B.3 General satisfaction with supervision

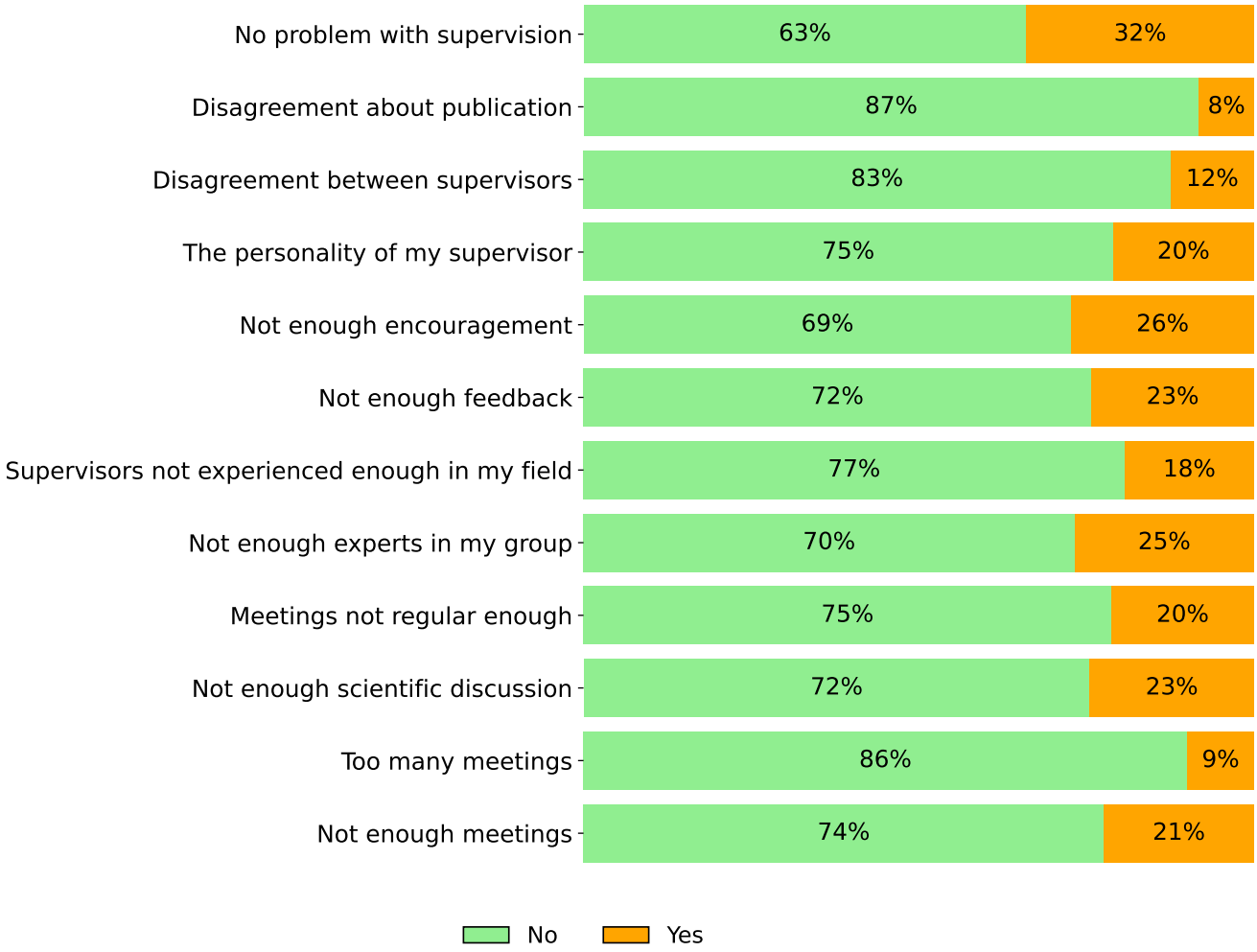

Figure B.10: Problems with either supervisor. Percentage within all DRs.

Appendix C

Supplementary Figures: Available Support Structures

C.1 Integration

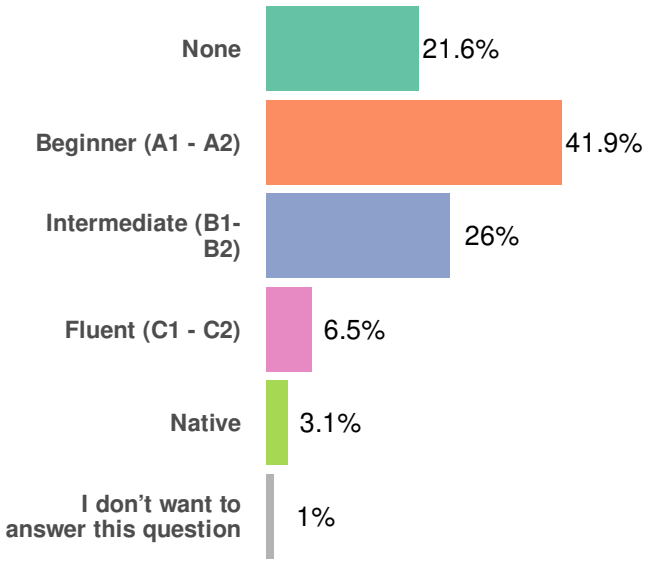

Figure C.1: German language level of DRs.

C.2 Career development

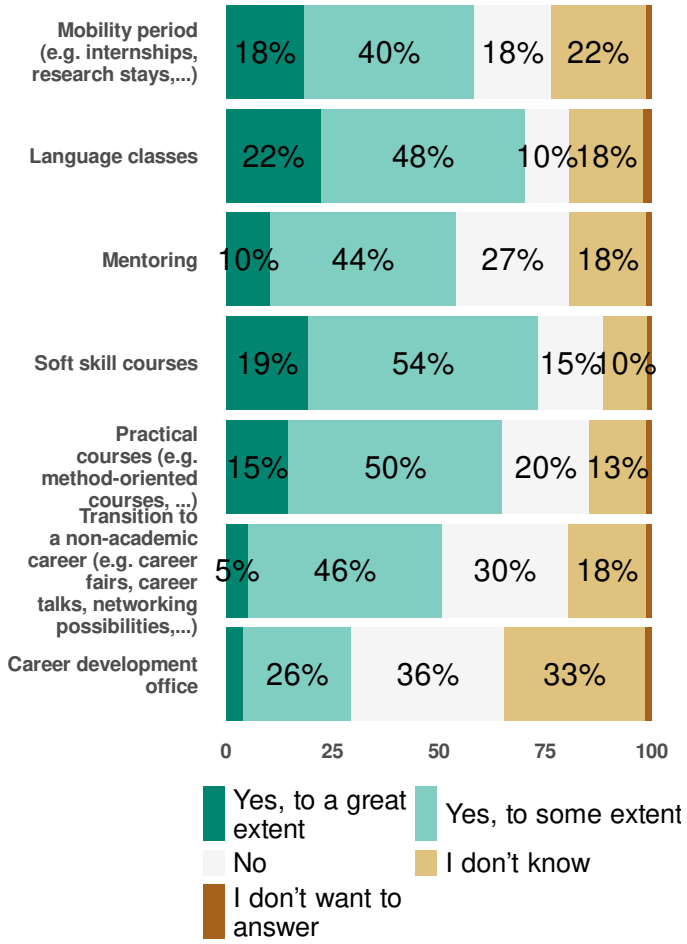

Figure C.2: DRs evaluate the support system at their institutes for career development.

