

## N<sup>2</sup> Survey-Report

Helmholtz Report



# Contents

<b>1</b>	<b>Introduction</b>	<b>5</b>
1.1	Participating centers . . . . .	5
1.2	Sensitive questions and importance for the survey . . . . .	6
1.3	Last information . . . . .	6
<b>2</b>	<b>General</b>	<b>14</b>
2.1	Gender diversity and orientation . . . . .	14
2.2	Nationality . . . . .	15
2.3	Age . . . . .	15
2.4	Field of work . . . . .	16
2.5	Estimated project duration . . . . .	16
2.6	Key messages . . . . .	18
<b>3</b>	<b>Working conditions</b>	<b>19</b>
3.1	Contracts . . . . .	19
3.1.1	Contract types . . . . .	19
3.1.2	Payment level . . . . .	20
3.1.3	Contract duration & extensions . . . . .	23
3.2	Vacation days and working hours . . . . .	25
3.2.1	Vacation days . . . . .	25
3.2.2	Working hours . . . . .	25
3.3	Summary open-text answers . . . . .	27
3.4	Key messages . . . . .	28
<b>4</b>	<b>Satisfaction</b>	<b>30</b>
4.1	Satisfaction factors . . . . .	30
4.2	Quitting doctoral project . . . . .	30
4.3	Aspects in need of improvement . . . . .	32
4.4	Summary open-text answers . . . . .	32
4.5	Key messages . . . . .	35
<b>5</b>	<b>Mental health</b>	<b>36</b>
5.1	PHQ-8 and the STAI questionnaires . . . . .	36
5.2	Mental health in the workplace environment . . . . .	38
5.3	Satisfaction and mental health . . . . .	39
5.4	Comparison with the N <sup>2</sup> -Survey 2019 . . . . .	39
5.5	Summary open-text answers . . . . .	39
5.6	Key messages . . . . .	41

<b>6</b>	<b>Supervision</b>	<b>42</b>
6.1	Supervision structure . . . . .	42
6.2	Implementation of the supervision structure . . . . .	44
6.2.1	Meeting frequency . . . . .	44
6.3	Supervision quality . . . . .	44
6.4	Summary open-text answers . . . . .	49
6.5	Key messages . . . . .	49
<b>7</b>	<b>Power abuse</b>	<b>50</b>
7.1	Conflicts and reporting . . . . .	50
7.2	Sexual harassment . . . . .	51
7.3	Bullying . . . . .	52
7.4	Discrimination . . . . .	54
7.5	Summary open-text answers . . . . .	57
7.6	Recommended trainings . . . . .	58
7.7	Key messages . . . . .	61
<b>8</b>	<b>Integration</b>	<b>62</b>
8.1	Support at the beginning of doctorate . . . . .	62
8.2	Language barrier . . . . .	62
8.3	Social events and integration . . . . .	64
8.4	Summary open-text answers . . . . .	64
8.5	Key messages . . . . .	65
<b>9</b>	<b>Career development</b>	<b>66</b>
9.1	Graduate school enrollment . . . . .	66
9.2	Future career plans . . . . .	66
9.3	Career development offered within Helmholtz Association . . . . .	66
9.4	Perceived preparedness for later working life . . . . .	69
9.5	Summary open-text answers . . . . .	69
9.6	Key messages . . . . .	70
<b>10</b>	<b>Family</b>	<b>71</b>
10.1	Parenthood . . . . .	71
10.2	Sub-analyzes for parents . . . . .	73
10.3	Further caring responsibilities . . . . .	73
10.4	Changes during COVID-19 . . . . .	73
10.5	Reconciliation between doctorate and family . . . . .	74
10.6	Summary open-text answers . . . . .	74
10.7	Key messages . . . . .	77
<b>11</b>	<b>COVID-19</b>	<b>78</b>
11.1	Impact of the COVID-19 pandemic on DRs . . . . .	78
11.2	Impact of the COVID-19 pandemic on private life . . . . .	78
11.3	Home office . . . . .	79
11.4	Response of the institute and satisfaction . . . . .	80
11.5	Summary open-text answers . . . . .	82

11.6 Key messages . . . . .	83
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<b>12 Conclusion</b>	<b>84</b>
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12.1 Last question . . . . .	84
------------------------------	----

12.2 Summary open-text answers . . . . .	84
--	----

12.3 Thank you! . . . . .	85
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# 1 Introduction

We would like to start with a short introduction to the general structure of the N<sup>2</sup>-Survey 2021. This survey is conducted to assess the overall situation of Doctoral Researchers (DRs) at three of Germany's non-university research organizations, the Max-Planck Society, the Leibniz Association and the Helmholtz Association. In addition, it was also run by the IPP Mainz and the Technical University Munich as university controls. This joint format was first introduced in 2019, and now is the second time that the survey runs in a harmonized manner, meaning that the vast majority of questions were asked to all DRs in the same way in all organizations.

The present report examines the results for DRs in the Helmholtz Association.

The N<sup>2</sup>-Survey 2021 was sent out to more than 16.000 DRs within Germany, from which more than 5.500 belonged to the Helmholtz Association. In 2021, we increased our total participation number to 2.143 DRs (1200 participants in the N<sup>2</sup>-Survey 2019), representing at least 38 % of all DRs within the Helmholtz Association. Please note that the calculated percentages depend on the official numbers of DRs within the Helmholtz report from 2020 (external DRs or stipend-holders might not be included in the count). This increase in participation highlights our growing importance and acceptance as stakeholders also in the minds of our peers. The complete catalog of questions answered by participating DRs will be published as Supplementary Material along with this report. Answering the entire questionnaire took the participating DRs approximately 36 minutes.

The N<sup>2</sup>-Survey collected data on 10 broader topics, namely: General (Section 2), Working conditions (Section 3), Satisfaction (Section 4), Mental health (Section 5), Supervision (Section 6),

Power abuse (Section 7), Integration (Section 8), Career development (Section 9), Family (Section 10) and COVID-19 (Section 11), which will be presented here in the respective order.

## 1.1 Participating centers

Of all 18 Helmholtz centers, 17 participated in the N<sup>2</sup>-Survey 2021:

- Alfred Wegener Institute (AWI),
- Helmholtz Centre for Information Security (CISPA),
- Deutsches Elektronen-Synchrotron (DESY),
- German Cancer Research Centre (DKFZ),
- German Aerospace Centre (DLR),
- German Centre for Neurodegenerative Diseases (DZNE),
- Forschungszentrum Jülich (FZJ),
- Helmholtz Centre for Ocean Research (GEOMAR),
- German Research Centre for Geosciences (GFZ),
- Helmholtz Centre for Heavy Ion Research (GSI),
- Helmholtz Zentrum Hereon (Hereon),
- Helmholtz Center Munich (Helmholtz Munich),
- Helmholtz Zentrum Berlin for Materials and Energy (HZB),
- Helmholtz Zentrum Dresden-Rossendorf (HZDR),

- Helmholtz Centre for Infection Research (HZI),
- Max Delbrück Center for Molecular Medicine (MDC),
- Helmholtz Centre for Environmental Research (UFZ).

Their participation numbers are displayed in Figure 1.1. The Karlsruher Institute for Technology (KIT) did not participate. As the 17 centers differ in size, the raw number of participating DRs does not necessarily represent the coverage of DRs at the respective centers, which ranges between 15.5 % and 91.7 %. To ensure anonymity, all centers had to have at least 50 participants in order to receive center-specific results, which were sent out at the end of November 2022. Thankfully, all centers reached this goal.

## 1.2 Sensitive questions and importance for the survey

Our survey covers sensitive topics, such as mental health, power abuse, sexual identity, and ethnicity. We asked these questions for two reasons:

1. To assess the general demographic situation for DRs in Germany, as such data is not available in this context.
2. It is important for us to not only descriptively present cases of discrimination and power abuse but also to assess the underlying reasons. 50 cases of discrimination could for example represent either 2.5 % or 62.5 % of a specific group. Even though the first would be a problem, since every single case is one too many, the second one would indicate a structural problem.

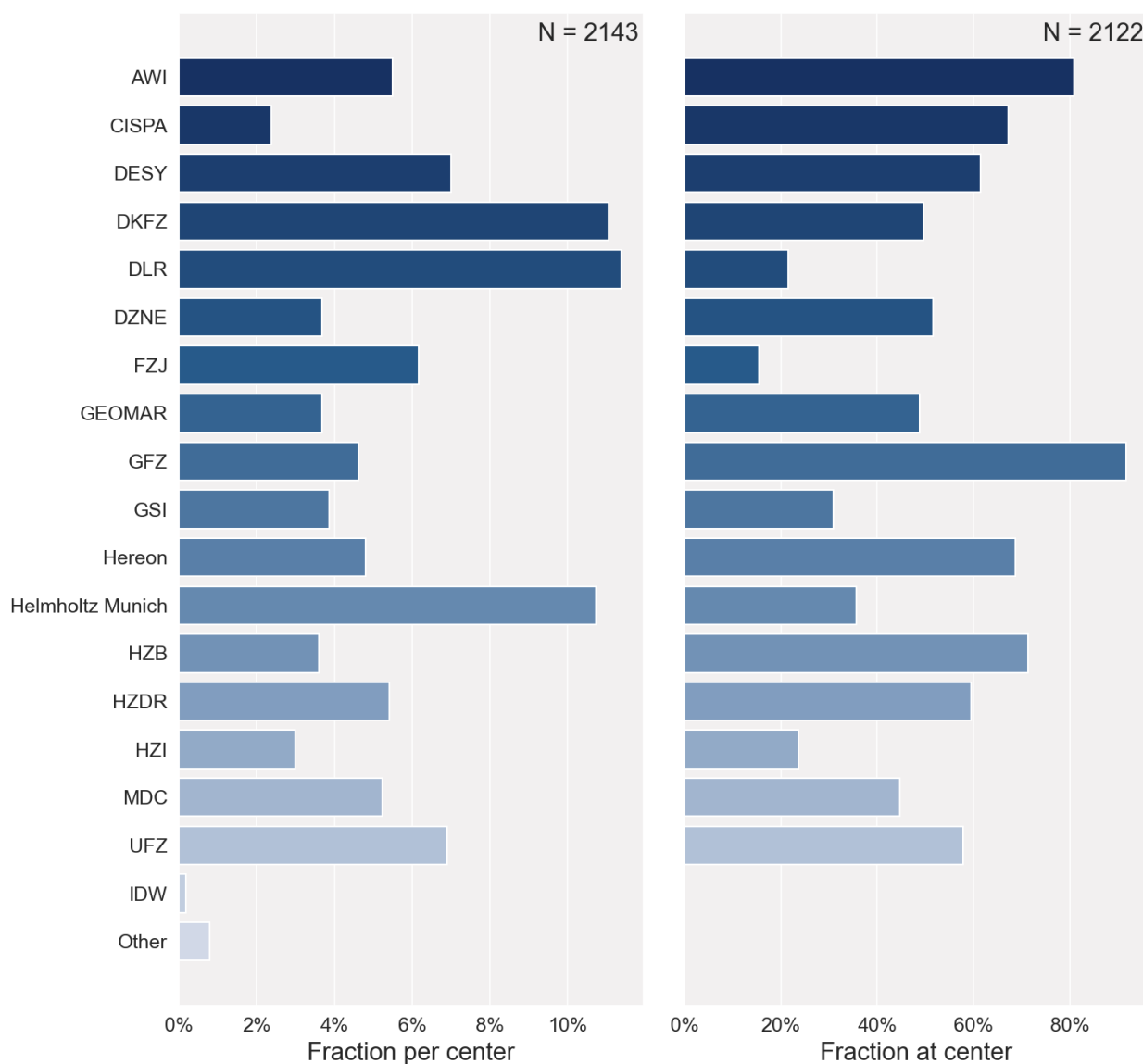
To give our participants the option to choose whether they want to answer these questions, they could opt out from participating in the survey entirely or sections individually. They could also answer individual questions with (*I don't want to*

*answer this question*). Encouragingly, 97 % of the participating DRs chose to see these questions.

## 1.3 Last information

We would like to thank you for showing interest in our work and the situation of DRs within the Helmholtz Association. We hope you enjoy the report and find a lot of useful information. For further questions, please contact our survey team ([heju-survey@listserv.dfn.de](mailto:heju-survey@listserv.dfn.de)) or the respective doctoral representations at the centers in the Helmholtz Association (see Tab.12.1).

**Have a good read!**



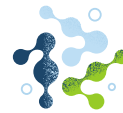
**Figure 1.1:** Distribution of participating DRs over all centers (left) and participation rates at the individual centers (right). Please note that the total number of participants for the two plots are different, since the categories (IDW (*I don't want to answer*) and *Other* are not shown for the plot on the right).

# N<sup>2</sup>Survey 2021



**2143**  
participating  
Doctoral Researchers (DRs)

from 17 of 18 Helmholtz Centers  
across Germany



DRs from diverse fields of  
natural sciences



Ethnic and national diversity



The median time taken to  
complete this survey was 36  
minutes

## Working conditions

### Contracts

84% internal or external contract  
11% stipend holders

**Disadvantages for stipend  
holders generate displeasure  
among all DRs**

### Contract length

64% have contracts of 25-36 months  
17% have contracts of 37 months or longer



### Payment level

Median pay range: 1900-2000€  
Female and male DRs reported different  
median pay range in some fields of research

### Working hours

36% work 40 h per week  
58% work 41-60 h per week  
5% work more than 60 h per week



### Holidays

83% contract with 26-30 days  
43% took fewer than 15 days in the past year

*Because of high workload (32%)  
I feel pressure from  
my supervisor (9%)*

## Satisfaction

**36% considered  
quitting  
at least occasionally**



*I do not feel qualified enough (22%)  
I can't cope with the workload (18%)  
I have no or poor academic results (17%)*

**Doctoral Researchers ask for improve-  
ments in salary and benefits, career develop-  
ment, psychological support, bureaucracy and  
administrative support, & social life at the  
institute.**

## Supervision

### Structure of supervision

72% signed a supervision agreement  
57% have a Thesis Advisory Committee  
61% set a project outline



### Meeting frequency

60% meet direct supervisor at least weekly  
15.1% meet formal supervisor at least every  
second week

**Doctoral Researchers ask for more frequent  
meetings with the formal supervisor**

## Mental health

### Anxiety

Based on the STAI questionnaire  
18% moderate, 50% high *trait* anxiety  
14% moderate, 47% high *state* anxiety



### Depressive symptoms

Based on the PHQ-8  
68% no to mild depressive symptoms  
13% moderate  
7% from moderately severe to severe

## Power abuse

**59% of experienced conflicts have not been reported**

*I was afraid of repercussion (62%)  
I didn't think that it would be resolved (62%)  
I think it was not severe enough (33%)*

Reasons

**Awareness of point of contacts** highest for PhD representative (60%), and Ombudsperson (51%)

**22% report bullying**


Perceived reasons: power/hierarchy (35%), gender (19%), ethnicity (8%), age (7%)


**17% report discrimination**


Perceived reasons: nationality (38%), gender identity (37%), ethnicity (19%), mental health (15%)

**7% report unwanted behavior that they would call sexual harassment**

## Family

 8% have or expect children

 41% state that center offers access to day care

 36% state that center offers parent friendly work environment

## Integration

**40% say that lack of German remains a barrier at work**

**Speak German [EU/non-EU citizen]**

[45/66%] none or beginner

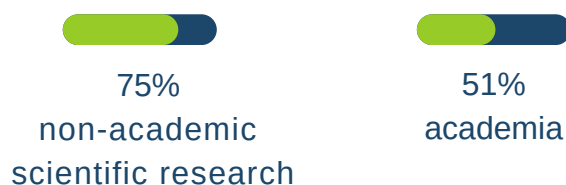
[30/25%] intermediate

[25/8%] fluent or native

**Internationals would benefit from help with** university enrollment, finding accommodation, translation of documents

## Career development

**Consider to work in**



**Feel prepared for a job**



**Female DRs feel more unprepared for a job outside academia than male DRs**



 **Centers offer** 

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• Courses</li> <li>• Career development office</li> </ul> | <ul style="list-style-type: none"> <li>• Mentoring</li> <li>• Support for mobility period</li> </ul> |
|--|--|

## COVID-19

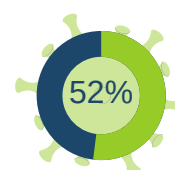
**Negative impacts on**



Productivity and project durations



Work atmosphere and networking



Satisfied with institute's response

## Summary key messages

### General

- It is crucial to take into account the needs of minorities that might be under-represented.
- There are important differences in gender distribution for different fields of work.
- The expected times for completion of a doctoral project are significantly affected by the current year of the DR and first- and second-year DRs tend to underestimate their project duration.
- The average expected times for completion of a doctoral project are influenced by the field of work, but in every field the average clearly exceeds 3 years. We therefore advocate for longer minimum contract periods that realistically reflect the time required.

### Working conditions

- Contracts are the main (84 %), but not the only form of employment.
- Contract durations got slightly longer compared to 2019, but still do not match the actual project duration.
- Contractual situation does not reflect the reality. Weekly working hours are high, but not compensated accordingly. In addition, DRs often work on weekends and do not take vacations to meet the requirements of a doctorate.
- Stipends are poor forms of contracts, which, in their current form, put these DRs in a worse position compared to those with a regular contract. E. g. vacation days and working hours are often not defined and social security is lacking.
- We find evidence of a gender pay gap, which needs further investigation.
- We are strongly encouraging that the contract situation of the DRs, including stipend holders, is transparently determined by the official side of the Helmholtz Association and its research centers and that the determined facts are communicated.