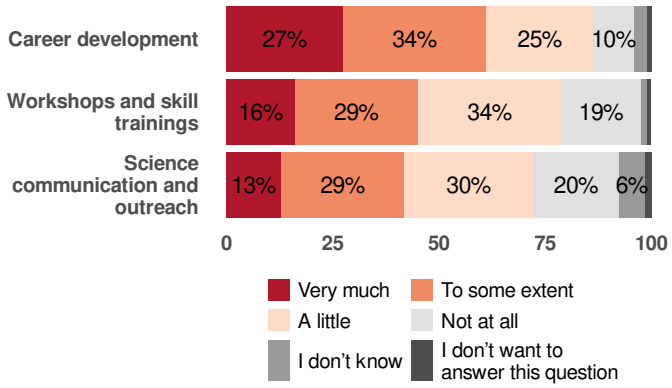

Figure C.5: Improvement desire with aspects of Career development

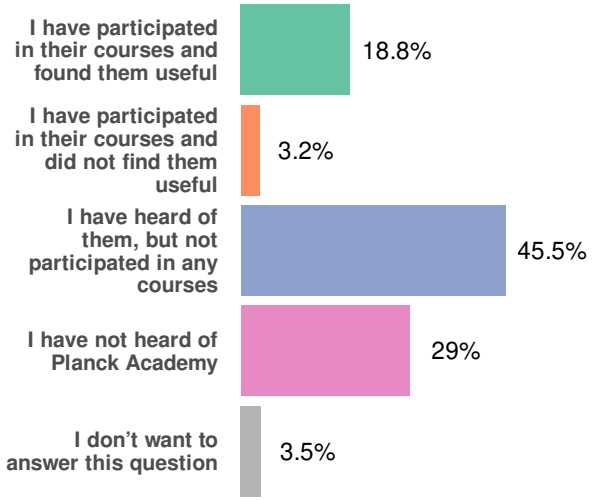

Figure C.4: Experience with Planck Academy.

C.3 Satisfaction with available support structures

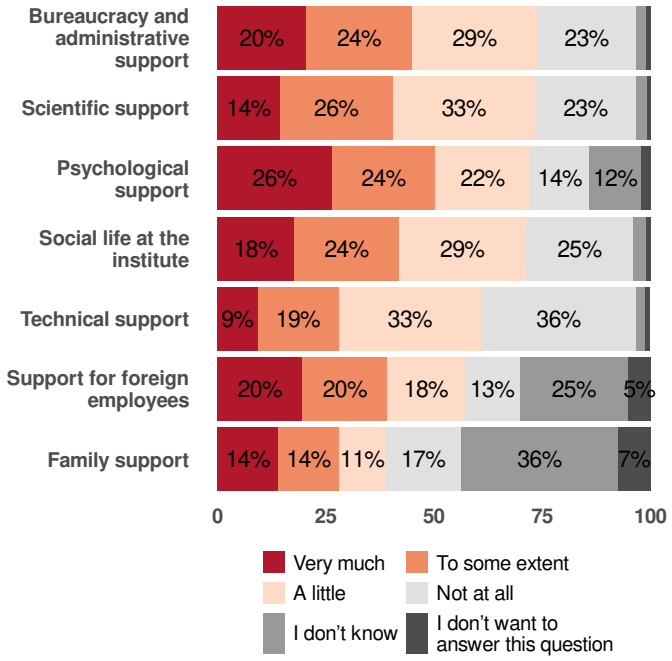

Figure C.3: Improvement desire with aspects of Support

Appendix D

Supplementary Figures: Conflict and Discrimination

D.1 Conflicts

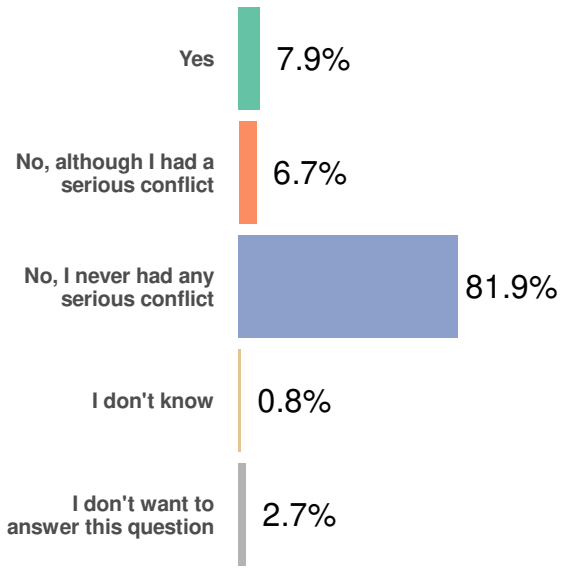

Figure D.1: Respondents who used formal reporting structures to report workplace conflicts

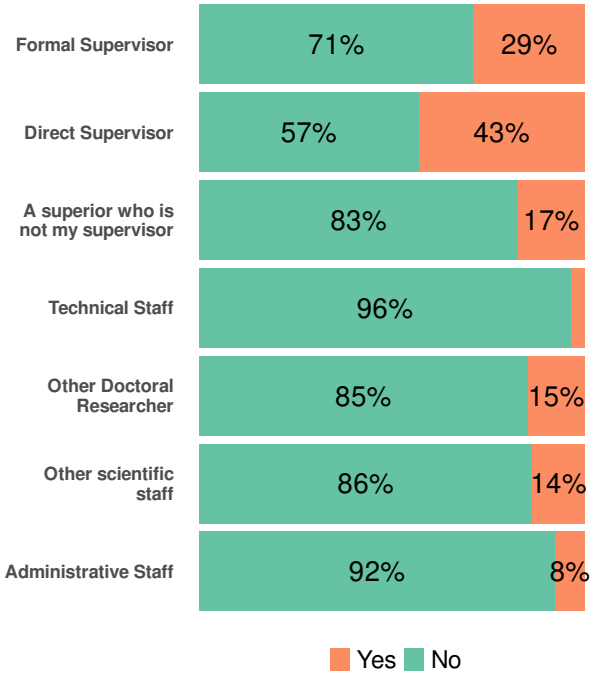

Figure D.2: Among DRs who experienced workplace conflict, with whom was the conflict?

D.2 Sexual Harassment

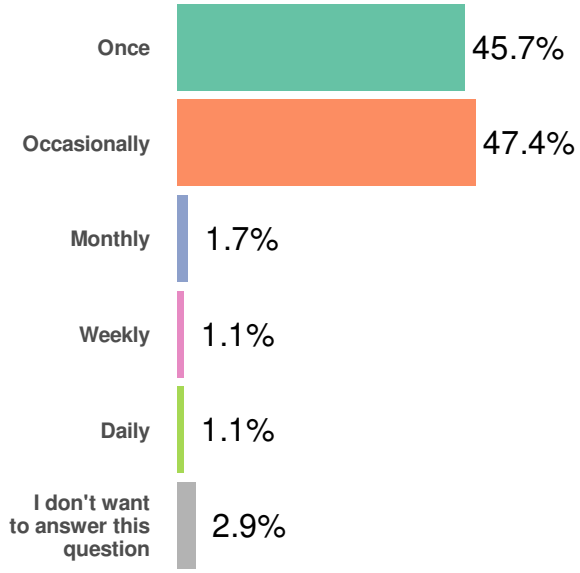

Figure D.3: Frequency of Sexual harassment cases

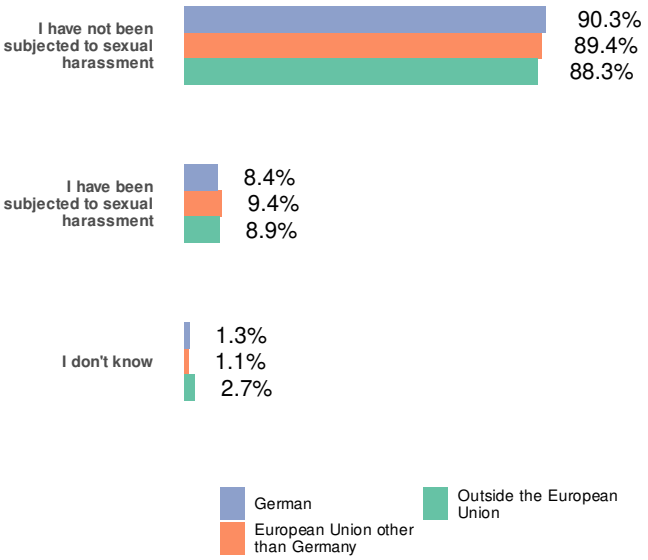

Figure D.5: Sexual harassment by Nationality

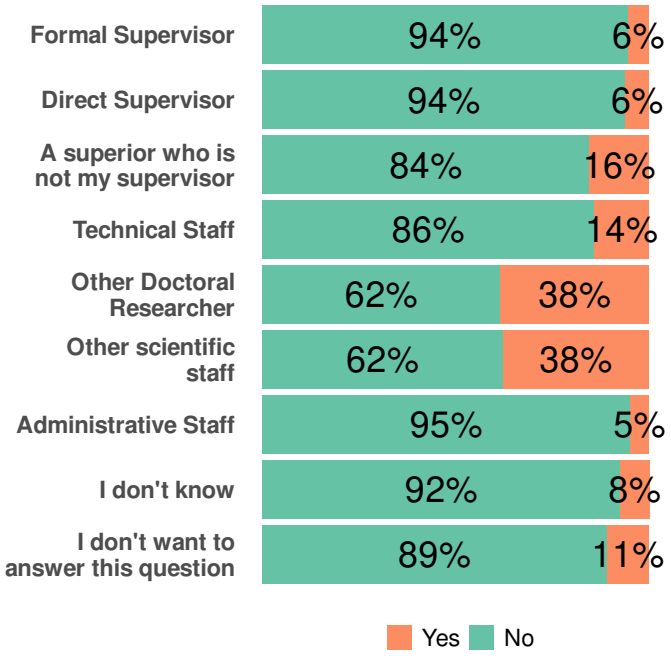

Figure D.4: Perpetrators of sexual harassment

D.3 Bullying

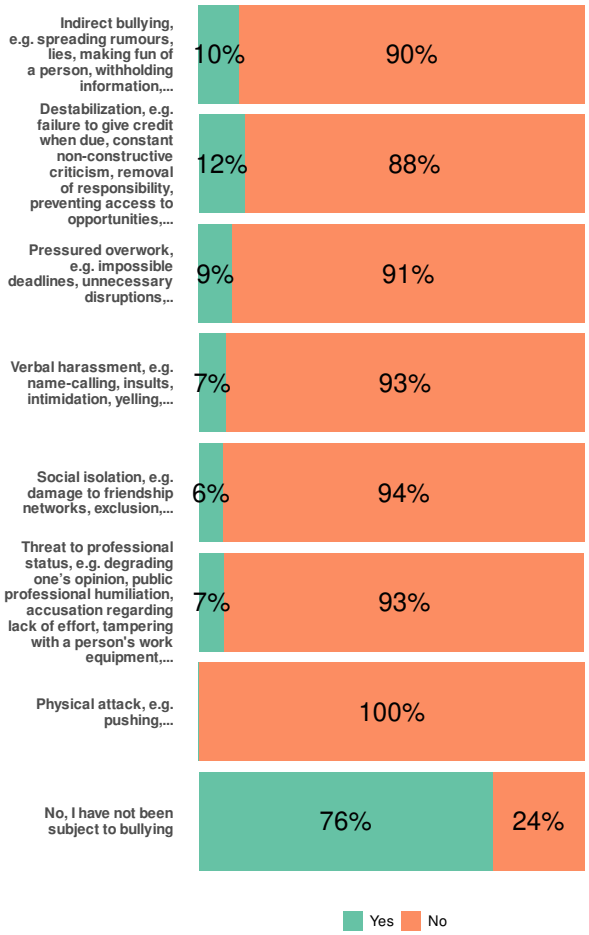

Figure D.6: Bullying on DRs

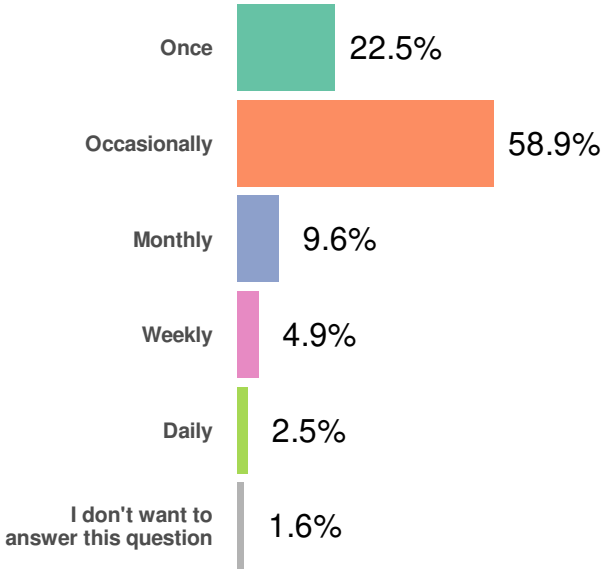

Figure D.7: Frequency of reported cases of bullying -by the victims

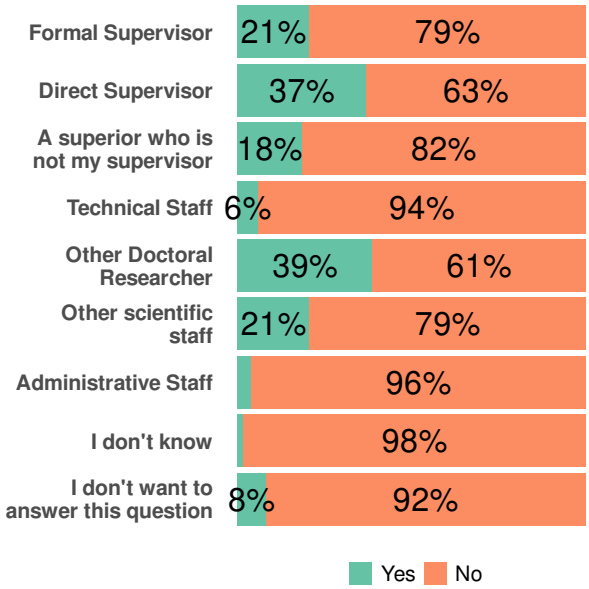

Figure D.8: Perpetrators of bullying, as evaluated by respondents who were bullied