### Satisfaction

- 36 % of DRs have occasionally considered quitting due to reasons such as not feeling qualified enough, workload, lack of results, career prospects, and work-related conflicts.
- Gender plays a large role in feelings of quitting the program, as more women DRs were likely to be affected by feelings of imposter syndrome than men.
- The percentage of DRs considering to quit rises as the project duration increases.
- Specific aspects of work that DRs would like to see improved include salary and benefits, career development, psychological and mental health support, administrative support, and social life at their centers.

## Mental health

- 68 % of DRs scored either a *no to minimal* or *mild* depressive syndrome (DS), 13 % of DRs show signs of *moderate* DS, and 7 % show a *moderate severe* to *severe* DS score.
- Compared to the results of the N<sup>2</sup>-Survey 2019 [19], the percentages of DRs showing *moderate* or more *severe* signs of DS increased from 18 % to 20 %.
- Around 25 % DRs show *no* or *low* anxiety scores. 14 % and 18 % show *moderate* state and trait anxiety signs, respectively. Whereas 47 % and 50 % of the DRs show *high* state and trait anxiety signs, respectively.
- 80 % of the participants indicate that their mental health hinders to some extent their work and only 57 % of the participants are informed about mental health resources within their institute.
- Mental health scores indicate that DRs suffer more and more in the course of their doctoral project.
- DRs seem to be most affected in terms of their mental health by their workload, lack of psychological support, and quality of supervision.

## Supervision

To continue improving the relationship and quality of the supervision, DRs would benefit from:

- Introduction of the Thesis Advisory Committee (TAC) and corresponding regular meetings for all DRs,
- increasing communication and regular meetings with the formal supervisor,
- improving the project outline and having clear requirements for the doctoral project,
- improving the leadership skills of the direct supervisor.

## Power abuse

- 13 % of DRs experience conflicts during their doctorate; however, only 41 % of them report these to the authorities.
- The main reasons for not-reporting are the fear of repercussions and missing trust in an actual resolution. This highlights that the protection of victims needs to be guaranteed and better definitions for conflict resolution must be made available.
- 7 % of DRs experienced some kind of sexual harassment, and there appears to be an insufficient knowledge on which actions count as sexual harassment.
- 22 % of DRs experience bullying. The main reason for this mistreatment seems to be the position of power of the perpetrators.
- Most participants report discrimination based on nationality, gender identity and ethnicity.
- We propose a mandatory course on various forms of power abuse for all new DRs (and also for all the employees) to tackle these toxic behaviors.



## Integration

- 35 % of DRs (German, EU, and non-EU citizen) reported that there should be more assistance for finding accommodation.
- 42 % of DRs answered that to some extent and very much the lack of German remains a barrier at work.
- We suggest that centers within Helmholtz Association communicate internal, administrative, and contract/stipend information in English.
- 30 % of DRs reported their institution offering German classes. It is recommended that more awareness of German course offerings should be made within Helmholtz Association.
- Social events are to achieve crucial to feelings of integration and inclusion, but 26 % of DRs reported no social activities in their respective working groups.

## Career development

- 79 % of the participants are enrolled at a graduate school.
- 51 % of the participants wish to continue working in academia, whereas larger percentages of participants consider to work in non-academic scientific research. The stronger agreement for a transition away from academia after the doctoral time may be due to numerous reasons [6]. It is a fact that many post-doctoral positions remain unfilled and PIs are often struggling to find suitable candidates [47, 25]. Therefore, it must be a goal to make academia an attractive option where work and effort are valued and recognized [48].
- 44 % of the participants feel either *very unprepared* or *unprepared* for a job outside of science. Especially, female compared to male DRs feel less prepared. We think that mentoring programs targeted for women in science could have a great potential to improve this.

## Family

- Only 8 % of DRs have or are currently expecting children. This is a constant trend over the past years within the Helmholtz Association.
- DRs with children are a unique group and should be supported accordingly. While they tend to take longer for their doctoral studies, they show fewer mental health issues.
- Another 8 % of DRs have further caring responsibilities apart from children, for example for the elderly or other relatives. These caring duties are not sufficiently supported at the moment and might grow more important in our aging society.

## COVID-19

- COVID-19 had a huge impact on the lives of DRs ranging from research progress, expected project duration, and interruptions of experiments, to financial, social and health challenges.



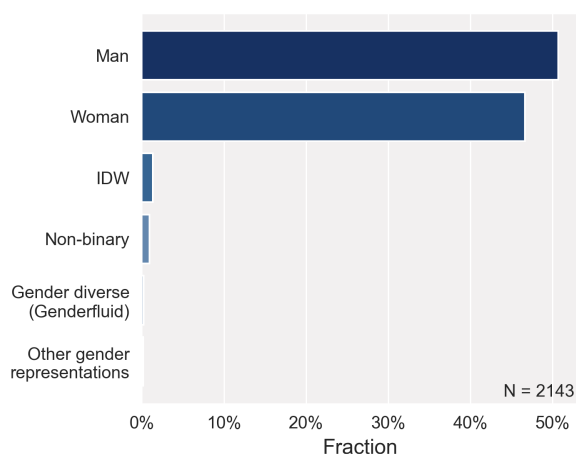
- The pandemic worsened both work and private life and led to consequences for mental health, with many participants rating their social and familial contacts as negatively/very negatively impacted.
- Participants said that opportunities to network (81 %) and general working productivity (53 %) were negatively affected due to COVID-19.
- 47 % of participants said their expected graduation time for the doctoral project was delayed due to the impacts of the pandemic with more than one third of DRs taking longer than extra half a year to finish due to COVID-19.
- Regarding future work options, participants appreciated the more flexible working environment related to remote work. It is suggested to offer training on how to separate work from leisure time in the context of home office.
- Overall, participants showed a relatively positive response to their respective institutes' support during the pandemic.

## 2 General

Within this section, we explore the diversity of all Doctoral Researchers (DRs) pursuing their doctorate within the Helmholtz Association. As we aim to create a diverse and inclusive community and work environment, the demographic status of the Helmholtz Association must be utilized to guide decisions in both short- and long-term policies regarding recruitment procedures and support mechanisms for DRs.

### 2.1 Gender diversity and orientation

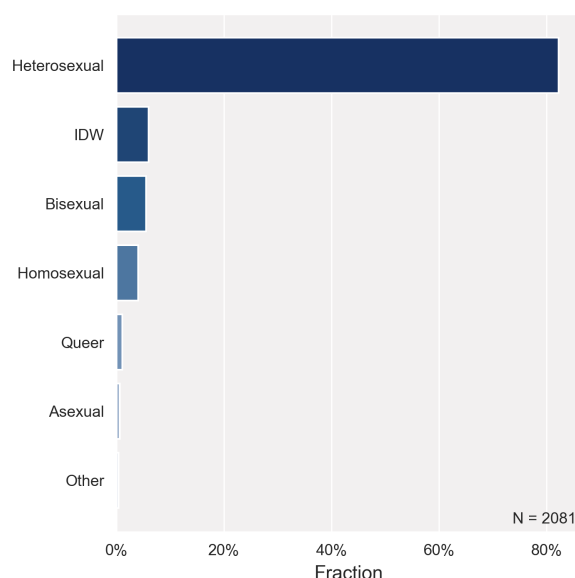
The diversity of gender identities is crucial to create an inclusive work environment, where each individual feels welcomed and supported. Figure 2.1 shows the gender distribution of the DRs in the Helmholtz Association.



**Figure 2.1:** Gender representation among DRs.

In the survey, there was slightly more *male* than *female* DRs participation with 50.7 % and 46.6 %, respectively (Figure 2.1). *Non-binary* and *gender-diverse* responses are low (1.4 %) in all Helmholtz centers, which could imply an

under-representation of these groups. In total 20 DRs identified as *non-binary*, 5 as *gender-fluid* or *gender-diverse*, and 4 as *other gender representations*.



**Figure 2.2:** Sexual orientation of participating DRs.

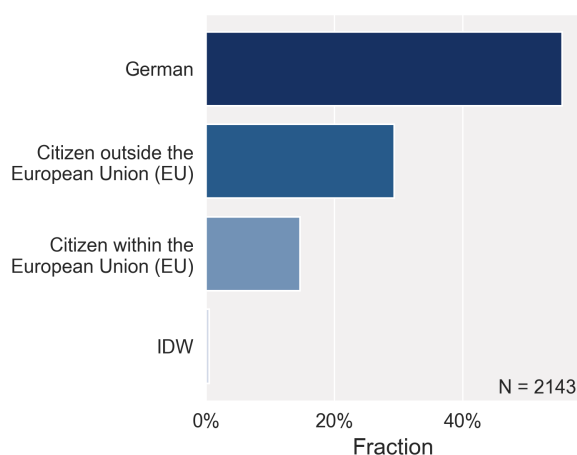
Furthermore, DRs were asked about their sexual/affectional orientation, which just as gender could be a basis of discrimination. 79.9 % of all participants identified as *heterosexual*, 4.0 % as *homosexual* and 5.4 % as *bisexual*. 2.9 % of all participants either did not answer the question or indicated they did not want to give an answer (Figure 2.2).

Please note that both gender and sexual identity will be further analyzed as different sub-populations within this survey report, specifically in the power abuse section.

## 2.2 Nationality

To support researchers with bureaucracy and increase diversity, it is important to assess the citizenship status of the DRs. It is crucial to support international DRs, especially non-EU DRs due to the high bureaucratic effort and other emerging challenges they might face. DRs in the Helmholtz Association are 55 % *German*, 14.7 % *EU* and 29.4 % *non-EU citizens* (Figure 2.3).

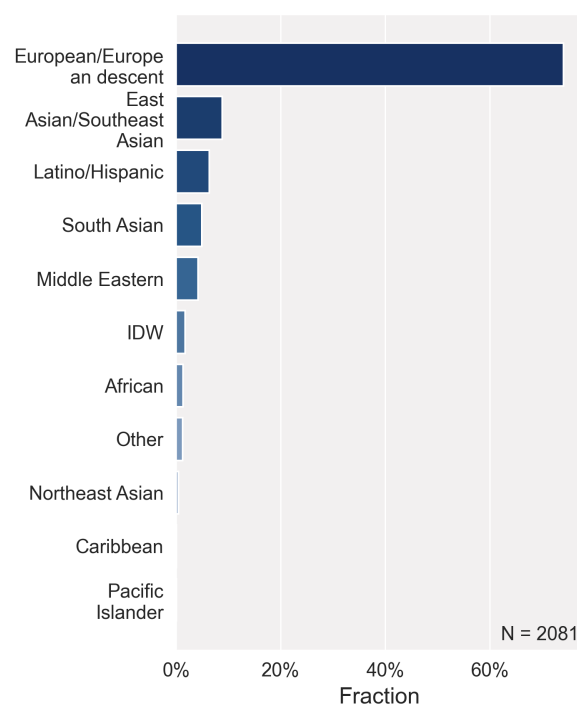
Of the German citizens, 11.8 % have a parental migration background (at least one of their parents was born outside Germany) and 3.5 % were themselves born outside Germany (data not shown).



**Figure 2.3:** Citizenship of participating DRs.

In all work sectors, a high diversity of working individuals who vary in gender, age, religion, ethnicity, cultural background, sexual orientation, and education level improves the overall working environment leading generally to greater creativity, innovation as well as more prosperous work and richer personal experiences [42].

The term *ethnic group* refers to a group of people whose members identify with each other through factors such as common heritage, culture, ancestry, language, dialect, history, identity and geographic origin. We think it is crucial to reinforce the importance of ethnic diversity in scientific collaborations. Figure 2.4 shows that a broad majority of the participants identifies their ethnicity as *European* or of *European descent* (72.0 %). All other ethnicities represent minorities



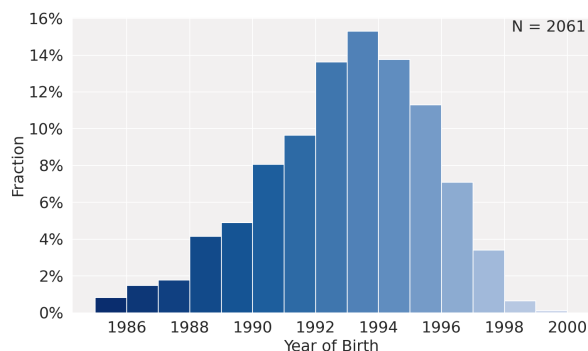
**Figure 2.4:** Ethnicity of participating DRs. Of note, this question was offered in a multiple choice fashion and 3.12 % chose more than one ethnicity.

with percentages below 10 %.

## 2.3 Age

Age diversity is a key component of diversity management and a significant factor while pursuing a doctorate. When starting a doctoral project, DRs enter a long educational period usually ranging from 3 to 6 years (see Section 2.4). Furthermore, continuing a career in research and in academia often comes with age requirements. The median age of the participants was 28 (calculated from the year of birth to 2021). Of note, 22 participants did not want to answer this question (Figure 2.5).

The ages between 20s and mid-20s are mostly regarded as the onset of one's career development [38]. For DRs it is usually the beginning of a long period where they are expected to be highly flexible in their personal and working schedules, their place to live, or their effective working hours, which often results in a lack of free time. This combination of factors and length of time devoted



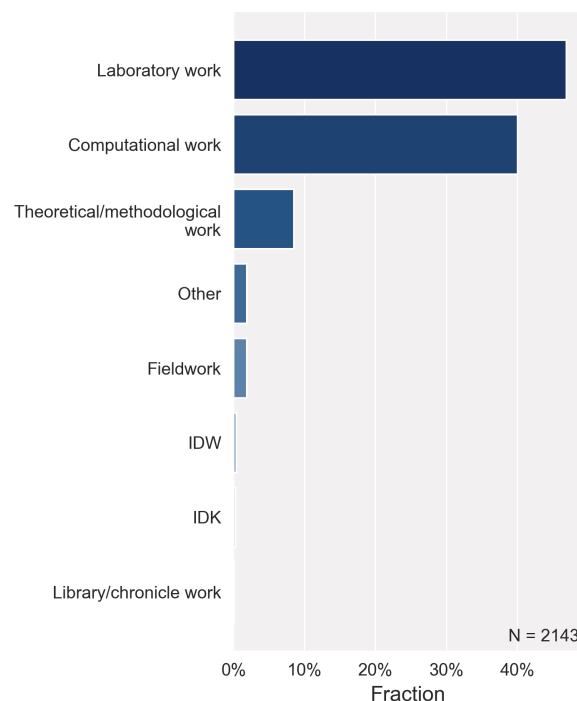
**Figure 2.5:** Age distribution of participating DRs. To ensure anonymity the plot was cropped to display the birth years from 1985 to 2000. A total of 60 participants lie outside of this range.

to completion of doctorate have an important impact on life and family planning as well as social interactions, which frequently derives in patterns of anxiety and/or other mental health issues [28]. This is the reason why we emphasize the broad age range distribution among DRs in this long educational period of their lives. Every age group might need a more tailored support from the supervisor/employer.

## 2.4 Field of work

Participants were further asked about the field (subject) they are working in, which represents the diversity of research covered within the Helmholtz Association.

Figure 2.7 shows the different fields of work in the Helmholtz Association linked to the gender distribution within each field. The most common working fields within the Helmholtz Association are biology and physics. Figure 2.7 shows considerable differences in the distribution of male and female DRs according to their field. The fields of physics, engineering, and computer science have a higher proportion of males. Biology, health sciences, and the medical field show a higher proportion of females. Such intra-field gender imbalances could bias the gender ratio observed within the entire Helmholtz Association, making it less likely to find gender-balanced working groups.