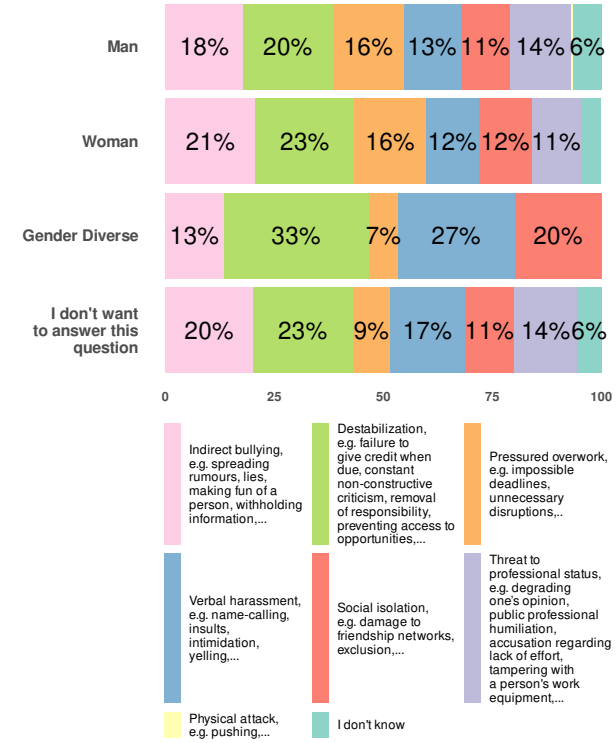

Figure D.9: Methods of bullying by gender of victims

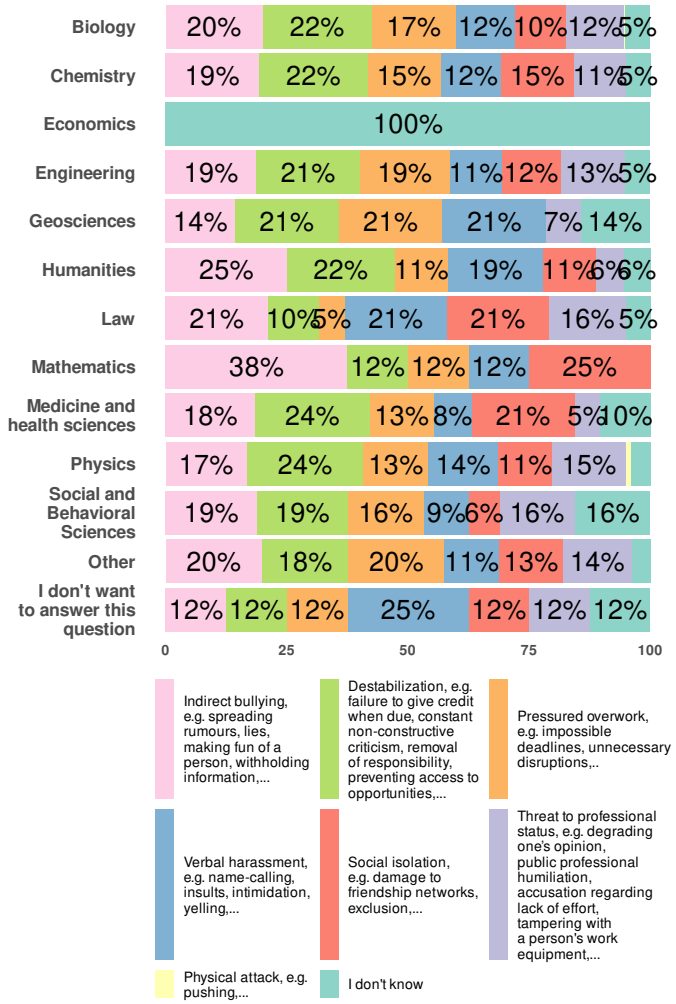

Figure D.10: Methods of bullying across research field

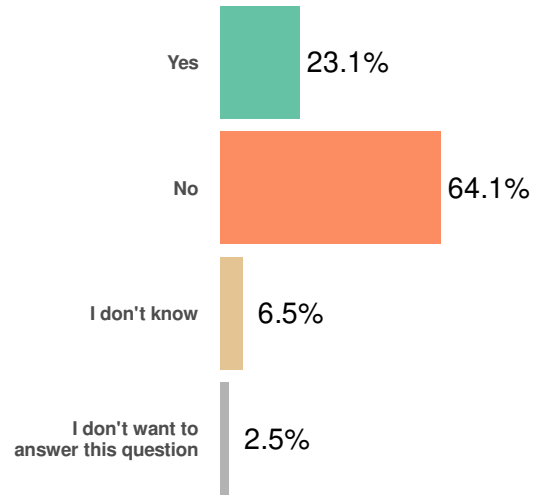

Figure D.11: Bullying cases-by the witnesses

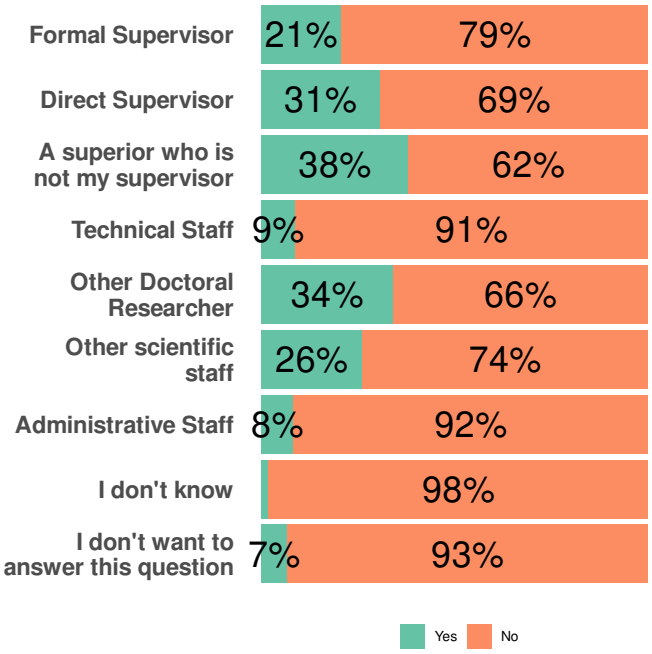

Figure D.12: Bullying perpetrator-by the witnesses