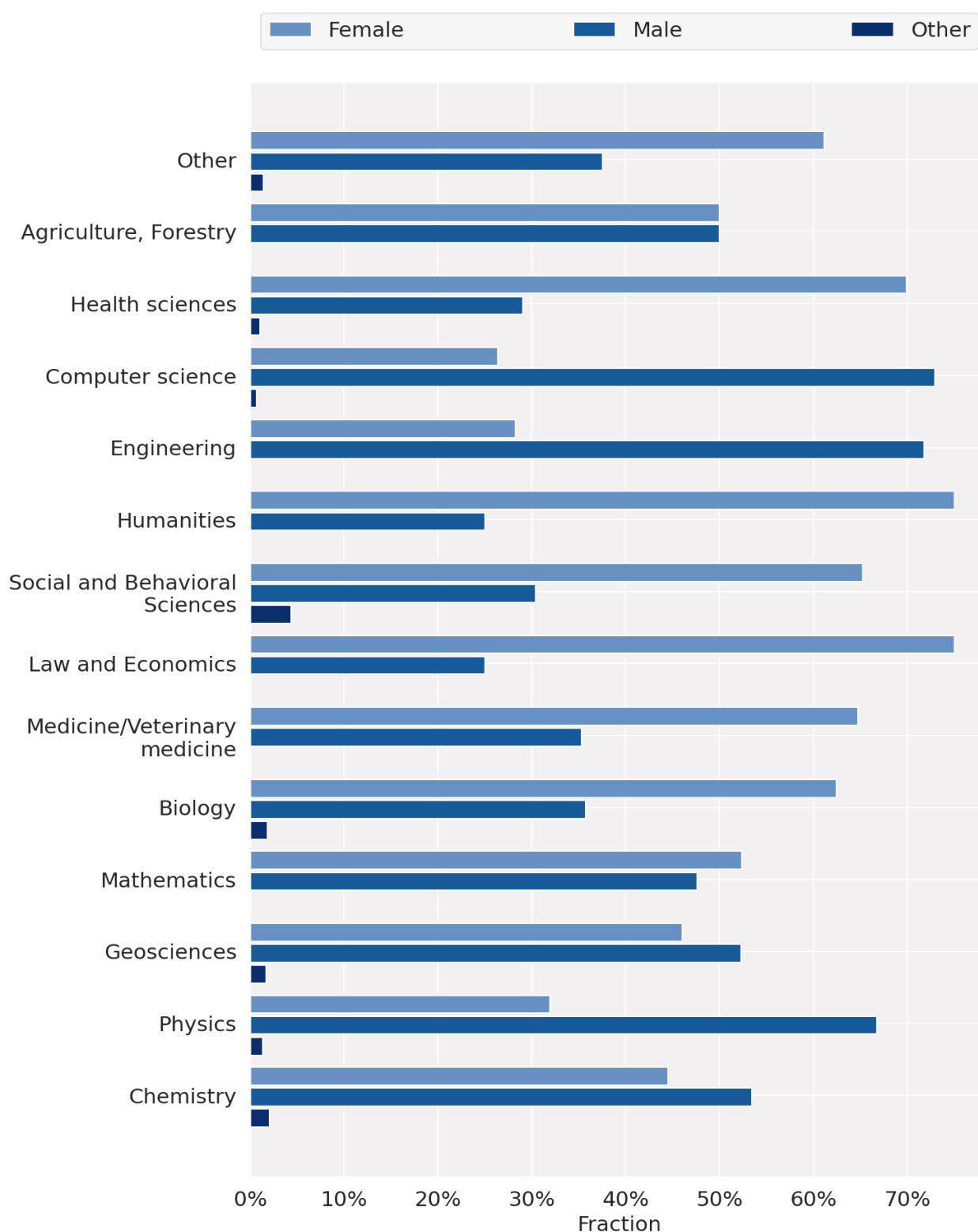


**Figure 2.6:** Type of work: how the doctoral work is primarily conducted by participating DRs.

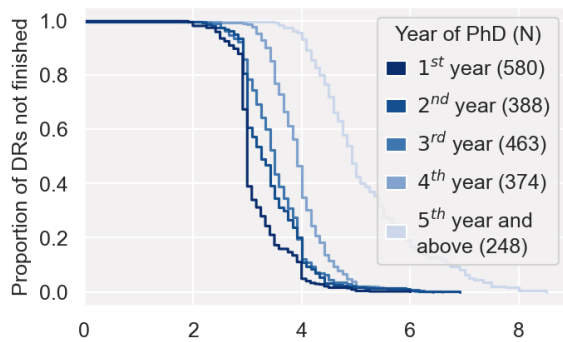
Specific scientific fields closely correlate with differences in daily work routines and work requirements. Some fields, for instance, allow DRs to do more home office, whereas in other fields there is an almost exclusive need to work in a laboratory. Every field has different demands on performance and structuring of work schedules, and work-life balance. Of note here is the fact that there is almost equal contribution of different types of work, namely *laboratory* and *field work* versus *computational* and *theoretical/methodological work* (Figure 2.6).

## 2.5 Estimated project duration

The duration of doctoral projects has a significant impact on DRs' lives, future job prospects, mental health, and family situations. A delayed completion of the project can lead to individual pressure, loss of valuable time and resources devoted to the research, and could potentially have a negative effect on the competitive benefit for the DR's future career path.



**Figure 2.7:** Field of work and gender representation. *Other* represents participants who identify as *non-binary*, *gender diverse (genderfluid)*, or *other gender representations*.



**Figure 2.8:** Survival plot of the expected project duration by year in the doctorate.

Figure 2.8 shows the expected duration of doctoral projects separated by the current year of the doctorate. We recognize that most first year DRs expect to finish their dissertation within three years. However, as they progress along their project, potential delays seem to add to the initially expected time frame, as second (3.25 years) and third year (3.5 years) DRs report longer times. The duration of the project was calculated by the reported start and the estimated end date of the DRs' projects (in months and years). For data analysis purposes, we assumed that all the participants will eventually complete their doctorate. Hence, here we do not consider events like quitting or premature withdrawal from DRs.

The average duration of a doctoral project in Germany has been shown to be approximately 5.7 years on average, excluding medicine [37]. In our sample, the expected mean duration of a doctoral project is 3.68 years. However, our estimations are based on self-reported expected dates, which can differ from the reality and are affected by subjective biases, and show signs for underestimation.

## 2.6 Key messages

- It is crucial to take into account the needs of minorities that might be under-represented.
- There are important differences in gender distribution for different fields of work.

- The expected times for completion of a doctoral project are significantly affected by the current year of the DR and first- and second-year DRs tend to underestimate their project duration.
- The average expected times for completion of a doctoral project are influenced by the field of work, but in every field the average clearly exceeds 3 years. We therefore advocate for longer minimum contract periods that realistically reflect the time required.

## 3 Working conditions

Scientific work within the Helmholtz Association is conducted by more than 9000 doctoral researchers (DRs), including employed and supervised (guest) DRs [16]. They contribute a substantial part of the scientific output, making Helmholtz an outstanding, renowned, world-class research association. On the other hand, they aim to graduate and earn a doctorate. This motivates them into spending time and energy on their projects. Working conditions should ensure that they can continue and successfully complete their projects. Furthermore, fostering healthy working conditions has been shown to be a cost-effective way of increasing employee satisfaction and labor productivity [1], and moreover improves the quality of research [41]. Therefore, ensuring good working conditions should be the aim of every scientific institution. In this section, we discuss results obtained by the N<sup>2</sup>-Survey regarding different aspects of working conditions, like *contractual situations*, *financial resources*, *working hours*, and *utilization of vacation days*.

### 3.1 Contracts

Contractual situation sets the framework of DRs' working conditions. Even though this does not regulate the details of scientific work, it should not be less valued than project planning and supervision agreements for the sake of employee protection. Details of the contracts are often not immediately obvious and are particularly difficult to get a full grasp on for international DRs since only the contract in German is legally binding and English translations are not always available. This requires that the highest standards are maintained not only in terms of scientific practice but also in terms of employee protection. That is why we

advocate for establishing four-year contracts that allow sufficient time for the qualification goal of the doctorate with a fair 100 % payment for the work performed. In the following, we will present the current contractual situation of DRs.

#### 3.1.1 Contract types

Within the Helmholtz Association, we find that 83.7 % of DRs have either an internal or external contract, and 11.1 % are financed by a scholarship or stipend<sup>1</sup> (Figure 3.1a) and thus at a similar level as in our N<sup>2</sup>-Survey 2019<sup>2</sup>.

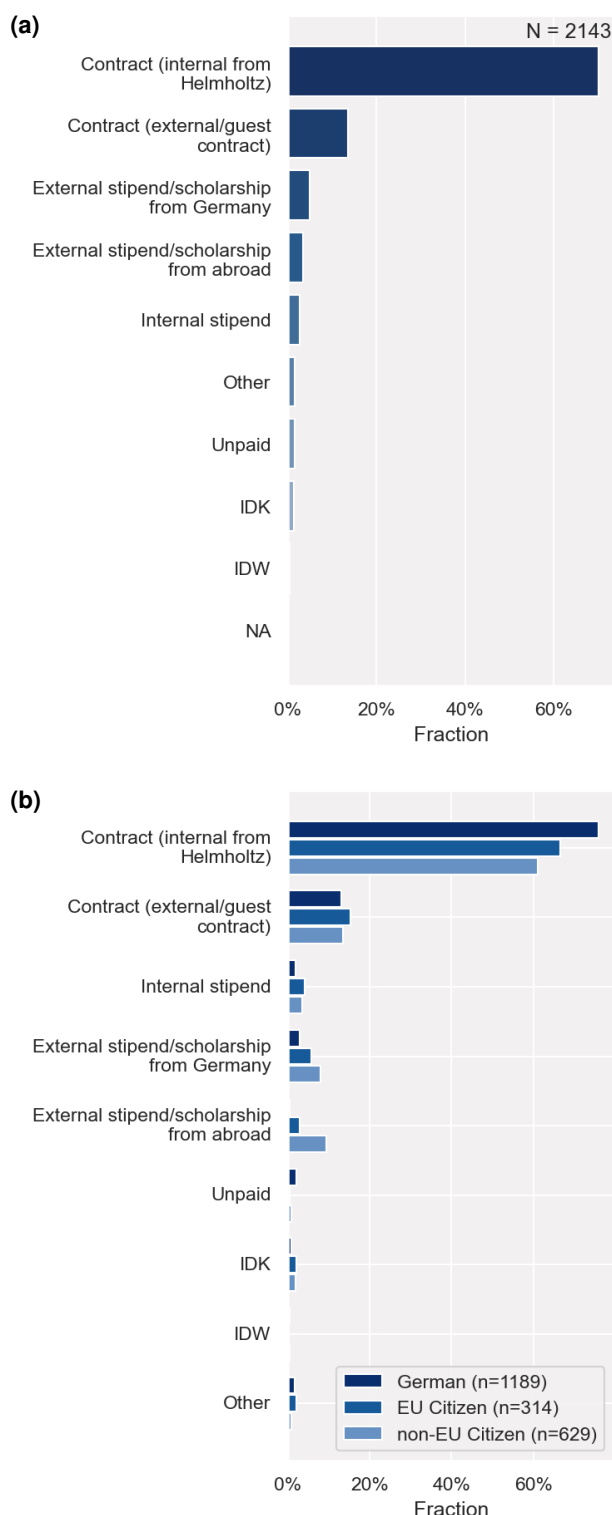
However, we find differences depending on the DRs citizenship (Figure 3.1b). 89.2 % of German, 81.8 % of EU, and only 74.6 % of non-EU citizens are employed either on an internal or external contract.

Reversely, the amount of scholarship fellows is 5.3 % for German, 12.7 % for EU, and 21.1 % for non-EU citizens. Among the scholarship holders, a majority have stipends from institutions within Germany. Still, 31.5 % are financed by scholarships from abroad. Although this enables them to obtain a doctorate in Germany, as we discuss in the following, stipends are a disadvantaged type of employment. Drawbacks range from missing aid from social security, to not being eligible for benefits coming from the Federal Travel Expenses Act (*ger.* Bundesreisekostengesetz), and not having well-defined working conditions, namely working hours and the number of vacation days (see also section 3.2.1). In general, this is a critical practice and in severe cases, it is against the

<sup>1</sup>The questionnaire did not distinguish between scholarship and stipend, and we will use both terms the same for simplicity.

<sup>2</sup>The question type was changed from multiple to single choice answers and does not allow direct comparison.





**Figure 3.1:** Contractual situation of (a) all DRs within the Helmholtz Association, and (b) filtered by citizenship (IDK - *I don't know*, IDW - *I don't want to answer*, NA - not applicable).

equal treatment policies [12].

Finally, there are no gender-based differences when it comes to types of employment (data not shown).

### 3.1.2 Payment level

One of the key components of a contract is the income stipulated therein. With a contract, the income is dependent on the pay scales (*ger.* Entgeltgruppe), pay grade (*ger.* Stufe), and the contracted working hours which differ based on scientific background, year of doctorate, and field of study. Stipends are often set to only a fixed monthly amount.

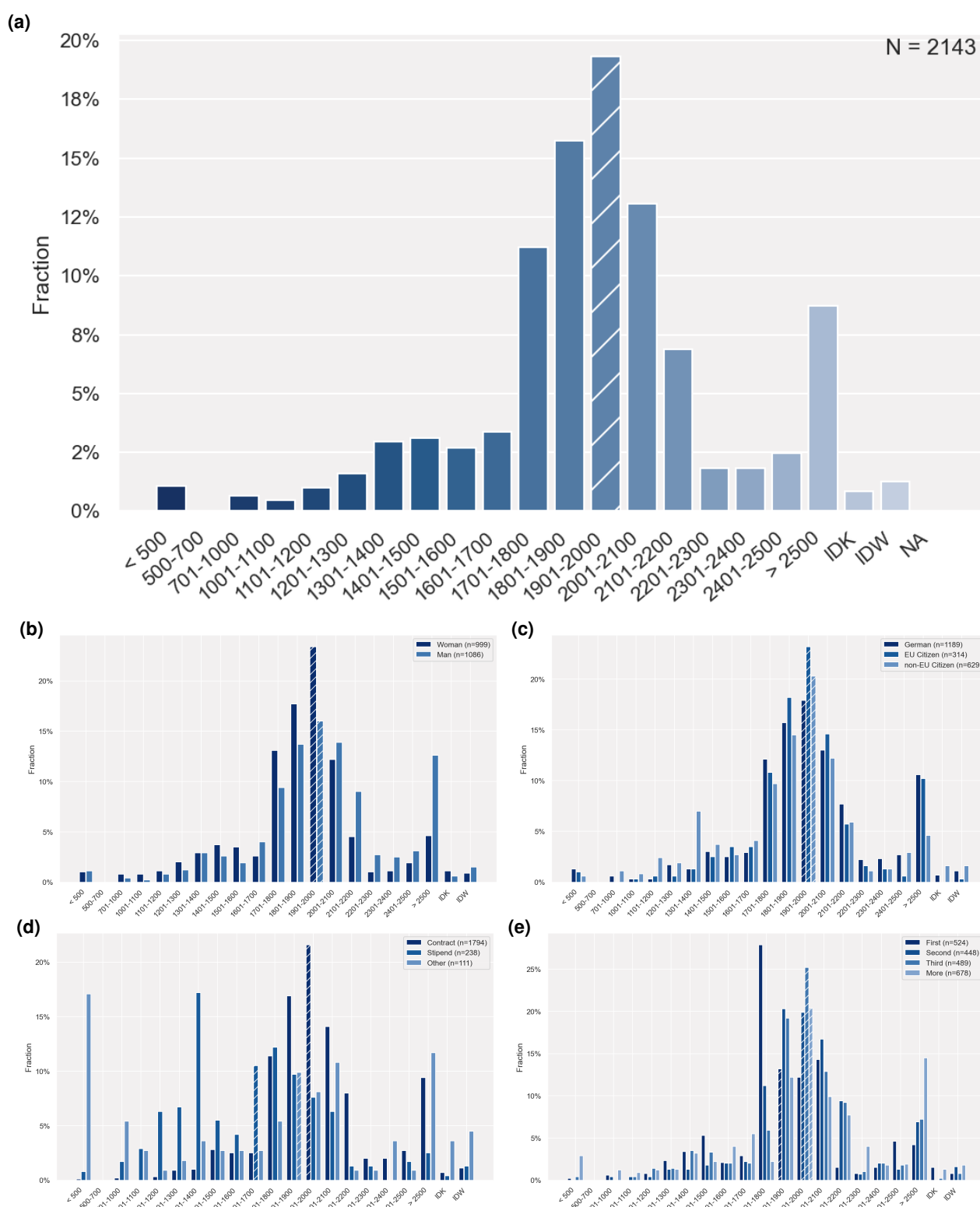
The salary of DRs varies over a wide range (Figure 3.2a). To quantify this, we calculate the median payment range  $\tilde{p}$  (marked by hatchings). Participants who did not specify their payment range have been excluded from this analysis.

DRs with citizenship outside of the EU show a slight downwards shift in their pay distribution compared to DRs with German or EU citizenship. Still, all groups have the same median pay range of  $\tilde{p}=1901-2000$  Euro (see Figure 3.2c).

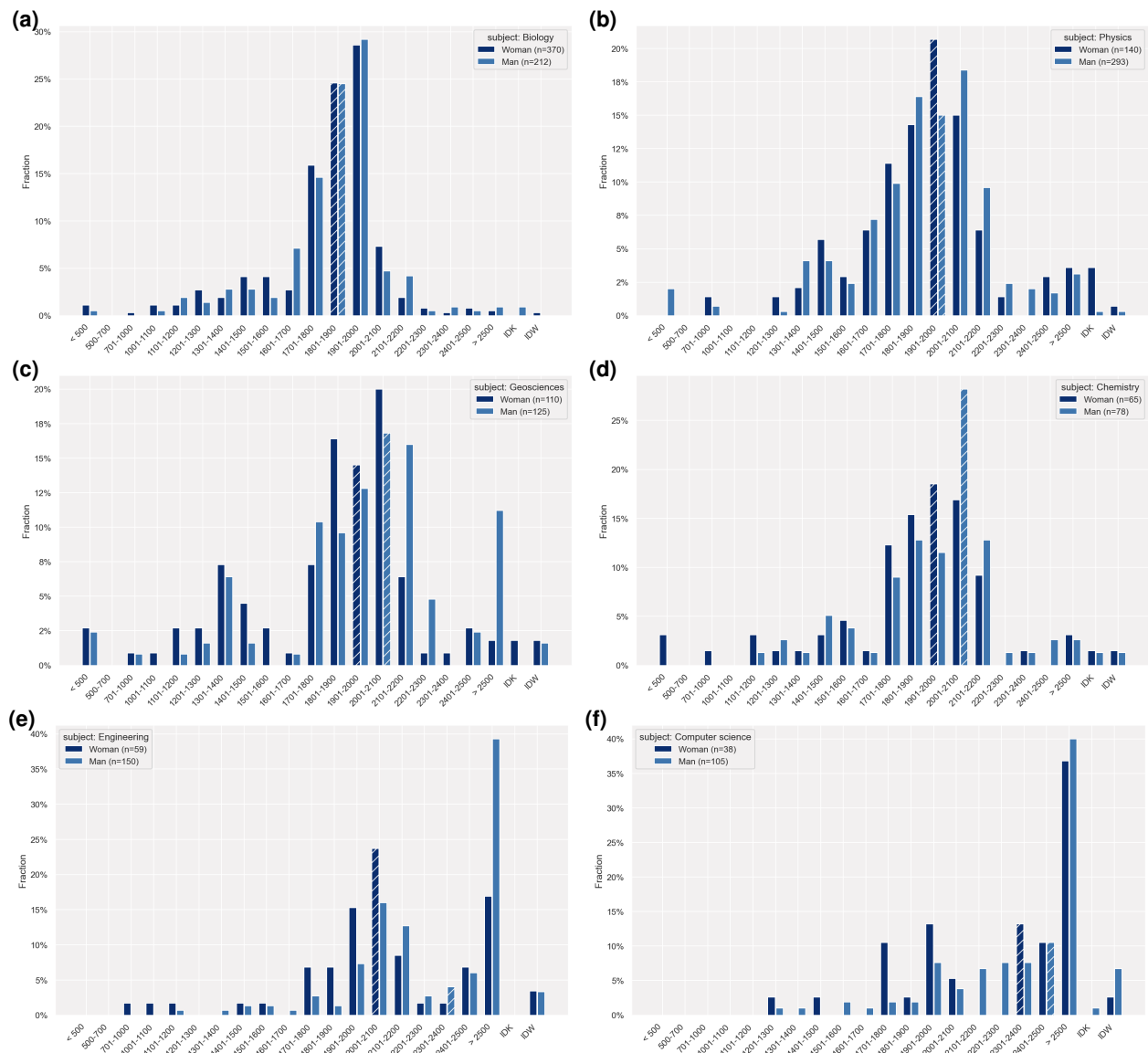
However, DRs with contracts ( $\tilde{p}$  1901-2000 Euro) often have higher incomes than their peers with stipends ( $\tilde{p}$  1601-1700 Euro), see Figure 3.2d. This is particularly problematic because this group is more likely to be financially responsible for others (data not shown). Other forms of financing, i.e. neither contract nor stipend, show strong downward outliers, which can be explained by the fact that unpaid DRs are also included in this group.

Another difference can be found in the year of the doctorate (Figure 3.2e). Since after the first year, DRs with a contract enter a higher experience level, their pay grade also rises. This is displayed by an increase of the median pay range from 1801-1900 Euro in the first year to 1901-2000 Euro in later years. Further, from the fraction of DRs earning below or above this median pay range, we can see that the distribution shifts towards higher payment with increasing doctoral age.





**Figure 3.2:** Monthly net income of DRs. Main plot for (a) all DRs, and subplots filtered by (b) gender, (c) citizenship, (d) contract type, and (e) year of doctorate. The hatching in subcategory plots marks the median pay range of each group (IDK - I don't know, IDW - I don't want to answer, NA - not applicable).



**Figure 3.3:** Payment level by subject and gender. The hatchings mark the median pay range (IDK - *I don't know*, IDW - *I don't want to answer*).

Although women and men have the same median pay range of 1901-2000 Euro (Figure 3.2b) it is notable that 49.7 % of female DRs earn less than this median range, but only 38.7 % of male DRs.

Putting this data in perspective, DFG (*ger.* Deutsche Forschungsgemeinschaft, *ang.* German Research Foundation) guidelines recommend different payment levels for DRs, according to their field of study [7]. Hence, we investigated the income according to the gender and field of study of participants (Figure 3.3).

For example, the field of biology, which is the strongest group within the survey with exactly 600 participants ( $n_f = 370 / n_m = 212$ )<sup>3</sup>, does not show an indication of a gender pay gap ( $\tilde{p}$  1801-1900 Euro, 35 %/40.4 % female and 33.5 %/42.0 % male DRs below/above  $\tilde{p}$ ), and also physics ( $n_f = 140 / n_m = 293$ ,  $\tilde{p}$  1901-2000 Euro, 46 %/33.1 % female and 47.3 %/37.7 % male below/above  $\tilde{p}$ ) shows a balanced pay distribution. Conversely, other fields such as geoscience ( $n_f = 110 / n_m = 125$ ,  $\tilde{p}$ -female 1801-1900 Euro,  $\tilde{p}$ -male 2001-2100 Euro), chemistry ( $n_f = 65 / n_m = 78$ ,  $\tilde{p}$ -female 1901-2000 Euro,  $\tilde{p}$ -male 2001-2100 Euro), engineering ( $n_f = 59 / n_m = 150$ ,  $\tilde{p}$ -female 2001-2100 Euro,  $\tilde{p}$ -male 2301-2400 Euro), and computer science ( $n_f = 38 / n_m = 105$ ,  $\tilde{p}$ -female 2301-2400 Euro,  $\tilde{p}$ -male 2401-2500 Euro), are not as balanced and display tendencies toward gender-based income inequality.

We are aware that it is difficult to claim that a gender pay gap exists for some subjects in the Helmholtz Association. However, our data suggest that this is the case, and we hope that this will be investigated in future studies and that action will be taken, if confirmed.

We encourage a transparent ascertainment of the contractual situation of DRs, including guest researchers. Having accurate data and making it available in an appropriate form not only helps to uncover shortcomings, but can also attract DRs who want to pursue a doctorate. It would also re-

duce the knowledge gap before signing a contract and create a fair negotiating situation.

### 3.1.3 Contract duration & extensions

The Federal Report on Young Scientists 2021 shows that doctoral studies in Germany take 5.7 years on average, excluding medical doctorates [37]. Our data discussed in section 2.5 shows that it takes 3.7 years to complete a doctorate in the Helmholtz Association, including a possible underestimation by DRs in the early years, so that the actual number is likely higher.

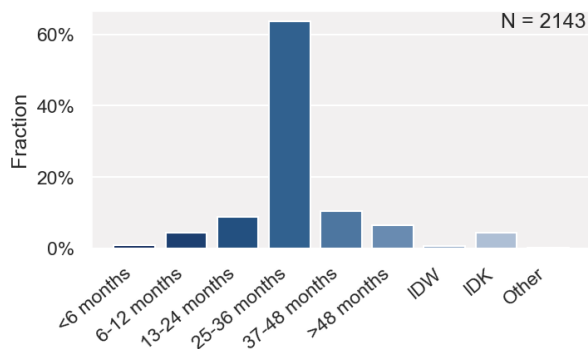
However, the reality is very different (Figure 3.4). A majority of DRs (63.6 %) have a contract duration of 25-36 months, which is not sufficient to finish a doctorate. 17.0 % have contracts of 37 months or more. Not having a secure working situation, specifically having a contract whose duration is not covering the whole doctorate, could contribute to high occupational stress due to financial insecurities. This combination of factors are triggers that are well-known to have detrimental effects on mental health [28]. Compared to 2019 (60.0 % with a duration of 25-36 months, 15.8 % more than 37 months), contract lengths got longer in general, which is a promising step towards a contract duration matching the required time for a doctorate.

Interestingly, a larger amount of non-EU citizens are endowed with longer contract periods (data not shown). This is desirable since this group of participants is constricted by visa restrictions and longer durations allow them to successfully complete their research.

The fact that the initial contract period does not suffice the requirements of a doctoral project can be reflected by the number of extensions granted to DRs (Figure 3.5), notably 17.9 % of participants received two or more extensions. No difference by citizenship or gender and between DRs financed by contract or stipend is observed (data not shown).

Sadly, extensions have become a standard tool used to allow for the completion of doctoral projects, which should not be the case. Consid-

<sup>3</sup>Other gender representations have been excluded from this analysis due to low numbers.

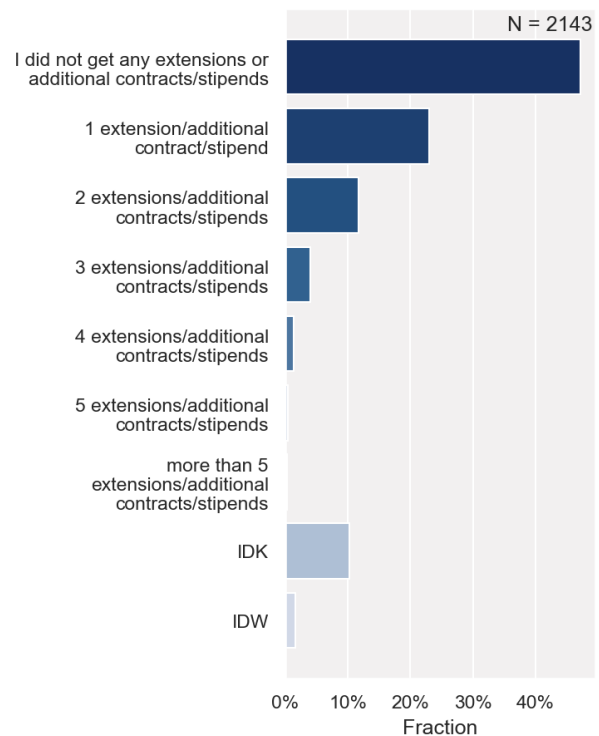


**Figure 3.4:** Contract duration of DRs (IDK - *I don't know*, IDW - *I don't want to answer*).

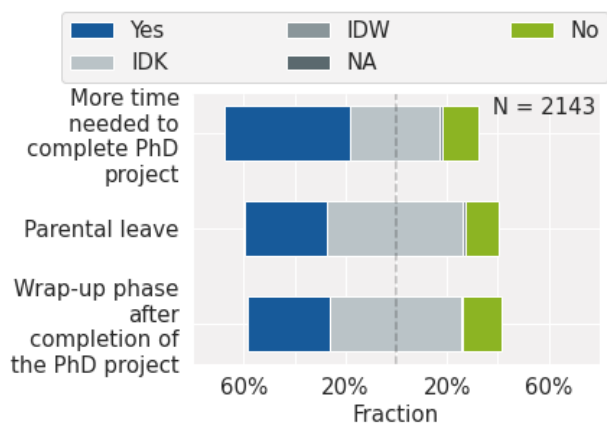
ering the fact that contracts typically include a clause that allows for an earlier dissolution, contracts can be invoked once the doctoral project has been successfully completed. In this regard, there would not be a need to deal with several contract extensions.

When asked about possible reasons for extending a contract, 49.8 % indicated that *more time [is] needed to complete doctoral project*, 32.2 % state that *parental leave*, and 32.2 % that *additional wrap-up phase after completion of the doctoral contract* are possible reasons to extend the current contract or stipend (Figure 3.6). Interestingly, only parental leave is legally binding, if the DR works on a fixed term employment according to WissZeitVG §2 (1), while the other reasons depend on the employer's willingness and financial resources. However, especially for non-EU citizens, who as discussed before, are more likely scholarship holders, only 21.0 % state that this is a possible reason. For German and EU citizens, 39.5 % and 27.7 % answered *yes* to *parental leave*, respectively. A similar discrepancy can be found between contracts (34.4 %) and scholarships (23.1 %). Between women and men, there were no significant differences in all categories.

A problematic aspect of all options is that a large number of DRs do not know what circumstances allow them to get an extension. The answer *I don't know* was given by 35.2 %, 53.6 %, and 51.7 % for the options *more time needed*, *parental leave*, and *wrap-up phase*, respectively.



**Figure 3.5:** Number of contract extensions received by the DRs (IDK - *I don't know*, IDW - *I don't want to answer*).



**Figure 3.6:** Possible reasons according to DRs to extend a current contract or scholarship (IDK - *I don't know*, IDW - *I don't want to answer*, NA - not applicable).

Here, we see the necessity to inform DRs about their entitlement, some of which might not be explicitly explained in their contract. Of note, our data shows only a small decrease in the lack of knowledge over the years of the doctorate.

Given the current contract lengths and the need for contract extensions, we advocate that DRs' contracts should be long enough to allow them to complete their doctoral project, with a minimum of four years. Also, the rules for extensions need to be clearly specified to allow DRs to finish their PhD with a contract instead of in unemployment, and they need to be communicated transparently.

## 3.2 Vacation days and working hours

Two other relevant components of employment contracts are the determination of working hours to ensure the safety and health of workers, and the entitlement to paid vacation, which according to the standard Helmholtz Association guidelines is 30 days per year for DRs with a contract. In this section, we will address the specification and utilization of these rights by DRs.

### 3.2.1 Vacation days

We find that 83.0 % of DRs could take 26-30 days of leave per year, and overall 88.4 % are entitled to more than 21 days per year (Figure 3.7). Compared to 2019, when 81.1 % were allowed to take more than 21 days per year, this is a promising increase.

Interestingly, for 5.1 % (8.6 % in 2019) of the participants, the funding does not specify the number of holidays. While the overall numbers have improved, there are still 36.6 % among the stipend holders who do not have a specified number of vacation days by funding. Combined with the fact that more EU and non-EU DRs are funded by stipends, we find a slight increase also by citizenship with 3.2 %, 5.4 %, and 8.6 % for German, EU, and non-EU citizens, respectively. This creates additional difficulties for an already vulner-

able group and increase inequalities and opens up opportunities for abuse of power and therefore needs to be changed. Besides the abolition of stipends, possible solutions would be the conversion into regular contracts or additional top-up contracts.

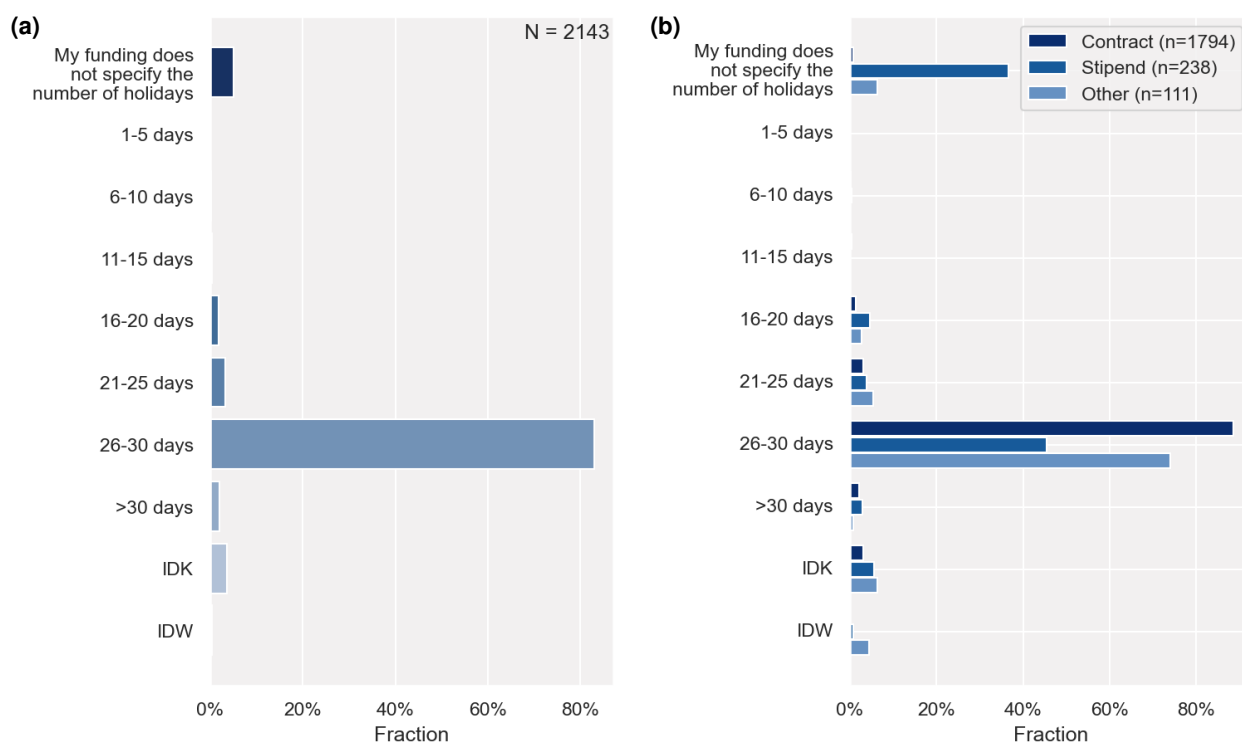
In regard to holidays, only minor differences were found between genders, and year of the doctorate (data not shown).

While there is an official number of vacation days for DRs, it is often the case that DRs do not take holidays. The DRs were asked in the survey about the number of vacation days that they took in the last year (see Figure 3.8). Over 43.1 % of the DRs have taken 15 or fewer vacation days in the past year (data not shown). While for German (38.9 %) and EU citizens (39.2 %) equal amounts of DRs take at least 15 vacation days, the figure for non-EU citizens is 52.8 %.