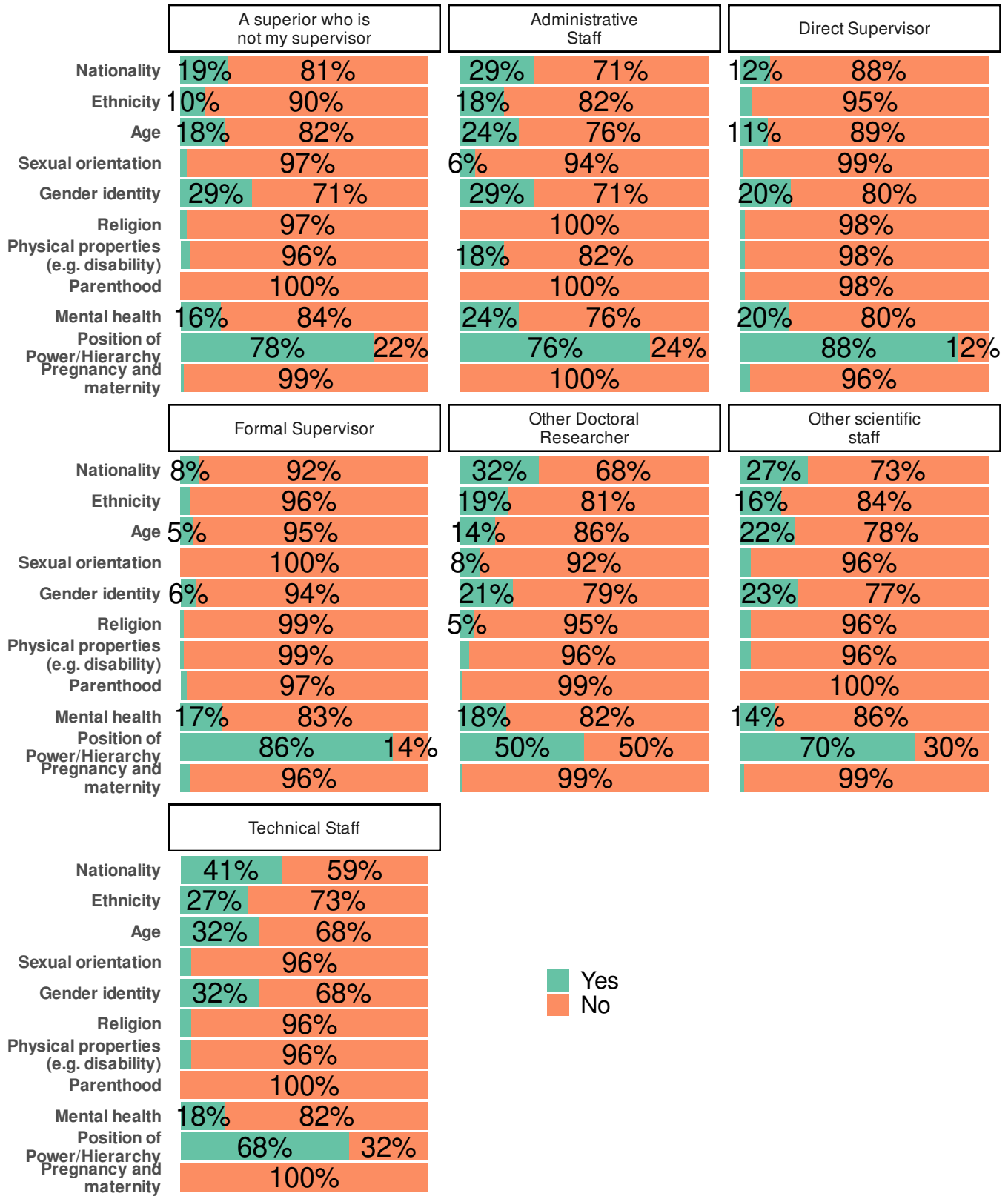

Figure D.13: Perceived reason for bullying broken down by who perpetrated the bullying

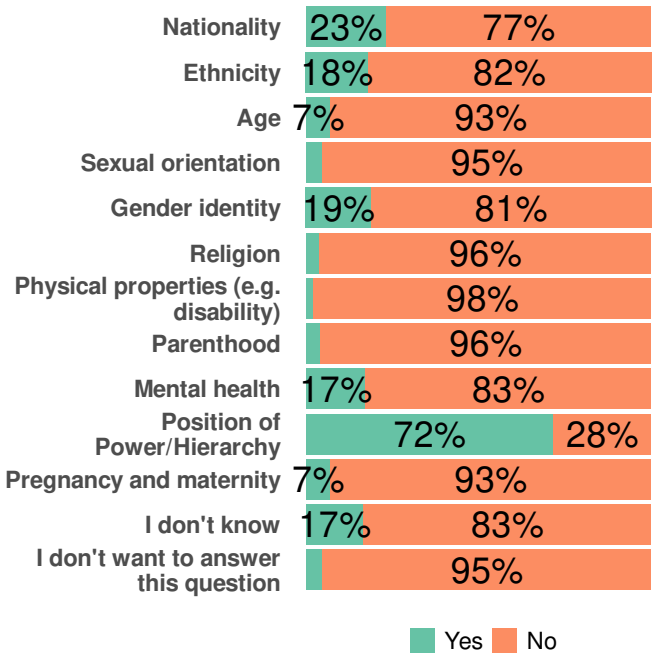

Figure D.14: Reasons of bullying - by the witnesses

D.4 Discrimination based on identity

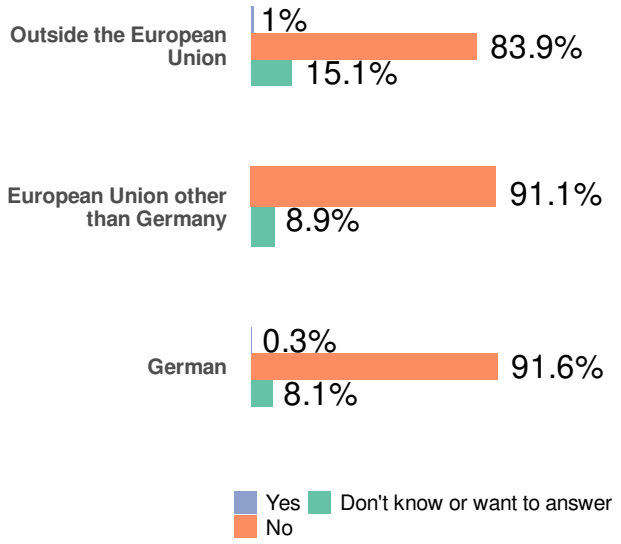

Figure D.15: Discrimination based on religion among Germans, non-German Europeans, and non-European citizens