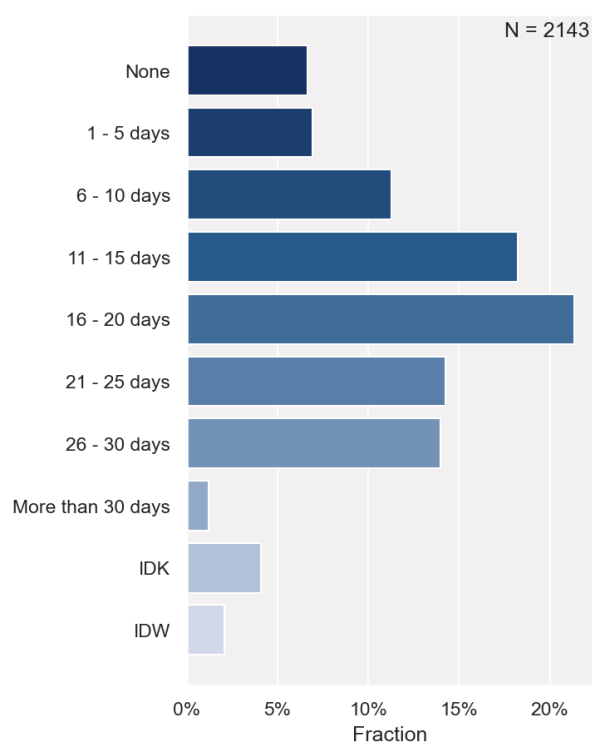
This may be due to a variety of reasons (see Figure 3.9). 32.2 % of DRs don't do so because of the *high workload* and 9.4 % because of *pressure from their supervisors*. For both options, the percentages increase over the course of the doctorate. While 8.0 % *save up time for a longer period of vacation*, this is especially high for non-EU citizens with 13.8 %. Furthermore, men (58.0 %) feel freer to take days off than women (47.4 %). While we only find small differences between DRs employed on contracts or stipends, those with other or no forms of employment feel less free to take days off.

### 3.2.2 Working hours

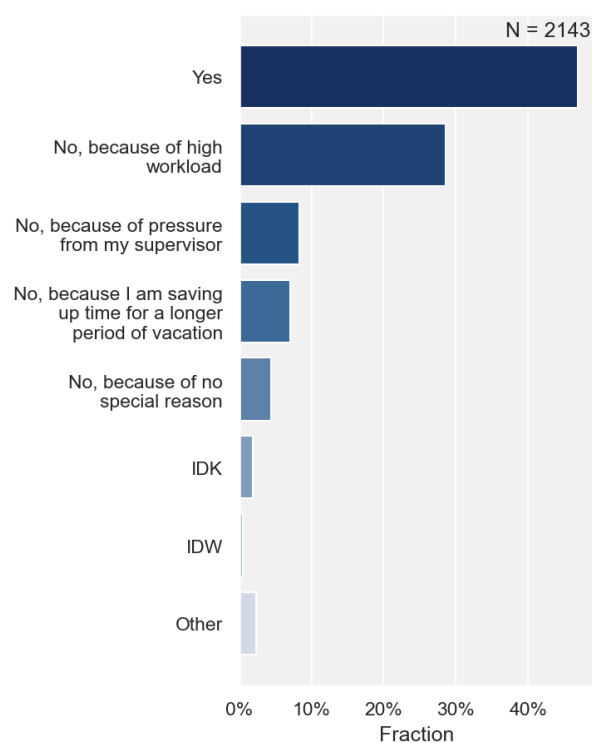
It is common for DRs in many fields of study to be employed at a fraction rather than a full time position. Their actual income is adjusted by specifying a lower number of working hours in the contract. For example, a 50 % contract is contractually obliged to work between 18 and 20 h per week, while in fact DRs with 50 % contracts are still expected by their employer to work 39 or 40 h per week. Of note, working hours depend on the federal state. These adjustments happen over a wide range, usually between 65 % and 100 %, and



**Figure 3.7:** Determination of entitlement to vacation days in the contracts of all DRs (left), and filtered by contract type (right) (IDK - *I don't know*, IDW - *I don't want to answer*).



**Figure 3.8:** Number of vacation days taken by DRs within the last year. Question was offered as single-choice (IDK - *I don't know*, IDW - *I don't want to answer*).



**Figure 3.9:** DRs who feel free to take vacation (yes), or reasons why not. Question was offered as multiple-choice (IDK - *I don't know*, IDW - *I don't want to answer*, NA - not applicable)..



resulting in inequality between DRs.

It is of interest how many hours DRs actually work, as the amount of workload spent is one of the key components contributing to the level of job satisfaction among DRs. Since only for 18.5 % of DRs the working hours are officially tracked, we asked DRs to report the hours per week they are expected to work, and the hours they are typically working. Figure 3.10 shows the data for these individual questions side by side, which vividly illustrates the discrepancy between the regulation and reality.

While only 35.7 % work up to 40 h per week, we find that 57.5 % work between 41 h and 60 h per week. Yet, 5.0 % state to work even more than 60 h per week. This is slightly better than it was in our 2019 survey, when 62.7 % worked 40-60 h per week and 4.0 % more than 60 h per week. Nevertheless, the percentage of DRs working exceptionally long hours is still too high.

As discussed before, working hours are often used to regulate payment, which follows regulations for different subjects. Our data, however, could not show any difference for the median working hours per week, which are between 41-45 h per week for eight out of ten subjects with at least 20 participants, and the two exceptions, geoscience and mathematics, still report a median of 36-40 h per week, still corresponding to a full position.

It is crucial to mention that working time consists not only of hours spent working on the dissertation, but also of scientific work not related to the doctoral research, such as helping with other projects, as well as attending courses and seminars, administrative tasks and, in some cases, teaching.

Moreover, 67.9 % of all DRs have indicated that they work at least once a month during weekends and public holidays within the past year (Figure 3.11). Again, the fraction of international DRs who do so is higher, with 72.9 % for EU and 74.4 % for non-EU citizens, in comparison to 63.1 % reported by German DRs.

Our results indicate that providing a platform

and support for well managed work-life balance and taking time off from work are incredibly important factors to improving DRs' working conditions. This is further highlighted in the next sections (especially in Figure 5.1), where the workload is the most important factor correlated to both depressive symptoms and state anxiety of DRs.

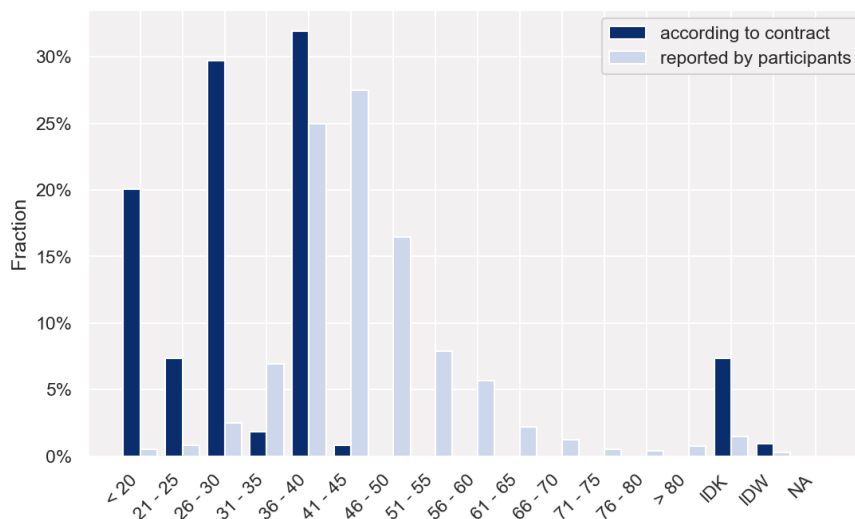
In addition, the practice of regulating payment through working hours while expecting all DRs to work the same amount can be considered unfair and is met with confusion in the doctoral community, especially among international DRs. We demand 100 % pay for 100 % work.

### 3.3 Summary open-text answers

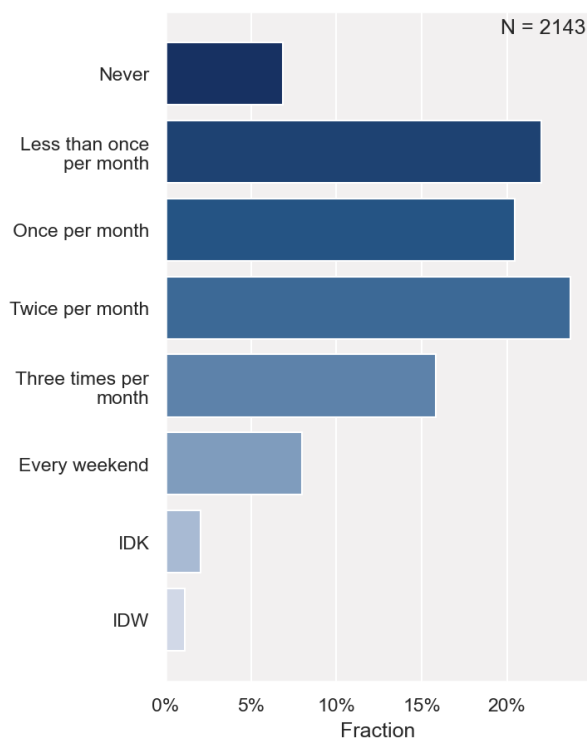
In this section we have received 216 open-text answers. The most prevalent topics covered contracts, working hours and workload, as well as expectations. Specifically, three things stood out: (1) discrepancies between the expected working hours in the contract and the expected actual working hours, which are filled with a heavy workload, (2) discrepancies between non-100 % contracts but contractually binding 39.5 h or 40 h work weeks, and (3) expected overtime.

Further, the drawbacks stipend holders deal with compared to DRs having TVöD/TVL contracts and TVöD-based contracts are mentioned. These include lack of benefits such as social security, recognition of years worked in academia when switching to a TVöD/TVL contract, full coverage of travel expenses for work, COVID-19 vaccination priority, regulation on working hours or vacation days, and furthermore stipends preclude non-EU to be eligible for a settlement permit or EU permit for permanent residency. All of these apply while scholarship holders are expected to carry the same workload as other DRs. Abolishing the stipend system would attract more people to stay in Germany and continue their contribution to science in this country.

It was also mentioned that some doctorate programs are planned for four years. However, these programs are only funded for three years, and it



**Figure 3.10:** Working hours per week according to contract (dark blue) and as reported by participants (light blue). Both questions were offered as single-choice (IDK - *I don't know*, IDW - *I don't want to answer*, NA - not applicable). The hours per week according to contract were asked in one hour steps and transformed in a five hour interval to match the options for reported hours.



**Figure 3.11:** Number of days DRs work on weekends or holidays (IDK - *I don't know*, IDW - *I don't want to answer*).

is expected that the DR receives unemployment benefits during the fourth year to finish the doctorate.

DRs brought up two aspects of COVID-19 pandemic in the context of working conditions: out-of-pocket home office equipment expenses and extension issues connected to either parental leave or increased workload when DRs were trying to reconcile childcare/homeschooling with their doctorate. Extensions themselves were also reported as problematic in general, not only due to COVID-19.

### 3.4 Key messages

- Contracts are the main (84 %), but not the only form of employment.
- Contract durations got slightly longer compared to 2019, but still do not match the actual project duration.
- Contractual situation does not reflect the reality. Weekly working hours are high, but not compensated accordingly. In addition, DRs often work on weekends and do not take vacations to meet the requirements of a doctor-



ate.

- Stipends are poor forms of contracts, which, in their current form, put these DRs in a worse position compared to those with a regular contract. E.g. vacation days and working hours are often not defined and social security is lacking.
- We find evidence of a gender pay gap, which needs further investigation.
- We are strongly encouraging that the contract situation of the DRs, including stipend holders, is transparently determined by the official side of the Helmholtz Association and its research centers and that the determined facts are communicated.

## 4 Satisfaction

Measuring and analyzing job satisfaction gives valuable insights into the health of a workplace and closely relates to mental health outcomes. Academic institutes, just as any other workplace, depend on motivation, productivity, and morale which are closely linked to job satisfaction and work culture. It is important to consider this aspect of a workplace, since job dissatisfaction can be closely related to mental health (depression, anxiety, and stress) [30].

### 4.1 Satisfaction factors

In this section of the survey we focused on different aspects of satisfaction of Doctoral Researchers (DRs). Importantly, lack of job satisfaction can also lead to situations in which DRs would seriously consider quitting their doctorate (Figure 4.1) which we addressed as well.

The overall job satisfaction was assessed with the following question *If you think about your own situation as a doctoral researcher, how satisfied are you with the following aspects?* which were rated from *very dissatisfied* to *very satisfied*.

Interestingly, we did not observe differences in overall satisfaction per research field (data not shown). Figure 4.2 shows satisfaction with individual factors. The following satisfaction components have been found to be the most dissatisfying for the participants:

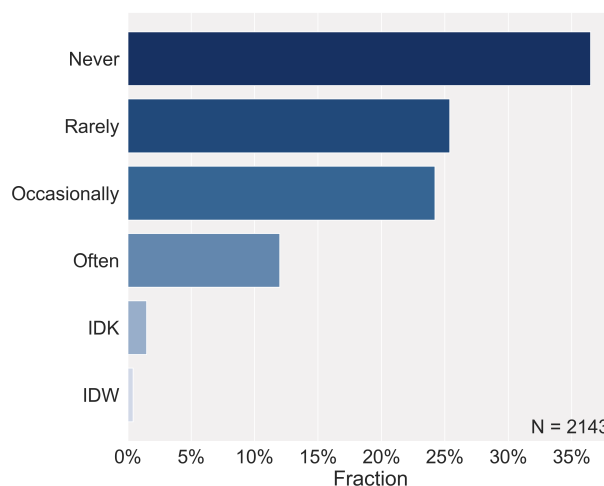
- *psychological support,*
- *bureaucracy and administrative support,*
- *social life at the institute,*
- *workload,*
- *support for international DRs,*

while the following were rated as the most satisfying:

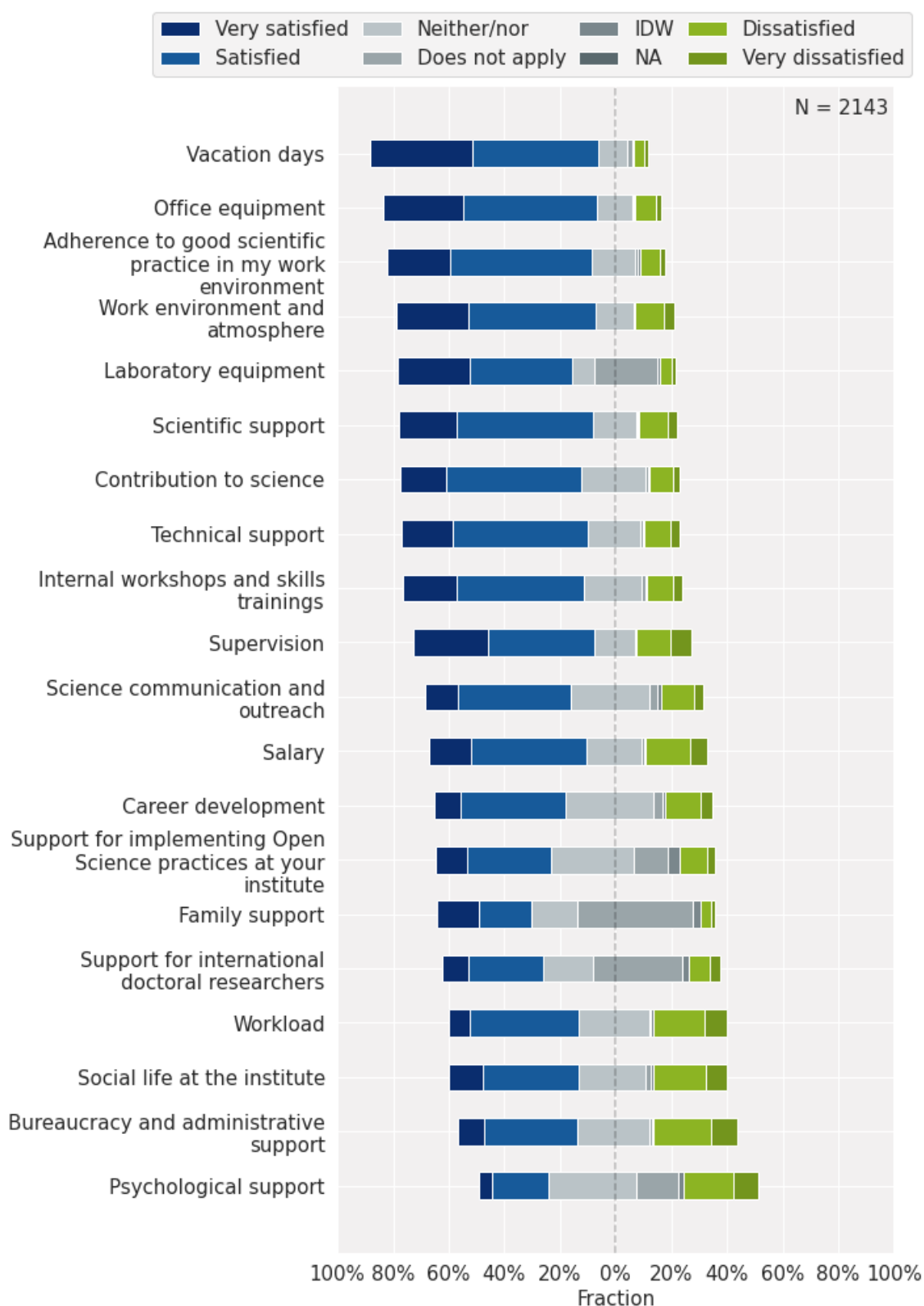
- *vacation days,*
- *office equipment,*
- *adherence to good scientific practice in my work environment,*
- *work environment and atmosphere,*
- *laboratory equipment.*

### 4.2 Quitting doctoral project

DRs were also asked if they have considered quitting their doctoral project (Figure 4.1). 36.2 % of participants have considered quitting at least occasionally (sum of percentages from often and occasionally). This number has slightly increased from 34.4 % in 2019, according to our previous N<sup>2</sup>-Survey.