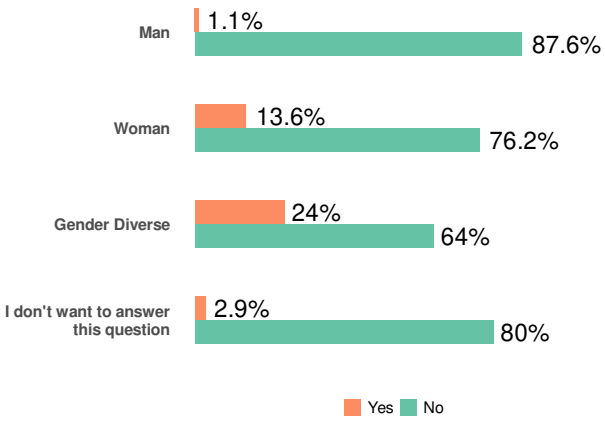

Figure D.16: Discrimination based on gender identity among women, men, and gender diverse people

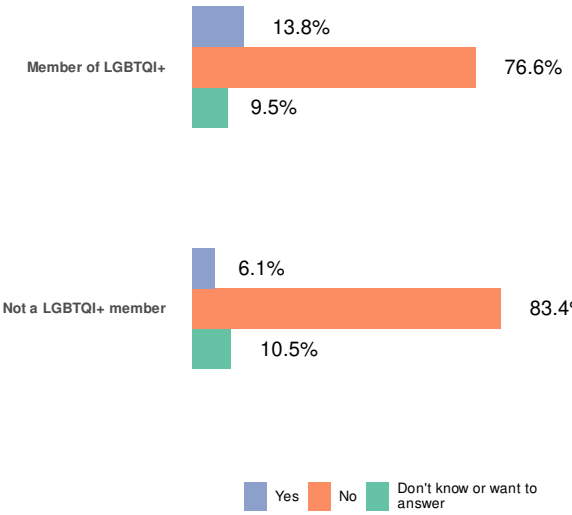

Figure D.17: Discrimination based on gender identity among LGBTQI+ and non-LGBTQI+ respondents

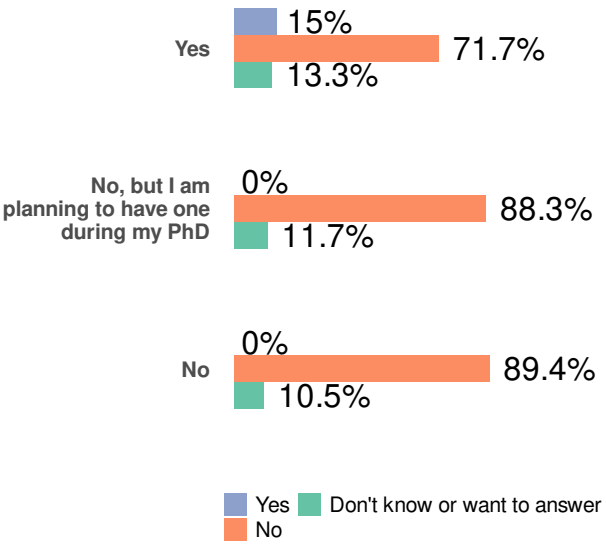

Figure D.18: Discrimination based on parental status among DRs who already have children, expect to have children during their PhD, and do not have or expect children at this time

Appendix E

Methods

E.1 General Analysis

All chapters, with the exception of chapter 4, were analysed with R [18], and figures plotted with ggplot2 [19]. Used color pallets are colorblind friendly and were taken from RColorBrewer[20].

Chapter 4 was analysed with python and matplotlib.

E.1.1 Data cleanup

For the 2022 PhDNet survey, 2323 valid responses were collected, out of 5455 eligible participants.

Each DRs was attributed to one section per their associated institute/center/unit name. Institute names that were given through the free-text option were manually curated and attributed to their respective section whenever possible. In total, 253 responses could not be associated with a given institute and are therefore missing from all section-related analyses.

DRs were also given the option of whether they agreed to being asked sensitive questions. 3.8% of the DRs opted not to be shown sensitive questions and were not considered for the following questions:

- *Question A5*: Do you identify as a member of the LGBTIQ+ community?
- *Question A9*: Do you consider yourself to have a disability?
- *Question C8*: During the last four weeks, how much have you been bothered by any of the following problems?
- *Question C9*: Have you had such symptoms in this intensity before?
- *Question J1*: Do you have or are you currently expecting children?
- *Question F4*: While working at your institute/center/unit, have you at any point experienced unwanted behaviour that you would call "sexualized harassment"?
- *Question F5*: While working at your institute/center/unit, have you at any point witnessed unwanted behaviour that you would call "sexualized harassment"?
- *Question F6*: While working at your institute/center/unit, have you at any point been subject to any of these forms of bullying?
- *Question F7*: While working at your institute/center/unit, have you at any point witnessed bullying?
- *Question F8*: Have you ever felt discriminated against in your work environment because of one or more of the following?

The answers "I don't know" and "I don't want to answer" were removed for some specific questions. This can be seen for example, in the income section of the working

conditions section (Section 3)

Underrepresented categories, with a percentage of less than 5%, were not annotated in the stacked bar plots figures for an ease of visualization.

For qualitative figures a sequential blue-brown color scheme was applied. Where dark blue denotes a higher agreement with the statement and dark brown a higher disagreement.

For *question C7* ("Which of the following aspects of your work as a doctoral researcher would you like to be improved?") where agreeing with the statement was considered negative a second color scheme was applied: red-grey. Where dark red denotes a higher negative agreement, and grey a neutral statement.

E.2 Re-categorization of variables

To simplify the analysis and the correlations performed between different variables, we have in some cases re-categorised, grouped or renamed the variables.

The following variables were modified during the analysis of the data:

1. *PhD Year*: Based on question A6 ("When did you start your PhD?"). This is the difference between the month and year of start date, and the submission date of the survey response. DRs who started their project in 2022 were considered to be first years. DRs who started their PhD more than 4 years ago were grouped together in the "Fourth+" category..

2. *Question J1* ("Do you have or are you currently expecting children?"): the answers "Yes" and "No, but I am planning on having one during my PhD" were merged into the item "Has or Expects Children"

Most of the analyses on this report were done by directly correlating one or two variables of interest and calculating their percentage.

E.3 Demographics

The age of the DRs at the start of their project, was calculated as the difference between their year of birth and the year the PhD was started.

The expected duration from start of a PhD until the submission of a thesis was calculated as the difference between the start date (Question A6: "When did you start your PhD?"), and that of expected submission (Question A7: When do you expect to submit your PhD thesis?). This difference was then divided by 365.25 to account for leap years.

The survival curve of the expected duration per section is a Kaplan-Meier curve, calculated with survival and survminer [21, 22]. It estimates the number of DRs who expect to finish their PhD at a given time in comparison to the population of DRs for their section.

E.4 Working Conditions

This section pertains to the different sections present in the working conditions (Chapter 3).

E.4.1 Contract type and duration

DRs were asked to describe all contracts they had received and other employment situations they experienced, as well as their and duration, in chronological order, up to

a maximum of 6. For each DRs we counted the total number of described contracts, and aptly number them from 1 to 6.