**Figure 4.1:** Thoughts about quitting doctoral project among DRs.



**Figure 4.2:** Factors contributing to satisfaction of DRs. This plot presents fractions of agreement of participating DRs, each bar represents 100 % of DRs and is filled according to their answer levels. Additionally, the bars are moved corresponding to their answer direction, with neutral or not given answer possibilities (e.g. *IDK* (*I don't know*), *IDW* (*I don't want to answer*) and *NA* (*No answer*) centered in the middle. According to the left- or right-alignment of the bars, you can compare the answer tendencies of DRs.

When asked to specify the reasons for that situation, they have reported as most problematic (Figure 4.3):

- *I do not feel qualified enough* (37.2 %),
- *I can't cope with the workload* (29.9 %),
- *I have no or poor academic results* (28.3 %),
- *I find my career prospective unattractive* (26.1 %),
- *I have work-related difficulties with my supervisor* (25.4 %),
- *I don't like my working conditions* (24.5 %).

Other studies have shown that women are more often affected by the so-called imposter syndrome, where people doubt their abilities and talents and are afraid of being exposed as frauds, than men [22], which can also be seen in our data. We have found that female DRs are significantly more likely to consider quitting their doctorate at least *occasionally* or *often* in comparison to their male peers (chi-squared test,  $p\text{-value} \leq 0.01$ ). Furthermore, they feel less qualified for their projects (27.8 %) in comparison to male DRs (18.2 %).

Next to gender, the year of doctoral studies plays a role in the intentions to quit the doctoral project and feelings of imposter syndrome. We found that, while the percentage of DRs considering to quit increases through the duration of the doctoral project, the tendency to feel unqualified enough, remains consistent. This might lead to the hypothesis that DRs who consider to quit later do not do this because they still do not feel qualified in their field but might do so because of increasingly intolerable working conditions and accumulating mental health issues (see Section 5).

### 4.3 Aspects in need of improvement

DRs were also asked for specific aspects of their work that they would like to be improved. Each

of these aspects was scored by the participants based on their satisfaction or lack thereof (Figure 4.4). To identify the most relevant ones, the sum of positive answers (*very much* and *to some extent*) was sorted and the highest ranked are:

- *salary and benefits,*
- *career development,*
- *psychological support,*
- *bureaucracy and administrative support,*
- *social life at the institute.*

Of note, those DRs who would wish to improve psychological support within Helmholtz Association got higher (t-test,  $p\text{-value} \leq 0.01$ ) scores for depressive syndrome on the PHQ-8 (see Section 5) which highlights the importance of the availability of mental health resources for people who are in need of them.

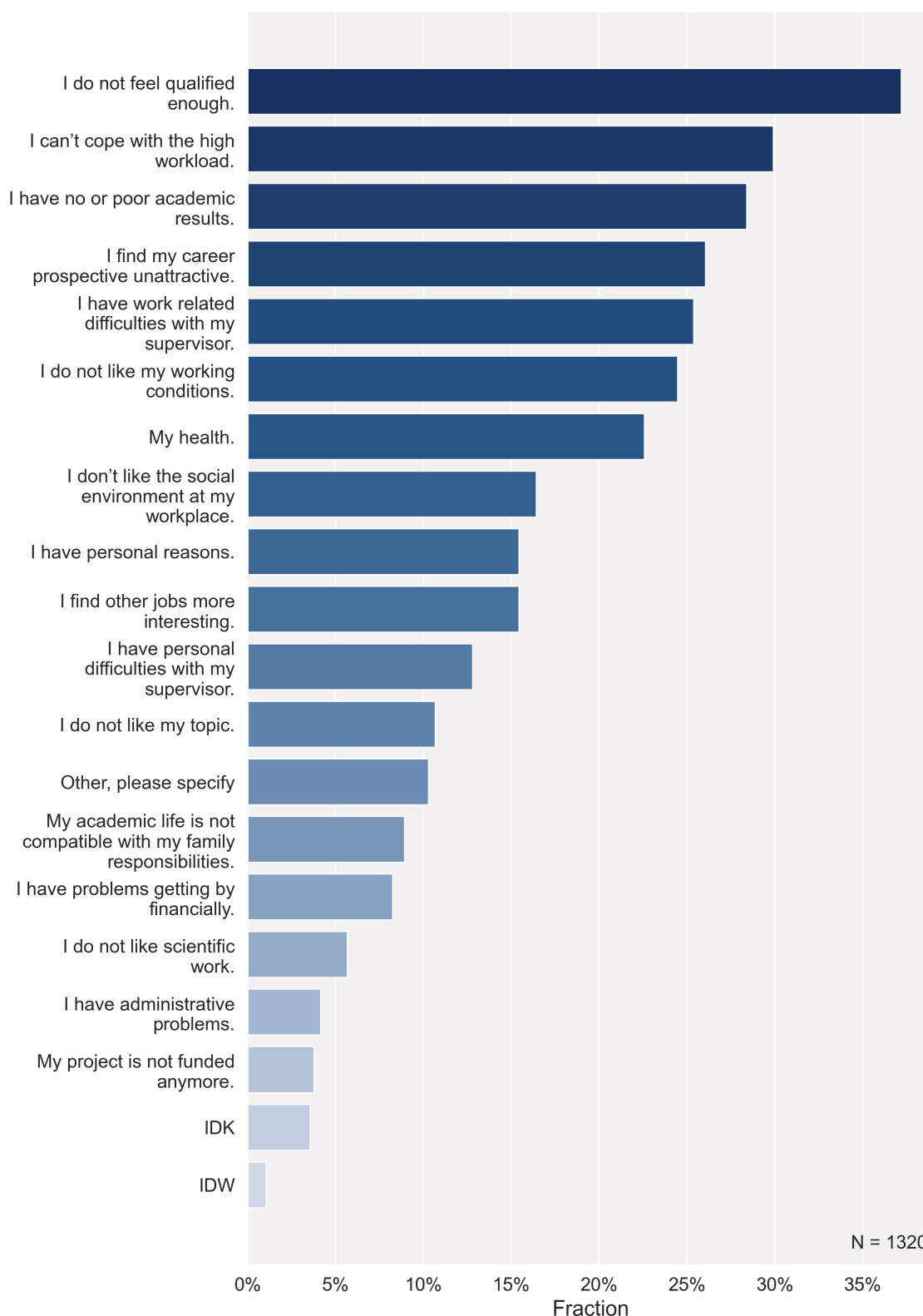
Moreover, it is important to note that significantly more non-German speakers are eager to see more support for foreign DRs (40.1 %) in comparison to German speakers (chi-squared test,  $p\text{-value} \leq 0.01$ ).

### 4.4 Summary open-text answers

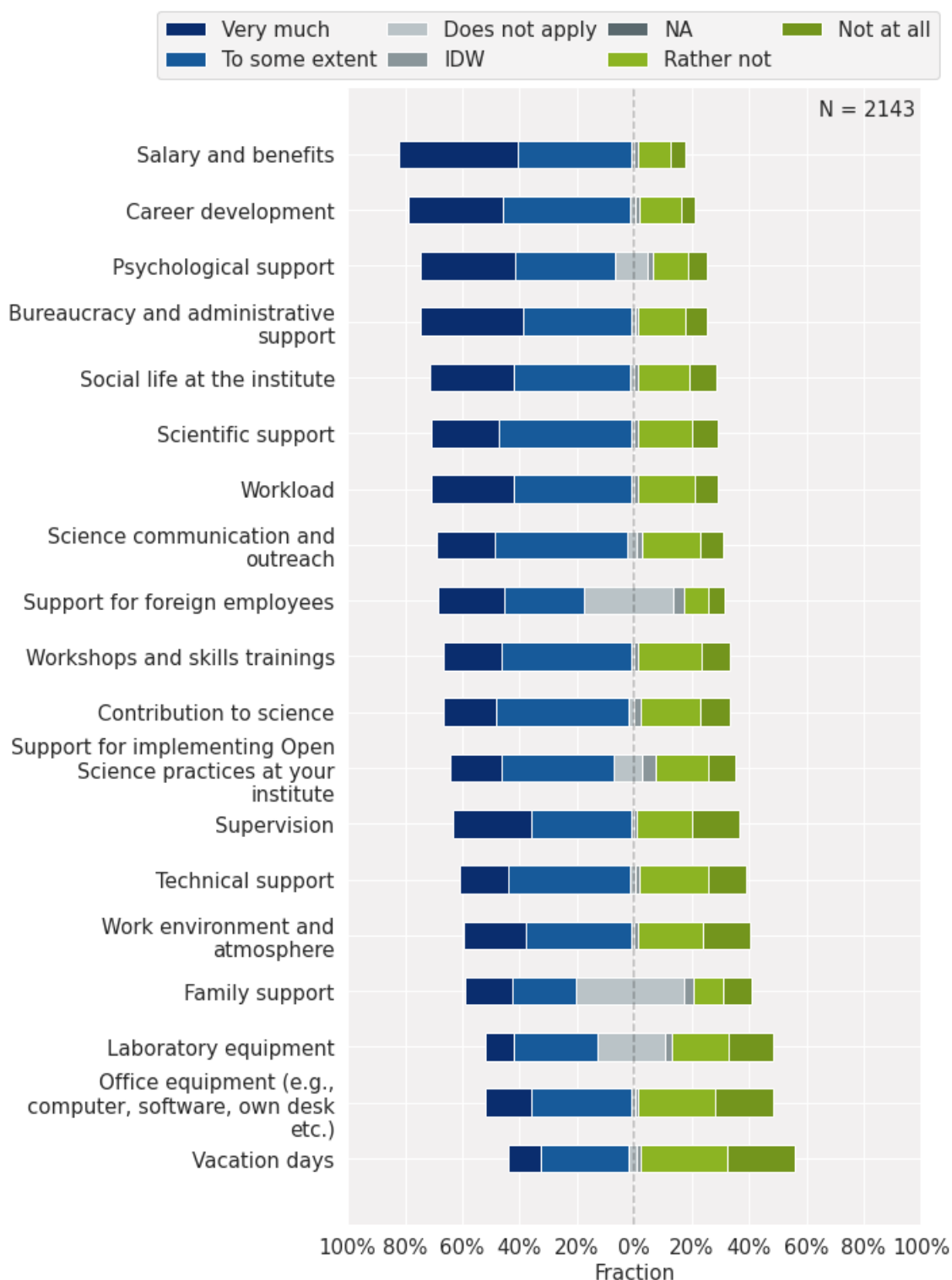
We received 152 comments for this section. The most prevalent opinion that affects DRs' satisfaction was the bureaucratic administrative system and subsequent work in addition to their doctoral project.

Many DRs also criticized the difference in salary, among students, and in comparison to industry and found them discouraging. Particularly, when it comes to the salary gap between DRs, it is argued that receiving different salaries despite the same amount of work makes no sense. The gap between regular contracts (such as TVöD or TVL) and stipends was also highlighted.

When it comes to the work-life balance, it was constantly said that taking holidays is not as easy as it is expected. Self pressure to achieve and



**Figure 4.3:** Reasons for quitting the doctoral project. Please note that the answers to this question were asked in a multiple-choice format. In addition, the percentages were calculated only for those DRs that at least rarely consider quitting their project.



**Figure 4.4:** Aspects which DR would wish to improve within Helmholtz Association. Each bar represents 100 % of DRs and is filled according to their answer levels. Additionally, the bars are moved corresponding to their answer direction, with neutral or not given answer possibilities (e.g. *IDK* (*I don't know*), *IDW* (*I don't want to answer*) and *NA* (*No answer*) centered in the middle. According to the left- or right-alignment of the bars, you can compare the answer tendencies of DRs.

perform, comparing oneself to peers, or pressure by one's supervisor, counted as critical reasons why DRs cannot take a proper holiday.

Of course, the pandemic situation has been shown to affect DRs' satisfaction. Particularly, the home-office environment was said to be one of the reasons to work overtime. The lack of social life and difficulties for DRs who are parents were also highlighted.

Lastly, some DRs suggest possible ways of increasing doctoral researchers' satisfaction. DRs are in need of support in regards to:

- office equipment,
- mental health,
- language training (non-German speaking DRs),
- family life,
- administrative work,
- other working conditions (e.g. regular check-ups with doctors, vaccinations, more office space).

## 4.5 Key messages

- 36 % of DRs have occasionally considered quitting due to reasons such as not feeling qualified enough, workload, lack of results, career prospects, and work-related conflicts.
- Gender plays a large role in feelings of quitting the program, as more women DRs were likely to be affected by feelings of imposter syndrome than men.
- The percentage of DRs considering to quit rises as the project duration increases.
- Specific aspects of work that DRs would like to see improved include salary and benefits, career development, psychological and mental health support, administrative support, and social life at their centers.

## 5 Mental health

Doctoral researchers (DRs) face numerous different challenges during their academic education, such as working autonomously in a highly innovative field, dealing with scientifically challenging questions, working under high pressure, competition, and high workload (Figures 3.10, 3.11).

Mental health was defined by the World Health Organization (WHO) as “a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community. [...] Mental health is a basic human right” [46].

Over the past years, awareness of the poor mental health among DRs has increased [11, 14, 15, 28, 36]. Compared to highly educated individuals in the general population, DRs often develop significantly more symptoms of mental illness [11]. This section aims to give an overview of the personal and psychological well-being of the DRs within the Helmholtz Association.

### 5.1 PHQ-8 and the STAI questionnaires

As a measure for depressive disorders the *Eight-Item Patient Health Questionnaire* depression scale (PHQ-8) was applied [24]. The WHO characterizes depression as “persistent sadness and a lack of interest or pleasure in previously rewarding or enjoyable activities. It can also disturb sleep and appetite. [...] The effects of depression can be long-lasting or recurrent and can dramatically affect a person’s ability to function and live a rewarding life” [45]. It also states that during a depressive episode “Several other symptoms are also present, which may include poor concentration, feelings of excessive guilt or low self-worth, hopelessness about the future, thoughts about

dying or suicide”.

In addition, to measure both the *state anxiety* (SA) – that is *how one feels at the moment* – and the *trait anxiety* (TA) – that is *how one generally feels* – the *Spielberger State-Trait Anxiety Inventory* (STAI) questionnaires were used [31].

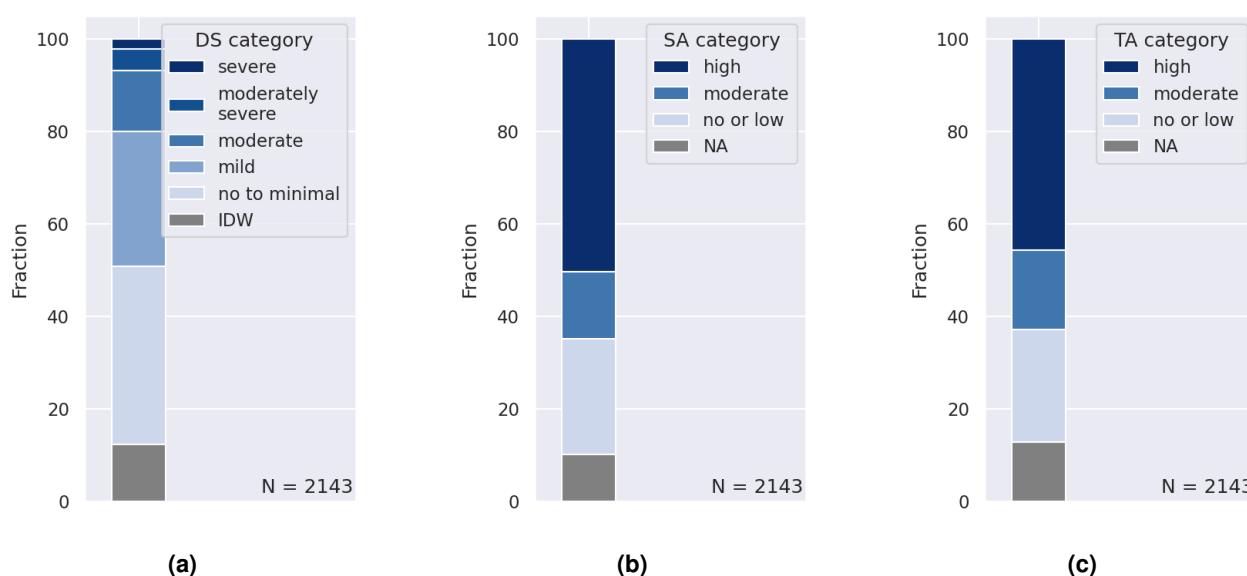
Specifically, state anxiety is a form of anxiety “experienced in a particular and temporary situation”, that is a “temporary experience of fear and arousal that is elicited from a real or potential threatening situation” [17].

In contrast, trait anxiety refers to the “tendency to attend, to experience, and report negative emotions such as fears, worries, and anxiety across many situations. [...] Trait anxiety also manifests by repeated concerns about and reporting of body symptoms. Trait anxiety is characterized by a stable perception of environmental stimuli (events, others’ statements) as threatening” [13].

Both, the PHQ-8 and the STAI questionnaires are reliable and sensitive measures well established in clinical studies. The results were calculated to a final standardized score assessing the presence of depressive syndrome (DS) or both anxiety states by applying a factor that was linked with all statements about the current emotional state.

For the PHQ-8, as measure of depressive disorders, DRs have been asked to answer how often they had been bothered with different problems, such as e.g. *trouble concentrating on things such as reading the newspaper or watching television, feeling down, depressed, or hopeless*, and more. The answer possibilities were given from *nearly every day* to *not at all*. To calculate the standardized assessment scores all answers had to be available from the PHQ-8 questionnaire. The ranges for the PHQ-8 are defined as follows: 0-4





**Figure 5.1:** Results of the a) PHQ-8 questionnaire and the STAI questionnaire on b) state, and c) trait anxiety.

points = no to minimal, 5-9 points = mild, 10-14 points = moderate, 15-19 points = moderate to severe, 19-24 points = severe depression. For the STAI questionnaires, only more than half of the item answers in this category needed to be given to adjust the mean accordingly.

For the SA measure, the DRs were asked how they feel right now, at this moment with respect to statements like *I feel calm, tense, worried, upset, etc.* Answer options were *not at all, somewhat, moderately, and very much*.

For TA, the DRs were asked to indicate how they generally feel with respect to statements such as *I am happy, I feel secure, I feel that difficulties are piling up so that I cannot overcome them, I have disturbing thoughts* and more. Possible answers were *not at all, somewhat, moderately, and very much*. The anxiety scores were obtained in a similar manner and categorized into 0-37 points = no or low anxiety, 38-44 points = moderate anxiety and 45-80 points = high anxiety.

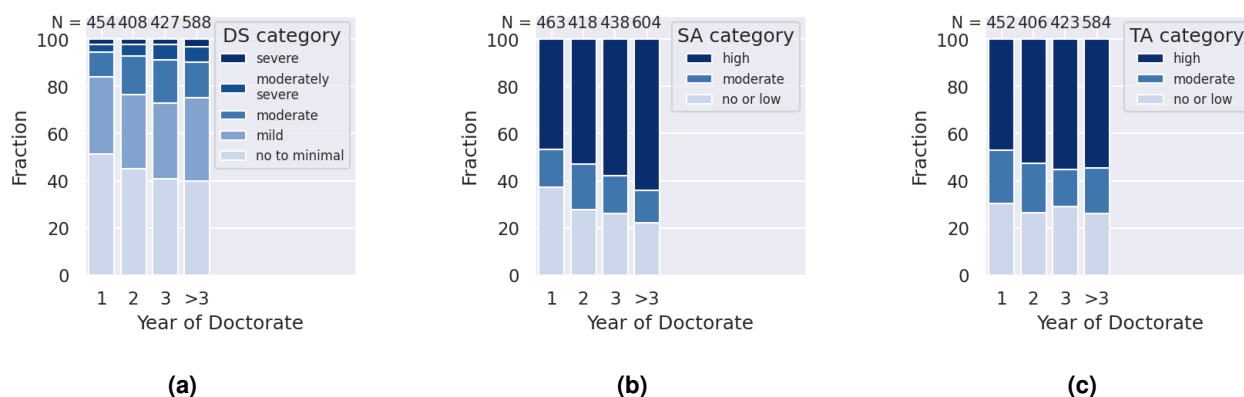
Figure 5.1a displays the results obtained from the PHQ-8 questionnaire. 87.7 % of the participants answered the questions. Based on the above-mentioned standardized assessment scores, 67.7 % of DRs scored either a *no to minimal* or *mild* DS, 13.2 % of DRs show signs of *moderate* DS, and 6.9 % show a *moderately se-*

*vere to severe* DS score. Discussed scores are averages for DRs who answered this question, independent of the year of doctorate.

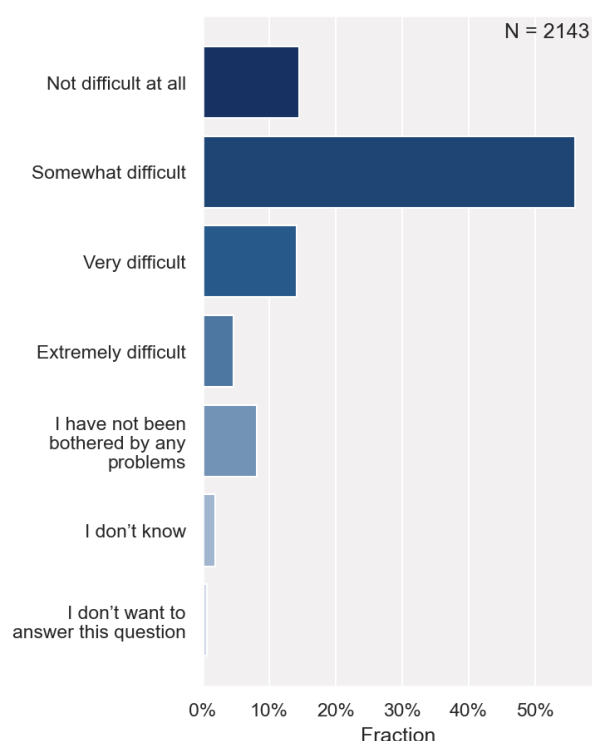
Compared to the results of the N<sup>2</sup>-Survey 2019 [19], the percentages of DRs showing moderate or more severe signs of DS increased from 17.8 % to 20.1 %. A detailed breakdown of DS score by year of doctoral project shows a clear increasing trend away from *no to minimal* DS to *mild* DS (Figure 5.2), indicating that the mental health of DRs suffers more in the course of their doctoral project.

Figures 5.1b and 5.1c show the results of the state and trait anxiety scores, respectively. SA and TA distribute similarly across our sample. Around 25 % DRs show *no or low* anxiety scores. 14.4 % and 17.6 % show *moderate* state and trait anxiety signs, respectively. Whereas 47.2 % and 50.4 % of the DRs show *high* state and trait anxiety signs, respectively.

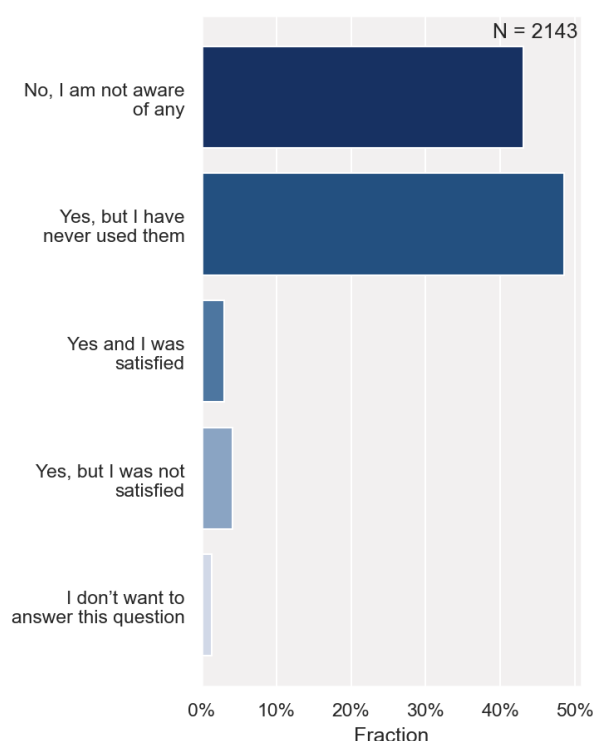
Again, the scores brought up here are the fractions from all DRs who participated in answering the question.



**Figure 5.2:** Results of the a) PHQ-8 questionnaire and the STAI questionnaire on b) state, and c) trait anxiety by year of the doctorate represented as fractions. In contrast to Figure 5.1, those who did not answer the questions are not included in the fraction. Numbers display responses of participants per year of doctorate.



**Figure 5.3:** Impact of mental health on DRs work life.



**Figure 5.4:** Awareness of the mental health resources and satisfaction with the provided services.

## 5.2 Mental health in the workplace environment

Subsequently, the DRs were asked how much their mental health condition has negatively affected their work life. The results are shown in Figure 5.3. 80.3 % of the participants who answered this question indicate that their mental health hinders their work at least to some extent.

62.6 % of the DRs stated that their work life was *somewhat affected* and approximately than 20 % stated it was *very* or *extremely difficult* to work due to their mental health condition.

Furthermore, the participants were asked whether they are aware of their centers' mental health resources (Figure 5.4). Unfortunately, 43 % of the participants are not informed about mental health resources within their institute.

This does not necessarily mean that there are no support offers available. In fact, there could very well be, as many centers have put in tremendous efforts to establish sufficient psychological support structures over the last years. However, these might still be unknown to the DRs. We therefore suggest and encourage a broad advertisement of the offered resources, which should also be available in English for the non-German speaking community.

### 5.3 Satisfaction and mental health

Moreover, we looked into the importance of different aspects of satisfaction on depressive syndrome and state anxiety by performing a Spearman correlation analysis (Figure 5.5). The coefficients for each individual aspect are depicted by magnitude, hence the higher respective factor in the plot, the higher its correlation with the respective mental health domain. This in turn indicates a high importance of this factor on mental health of DRs in general and should be focused on as a potential area of improvement. With this analysis, following aspects were identified as the most impactful:

- *workload*,
- *psychological support*,
- *supervision and Scientific support*.

Considering the fact that at least 80.3 % of participants have reported that their mental health has impacted their work life, we feel that it is absolutely necessary to raise awareness of this issue and simultaneously urge the centers to provide the best mental health support possible.

### 5.4 Comparison with the N<sup>2</sup>-Survey 2019

Compared to the results on mental health from the N<sup>2</sup>-Survey 2019 [19], increases in the mean DS score (from 5.80 to 6.37) and in the mean

TA score (from 43.6 to 45.1) are observed, which are both statistically significant at the 1 % significance level. Certainly, the COVID-19 pandemic has played a detrimental role in personal and work life (compare section 11, [40]), increasing the incidence of mental disorders and exacerbating preexisting conditions. Nevertheless, we have already reported alarming percentages of depressive and anxiety signs within our DRs in our N<sup>2</sup>-Survey 2019, which cannot be attributed to the pandemic.

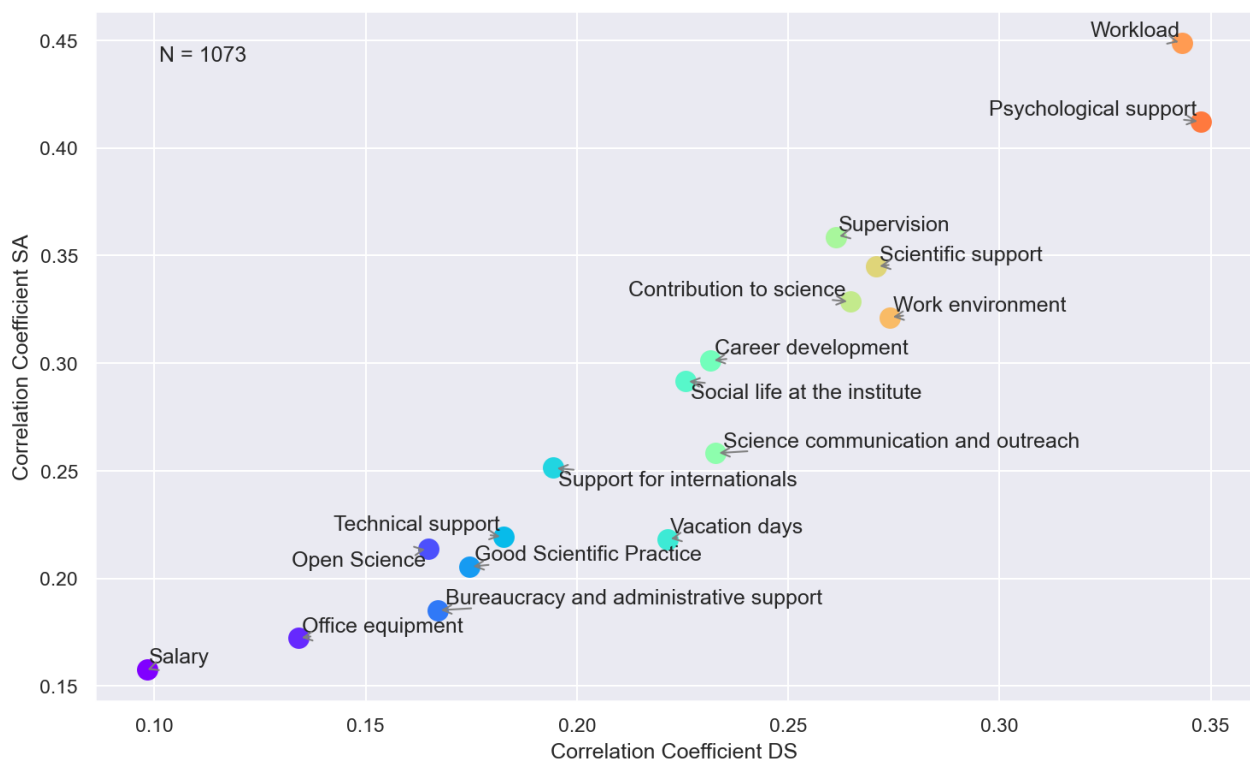
In summary, our results align with the increasing evidence of a “mental health crisis” among DRs [11], where the prevalence of depression and anxiety has been reported to be nearly 10 times higher than within the general population [5]. We want to raise awareness of this issue and the stigmas surrounding it, while simultaneously encouraging our centers to provide accessible professional support.

### 5.5 Summary open-text answers

In this section we have received 103 open-text answers. We would like to highlight that every single reported case here is one too many and should not have happened. The majority of the reported issues can be put into two categories: destabilization of DRs in regards to mental health, and privacy concerns and language barriers with mental health services.

Mental health issues, such as depression or anxiety, are serious problems; especially for DRs, as seen in this survey. Participants have reported very concerning situations such as blunt dismissal of mental health problems by supervisors, general rejection of the existence of mental health problems by their center’s organizational structures, toxic work environments where such problems were met with jokes and ridicule. In the light of such claims, we advocate for education on the topic of mental health.

The language barrier for accessing both the center physicians and the psychological support services, which are luckily available at all centers



**Figure 5.5:** Correlation between satisfaction components and their contribution to mental health (depressive syndrome and state anxiety). Spearman correlation coefficients were calculated for this plot, and are depicted by magnitude. Please note, that some of the satisfaction aspects were excluded from this analysis, and were focused on in other chapters (see 10, 8).

within Helmholtz Association in some form, was reported several times and for several centers. International DRs face additional challenges while pursuing their doctorate and their support should be of high priority for research centers who take pride in fostering international graduate programs.

Several DRs are also afraid that information about their mental state is passed on from the psychological services to supervisors or center's administration. This should not be the case and further process improvement as well as education about the scope and work of psychological services should be provided.

We want to thank all DRs who shared their personal experiences with us in this survey. In order to get your issues heard, we summarized the open answers on a general level and send a letter addressing the issues to Helmholtz Association headquarters and all centers. Centers with reports of privacy concerns and language barriers were specifically contacted about these as well. Please be assured that we did not share any verbatim answers – answers were summarized and divided into previously mentioned categories to ensure the privacy of DRs.

work and only 57 % of the participants are informed about mental health resources within their institute.

- Mental health scores indicate that DRs suffer more and more in the course of their doctoral project.
- DRs seem to be most affected in terms of their mental health by their workload, lack of psychological support, and quality of supervision.

## 5.6 Key messages

- 68 % of DRs scored either a *no to minimal* or *mild* depressive syndrome (DS), 13 % of DRs show signs of *moderate* DS, and 7 % show a *moderate severe* to *severe* DS score.
- Compared to the results of the N<sup>2</sup>-Survey 2019 [19], the percentages of DRs showing *moderate* or more *severe* signs of DS increased from 18 % to 20 %.
- Around 25 % DRs show *no* or *low* anxiety scores. 14 % and 18 % show *moderate* state and trait anxiety signs, respectively. Whereas 47 % and 50 % of the DRs show *high* state and trait anxiety signs, respectively.
- 80 % of the participants indicate that their mental health hinders to some extent their

## 6 Supervision

The relationship between supervisors and Doctoral Researchers (DRs) can be listed as one of the most essential parts of a successful doctorate [18]. Good supervision throughout the doctoral project is proven to increase the thesis quality [3].

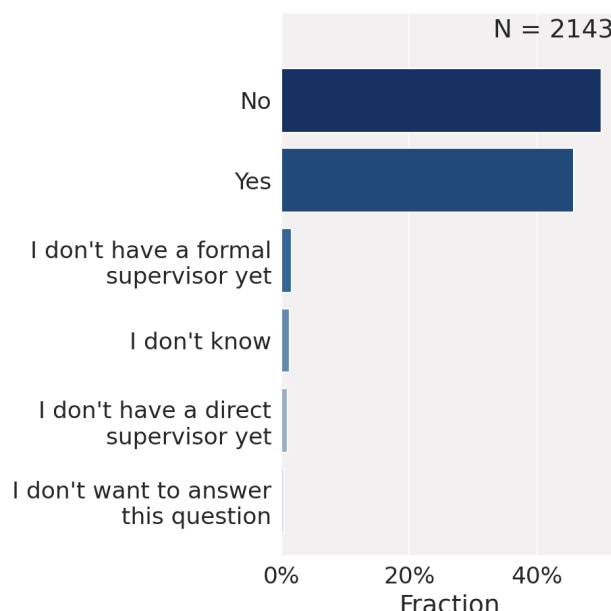
In this section, the DRs were asked about their supervision and related issues of their doctoral project. The questions addressed the supervision structure (meetings, supervision agreement, thesis advisory committee, guidelines, project outline), implementation of the supervision structure (frequency of meetings), and perception as well as measures of supervision quality (availability, support, and conflict management).