For those who described their current situation as being unpaid, a free-text option was given to describe why that was the case. Answers were manually grouped into four categories:

- Contract ended
- No extension granted
- Funding ran out
- Other

E.4.2 Income

To calculate the average income, we transform the answers into a numeric scale, by taking the midpoint of the inquired range of values. For the two extremes ("<500" and ">2500") the value shown was taken as the truth. Additionally, all answers that pertain to "I don't want to answer" and "I don't know" were removed. The average income across all respondents is given by the dashed line present in all income related plots.

E.4.3 Working hours and holidays

For an easier visualisation the number of hours each DR is expected to work, according to their current contract, was grouped in bins of 5.

We also compared the number of hours worked per week with the expected number of hours. For this, we directly compared the expected number of working hours with the midpoint of the range give in the number of hours worked per week. Results were accordingly grouped on whether a DR was working more, less or an equal number of hours.

DRs were also asked to self-report on the amount of time they spend on various tasks. The self-reported time, which needed to add up to 100%, was grouped into bins of 10.

E.4.4 Teaching

When it comes to teaching, we compared the working hours of DRs who either "have taught or will teach during their PhD" with those who won't teach during their PhD. For this comparison a welch two sample t-test was performed, but no statistical difference was found ($p > 0.05$).

E.5 Supervision

Count tables visualized as heatmaps in this chapter (Chapter 4) take the following format: the heatmap cells are labeled with raw counts, and the color of a cell corresponds to the percentage of its count in the total table counts. The color range is from zero to the table's maximum count, whose percentages in the total count are labeled on two ends of the colorbar.

To calculate a fold difference between ideal and actual supervision meeting frequencies, we convert the frequency options to numbers of meetings per year: "Almost daily": 144 per year (3x weekly), "Weekly": 48 (4x monthly), "Bi-weekly": 24, "Monthly": 12, "Quarterly": 4, "Six-monthly": 2, "Yearly": 1, "Less than once a year": 0.5, "Never": 0.5 (to avoid division error). Number of responses for each pairwise combination of ideal/actual frequencies and its corresponding frequency fold difference are counted and presented in the bar charts.

E.6 Available Support Structures

To evaluate the type of support structures available (chapter 5), we directly correlated one, or more, variables, and calculated their percentage.

For figure 5.1 questions H1a ("For which of the following aspects did you receive support from your institute/center/unit ?") and H1b ("For which of the following aspects would you have needed more support from your institute?") were merged and shown side-by-side for an easier comparison.

E.7 Conflicts and discrimination

Likewise, we also assess whether the DRs are subjected to discrimination or conflict in the workplace (chapter 6) by directly correlating one or more variable of interest.

For the discrimination figures, we directly associate gender (*question A4*: Which gender do you identify most with?), sexuality (*question A5*: Do you identify as a member of the LGBTIQ+ community?), nationality (*question A8*: What is your citizenship? If you have multiple citizenships, please select the one you feel best represented by.") and disabilities (*question A9*: Do you consider yourself to have a disability?) with question *F8* ("Have you ever felt discriminated against in your work environment because of one or more of the following?").

E.8 Mental and Physical health

For the mental and physical health section (chapter 7) only participants who agreed with being shown these questions were assessed. Thus the total participant number is 2020, lower than the total participation rate of the survey.

The 2022 report once again reassesses the mental health questions previously introduced in the 2019 and 2020 PhDNet report [5, 13], and expands it to include physical health related questions.

All questions on this section were based existing diagnostic tools for common mental disorders: the Patient Health Questionnaire (PHQ) [23].

E.8.1 Depression score

The depression score was calculated based on the PHQ-9 (module 9) [24] For this, eight statements were presented (Table E.1), and the DRs were asked to rate how frequently they had occurred in the past two weeks. The statements were valued according to their frequency. The more frequently a given statement occurred, the higher the score, and vice-versa. If one or more statements from a given DRs had a null score ("I don't want to answer this question"), then the entry was not considered (Table E.2).

The answers were scored for each DR independently and then categorized according to their sum. The minimum possible score was 0 and the maximum 24. To better evaluate the results these were split into 5 categories ranging from "No to minimal depression" (score between 0 and 4) to "Severe depression" (score between 20 and 24) (Table E.3)

Table E.1: Statements shown for question D3: "Over the last two weeks, how often have you been bothered by any of the following problems?". From module PhQ-9.

N°	Statement
1.	Little interest or pleasure in doing things
2.	Feeling down, depressed, or hopeless
3.	Trouble falling or staying asleep, or sleeping too much
4.	Feeling tired or having little energy
5.	Poor appetite or overeating
6.	Feeling bad about yourself - or that you are a failure or have let yourself or your family down
7.	Trouble concentrating on things such as reading the newspaper or watching television
8.	Moving or speaking so slowly that other people could have noticed? Or the opposite - being so fidgety or restless that you have been moving around a lot more than usual

Table E.2: Score chart for depression levels (PhQ-9 module statements).

Answer	Score
Nearly every day	3
More than half the days	2
Several days	1
Not at all	0
I don't want to answer this question	-

E.8.2 Trait and state anxiety

Both the trait and state anxiety were based on a short form of the Spielberger State-Trait Anxiety Inventory (STAI) [15].

For the state anxiety, we asked the DRs to describe how they feel in that specific moment (*Question D1*: "Please read each statement below and then indicate how you feel right now, at this moment.")(Table E.4), while for the trait anxiety they were asked to reflect on their general state of mind (*Question D2:"Please read each statement below and then indicate how you generally feel."*(Table E.5).

Table E.3: Depression levels calculated with the PhQ-9 module score.

Sum score	Category
0-4	No to minimal depression
5-9	Mild depression
10-14	Moderate depression
15-19	Moderately severe depression
20-24	Severe depression

Table E.4: Statements for state anxiety (STAI)

N°	Statement
1.	I feel calm*
2.	I feel tense
3.	I feel upset
4.	I feel relaxed*
5.	I feel content*
6.	I feel worried

* Reverse scored statements. Where agreeing has a score of 1 and disagreeing a score of 4.

Each statement was given a score from 1 ("not at all") to 4 ("very much"). For six of the statements, a reverse score was applied, where agreeing means low anxiety (score of 1)(Table E.6). Once again, entries with at least one null score ("I don't want to answer this question") were not considered.

The original scale for state and trait anxiety consists of 20 items each. Because we applied a short version of the scale, 6 and 8 items respectively, a weighted score was applied.

Each statement of the state anxiety had a weighted value of $\frac{20}{6}$, while the statements

Table E.5: Statements for trait anxiety (STAI)

N°	Statement
1.	I am "calm, cool and collected"*
2.	I feel that difficulties are piling up so that I cannot overcome them
3.	I worry too much over something that really doesn't matter
4.	I am happy*
5.	I have disturbing thoughts
6.	I lack self-confidence
7.	I feel secure*
8.	I take disappointments so keenly that I can't put them out of my mind

* Reverse scored statements. Where agreeing has a score of 1 and disagreeing a score of 4.

Table E.6: Score chart for state and trait anxiety (STAI).

Answer	Score
Very much	4
Moderately	3
Somewhat	2
Not at all	1
I don't want to answer this question	-

for the trait anxiety had an applied weight of $\frac{20}{8}$.

Finally, the anxiety scores were split into 4 categories according to their total. With the minimum score being 20 for "No anxiety" and the maximum being 80 for "High anxiety" (Table E.7)

Table E.7: State and trait anxiety levels, based on the short STAI questionaire.

Sum score	Category
20	No anxiety
21-40	Some anxiety
41-60	Moderate anxiety
61-80	High anxiety

E.8.3 Physical health

Physical health was investigated according to module PHQ-15, a somatic symptoms scale to quickly evaluate and assess the effects of mental health on physical symptoms. The 15 questions and their score evaluation were calculated according to Kroenke (2010)[16]. Symptom severity was calculated according to the answers given for each statement, where symptoms that "bothered a lot" had a score of 2, symptoms that "bother a little" had a score of 1, and symptoms that "do not bother" had a score of 0. If at least one statement had a null score ("I don't want to answer" or "I don't know"), the entry was not considered (Table E.8).

Table E.8: Score chart for physical pain symptoms

Answer	Score
Bother a lot	2
Bother a little	1
Not bothered	0
I don't want to answer this question	-
I don't know	-

E.9 Satisfaction

The satisfaction of the DRs regarding their current work situation and where they would like to see the biggest improvements were taken from *Question C1* ("If you think about your own situation as a doctoral researcher, how satisfied are you with the following aspects?") and *Question C7* ("Which of the following aspects of your work as a doctoral researcher would you like to be improved?"), respectively.

The 17 statements were grouped according to their topic and shown at the end of each associated chapter.

The grouping of the satisfaction statements were as follows:

Working conditions

- Contribution to science
- Laboratory equipment
- Salary (& Benefits)
- Vacation days
- Work environment and atmosphere
- Workload

Career Development

- Career development
- Science communication and outreach
- Workshops and skill training

Support

- Bureaucracy and admin support
- Family support
- Psychological support
- Scientific support
- Social life at the institute
- Support for foreign employees
- Technical support

Supervision

- Supervision

Appendix F

Acknowledgements

We are very thankful to the PhDnet Steering groups of 2021/2022 and 2022/2023 for their invaluable contributions. Their active involvement in all stages of decision-making, from shaping the main topics of the survey to providing continuous support in optimizing the report, has been instrumental in making this project a success. We deeply appreciate their dedication and guidance throughout this journey.

A special thank you goes to Hang Liu, who, alongside Danielle Pullan and Adriana Vucetic, worked on formulating the questions for the PhDnet Survey 2022.

We greatly appreciate the constructive feedback from Sabine Ziegler, Ilka Schiessler and Fabian Ochsenfeld.

We express our gratitude to Alejandro D. Bonive Boscan, a doctoral researcher at the Max Planck Institute for Evolutionary Biology in Plön, for creating the magnificent cover art for this year's report.

We would also like to express our sincere gratitude to all the doctoral researchers who participated in the PhDnet survey of 2022. Your valuable insights, experience, comments and contributions have been instrumental in shaping this report.

Appendix G

About the authors

Beatriz Vieira Mourato

I am a doctoral researcher at the Max Planck Institute for Evolutionary Biology in Plön. As a bioinformatician I am searching for a method to identify functionally important regions in a genome.
I joined the Survey Group because I was curious about the process of how to evaluate and put together a survey report. For this report I was in charge of the data analysis, graphics and the methodology for the majority of the chapters. Apart from science and biology I like to travel to new places, read books and to collect different varieties of tea.

Adriana Vucetic

I am a doctoral researcher at the Max Planck Institute for Heart and Lung Research in Bad Nauheim. I am a molecular biologist and my PhD work aims to understand the role of blood cells in tumor development and metastasis.
Although I enjoy science and research, I also felt a strong passion to voice the opinions of my peers. Therefore, I was a member of internal PhD Committee and External PhD representative. Two years ago I decided to join PhDnet survey group with objective to contribute to the improvements of PhD life of all DRs at the MPS. I have been survey group coordinator and I contributed to survey question design and survey conduction. In this year survey report, I have been interested and contributed to chapters Demographics, Working Conditions and Mental and physical health.
Apart from my activities as DRs and survey group member, in my free time, I like to do sports, play board games, read books, watch series, travel and camp.

Danielle Pullan

I am a doctoral researcher at the Max Planck Institute for the Study of Societies and the University of Cologne. I study abortion access in Europe from a political science and public administration perspective as well as other questions related to gender and families.
I have been involved in PhDnet throughout my PhD, first as my institute's representative, then as a member of the Steering Group in 2022, as co-coordinator for the Equal Opportunities Working Group, and as a member of the social media and survey groups. In my academic activism, ending the use of stipends to pay doctoral researchers has been particularly important to me, alongside increasing the diversity and inclusion of our academic community.
Outside of work, I enjoy traveling, baking, and reading.

Davy Lin

I am a doctoral researcher at the Max Planck Institute für Kohlenforschung in Mülheim an der Ruhr. As an organic chemist, my goal is to synthesize a marine natural product from simple chemical precursors. Those natural products may exhibit interesting biological activity.
Speaking up the voices of my peers, improving their overall lives, bringing more diversity and safety to their working environment are very important to me. These are the reasons why i was also Internal and External PhD Representative of my institute this year, and a redactor for the PhDnet Offspring magazine besides my involvement to this survey. In this years's report, i have been interested and have co-written the Working Conditions, the Conflict and Discrimination and the Available Support Structures chapters. I also contributed to the elaboration of the questions of the next survey.
Outside of a lab, you can find me on hiking trails, board-game clubs, libraries, perfumeries and craft breweries.

Junyu Li

I am a doctoral researcher at the Max Planck Institute for Evolutionary Anthropology in Leipzig. As a psychologist, I study the normative perception of children's moral responsibility.
I joined the Survey Group because I was impressed by the data and valuable insight from the previous years' survey reports. I am proud to have contributed to analyzing and writing on the current condition of our community. Aside from the Survey Group, I serve as the external representative at my institute. Outside of work, I like to read philosophy, play violin, dance and go to coffee shops.

Tianlin Lu

I am a doctoral researcher at the Max Planck Institute for Heart and Lung Research in Bad Nauheim. As a molecular biologist, I aim to study aging and mechanism of increased cancer rate behind it.
I joined PhDnet Survey Group since the second year of my PhD when I felt more prepared and capable to support fellow researchers at Max Planck Society as a whole. It has been a great honor and my primary focus to contribute to the support section of the survey this year, including integration, career development, and family aspects.
Outside of work, you can find me in gallery and museums, on hiking trails, and sometimes at flea markets.

Thank you for doing this!

I hope this results will have impact and improve things in coming future.

Thank you for caring about us.

It covered almost all aspects of doctoral research work!

Thank you for supporting and fighting for us.