### 6.1 Supervision structure

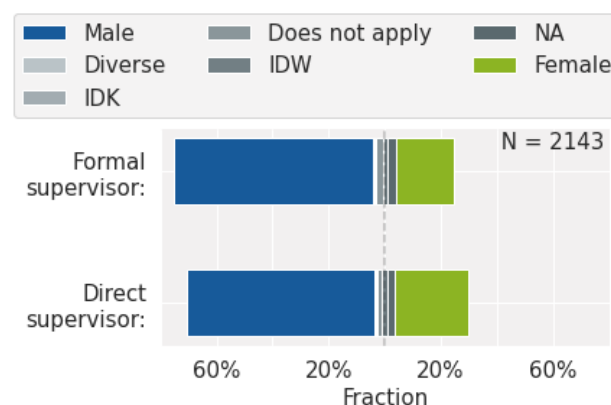
Supervision is usually undertaken by a formal supervisor, and a direct supervisor who more commonly assists in the day-to-day research issues. At the Helmholtz Association, 45.7 % of the DRs have the same person as their formal and direct supervisor, while 50.1 % of the DRs indicate to have two contact persons. A small percentage does not have a formal supervisor (1.6 %) or a direct supervisor (0.9 %) yet (Figure 6.1).

Interestingly, the female-to-male ratio (FMR)<sup>1</sup> among supervisors is considerably low at the Helmholtz Association: 0.29 for formal supervisors and 0.39 for direct supervisors (Figure 6.2). This clearly displays the presence of a gender gap in the Helmholtz Association and a diversity issue. The fact that FMR for supervisors is much lower than for DRs, especially for formal super-

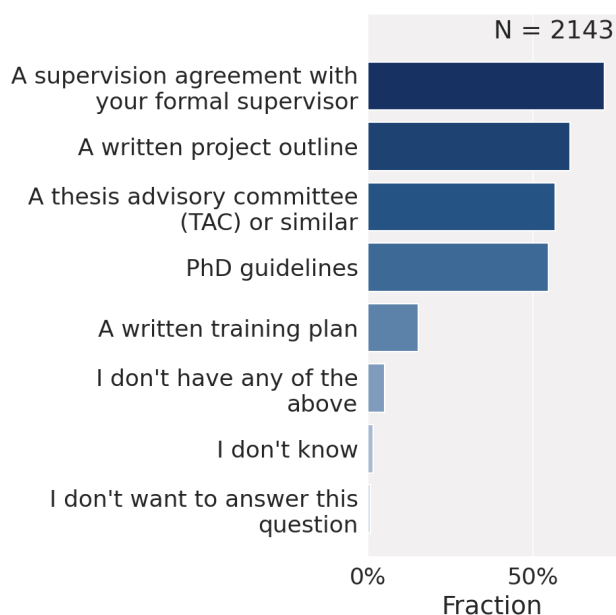
<sup>1</sup>The FMR is calculated as  $nf/nm$ , where  $nf$  ( $nm$ ) is the number of females (males). If the FMR is one it indicates equality, while values above and below unity indicate female and male prevalence, respectively.



**Figure 6.1:** Formal and direct supervisors for DRs as the same person.



**Figure 6.2:** Gender of supervisors within the Helmholtz Association as identified by their DRs. The bars are moved corresponding to the answer, with neutral or not given answer possibilities (e.g. *IDK* (*I don't know*), *IDW* (*I don't want to answer*) and *NA* (*No answer*) centered in the middle.

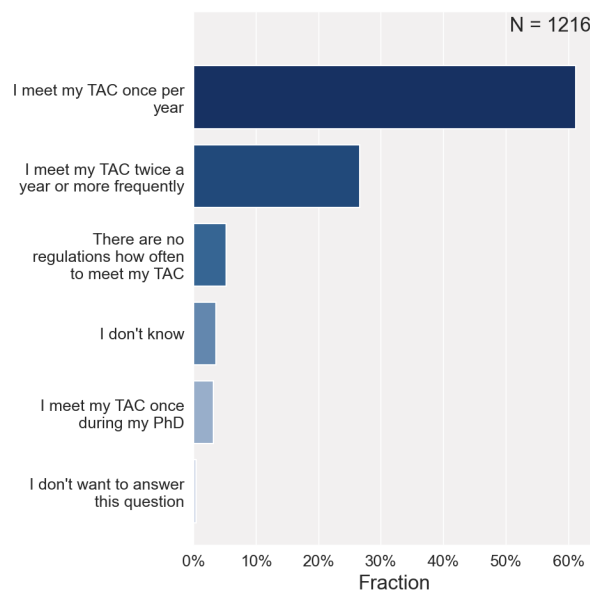


**Figure 6.3:** Supervision tools implemented in the Helmholtz Association.

visors who tend to be senior in comparison to direct supervisors, can be described as indicator a phenomenon called leaky pipeline [8].

To support both the DRs and the supervisors, various supervision structures might exist within the different institutions. Among these are:

- **Supervision agreement:** A written agreement between the formal/primary supervisor and the DR outlining their responsibilities from the beginning of the doctoral project until the completion of their doctoral thesis.
- **Project outline:** Preliminary project plan defining the objectives of the doctoral project, as well as the methodology to achieve them within a given period as a doctoral research project.
- **Training plan:** It contains the details about the courses that are mandatory for the completion of the doctoral project.
- **Thesis advisory committee (TAC):** Group of two or more independent researchers (including the formal supervisor). The DR meets with the TAC on a regular basis and gets advice on how to progress and successfully complete their doctoral project.



**Figure 6.4:** Thesis advisory committee (TAC) meeting frequency. Note that only participants who indicate to have a TAC were taken into consideration.

These are agreed on in the *Helmholtz Doctoral Guidelines* [33] or guidelines of the individual centers, but may not be mandatory at each of the centers in the Helmholtz Association. Also, similar regulations may be implemented by the universities in which the DRs are enrolled.

Nonetheless, in this survey majority of participants reported to have supervision agreement with their formal supervisor (71.8 %), written project outline (61.4 %), and PhD guidelines (54.7 %). These results are comparable with the trends observed in the N<sup>2</sup>-Survey 2019 where 68.8 %, 58.5 %, 54.3 % DRs have reported to have *supervision agreement*, *project outline* and *PhD guidelines*, respectively. Currently, only approximately half of the DRs have a TAC (56.7 %), which is a decline from the state observed in 2019 (65.6 %). On the other hand, we observed a slight uptick in the percentage of participants who report to have a written training plan (2019: 13.5 %; 2021: 15.3 %). Nevertheless, 5.0 % do not have any of the options listed (Figure 6.3).



## 6.2 Implementation of the supervision structure

Frequent meetings do not inherently lead to better research projects or a shorter duration of the doctoral project. However, they are an important part and helpful tool to keep track of the progress of the project.

### 6.2.1 Meeting frequency

Regarding the frequency of meetings, 61.2 % of the DRs meet their TAC once a year, while 26.6 % meet twice a year or more frequently. Of note, 3.1 % only meet their TAC once during their doctoral time, 5.2 % have no regulations on how often to meet their TAC, and 3.5 % do not know how to answer this question (Figure 6.4). Participants without a TAC are excluded from the analysis. It would be best to establish means to enforce target agreements and thesis meetings as often as suggested by the graduate program, but at least once per year as described in the Helmholtz Doctoral Guidelines.

Moving on to the frequency of meetings with both the formal supervisor and the direct supervisor, the percentages show clear differences in the oversight of each supervisor. More than half of the DRs indicate to communicate *almost daily* (19.5 %) or *weekly* (41.0 %) with their direct supervisor (Figure 6.5). In comparison, only 15.8 % of DRs communicate at least *every second week* with their formal supervisor (Figure 6.6). Notably, there are 4.8 % of DRs who answered to *never* communicate to their formal supervisor. While actual and desired frequency of meetings with direct supervisor are similar (Figure 6.5), it is apparent that a higher frequency of meetings with formal supervisors would be a welcomed change (Figure 6.6).

## 6.3 Supervision quality

The DRs were asked to rate different aspects of their professional relationship with both their

formal and direct supervisors. For the formal supervisor, most of the aspects were rated positively (Figure 6.7). Percentages below present participants who have chosen *fully agree* or *partially agree* with following statements:

- *My supervisor treats me politely* (83.9 %),
- *My supervisor treats me professionally* (81.1 %),
- *My supervisor adheres to good scientific practice* (71.8 %).

In contrast, the results show lower percentages for the statements:

- *My supervisor supports my professional development* (46.5 %),
- *My supervisor is well informed about the current state of the Ph.D. project* (43.8 %),
- *My supervisor has clear requirements for my work* (36.5 %),
- *My supervisor has strict requirements for my work* (27.7 %).

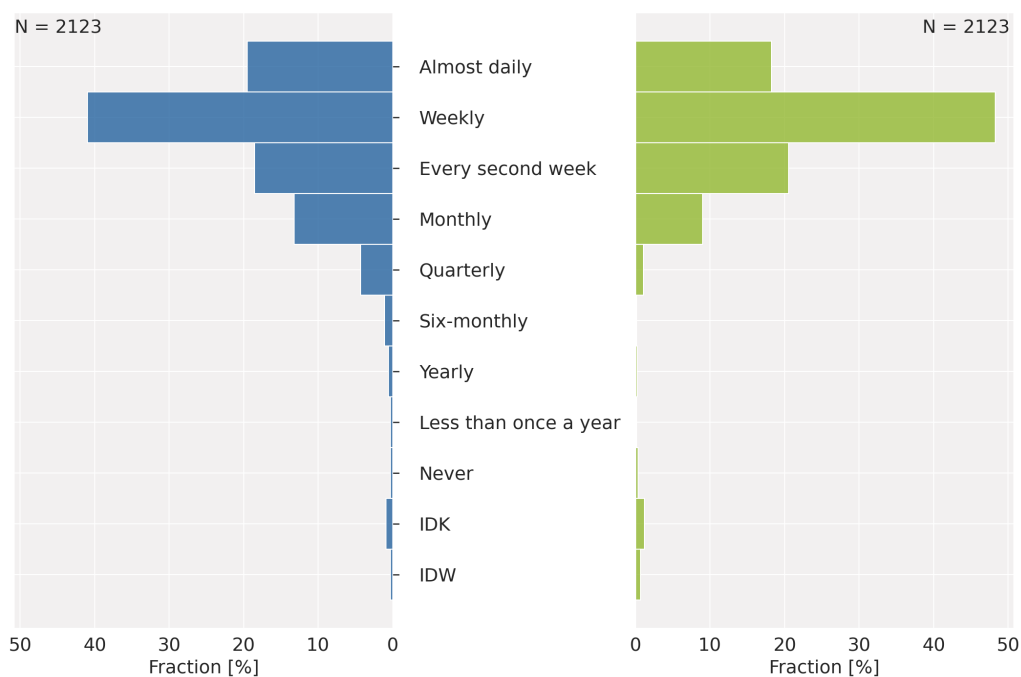
When it comes to direct supervision, the majority of the participants positively evaluated their direct supervisors (Figure 6.8). Worryingly, around a fifth of all DRs indicated that they *partially disagree* or *fully disagree* with the statements:

- *My supervisor has good leadership skills* (21.1 %),
- *My supervisor has clear requirements for my work* (24.9 %),
- *My supervisor has strict requirements for my work* (19.0 %).

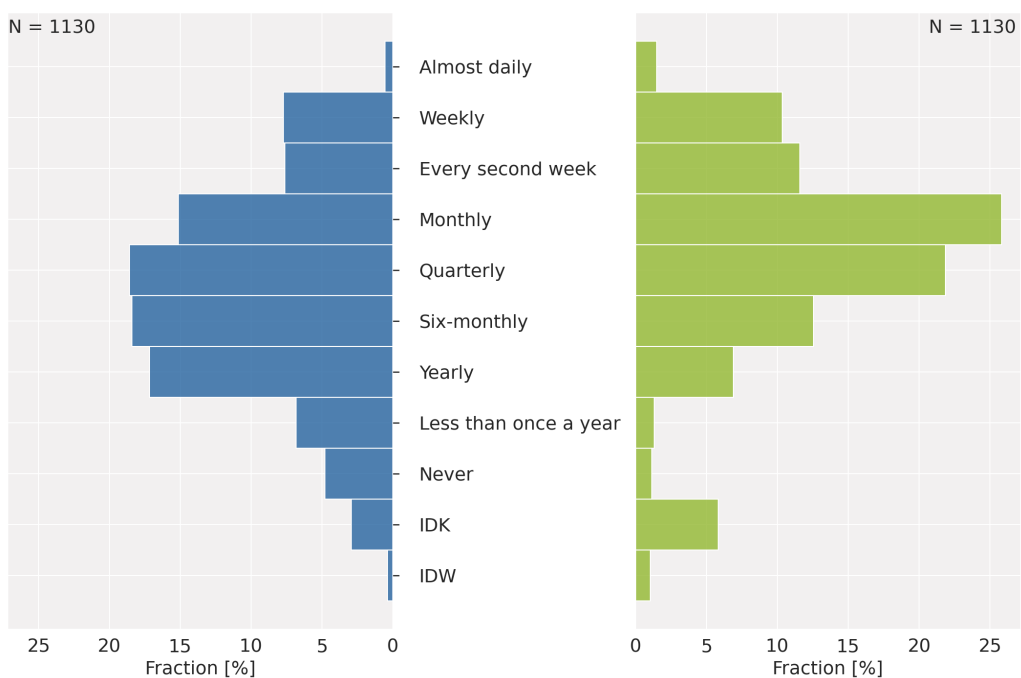
About one third of the DRs never encountered any problems with their direct supervisor (Figure 6.9). The fact that the remaining of the DRs generally experience challenges with supervision is alarming:

- *Not enough expert in your group* (28.7 %),

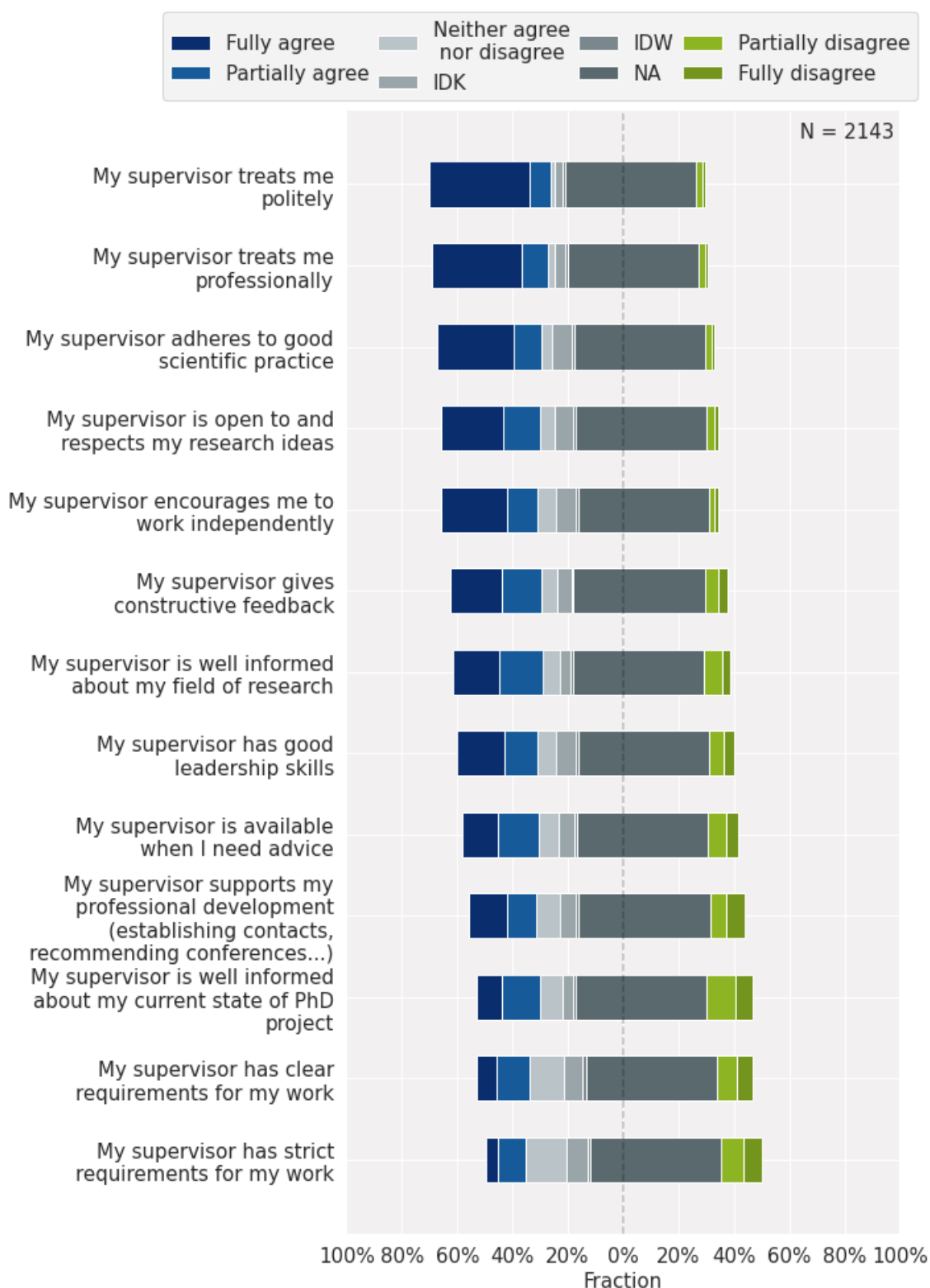




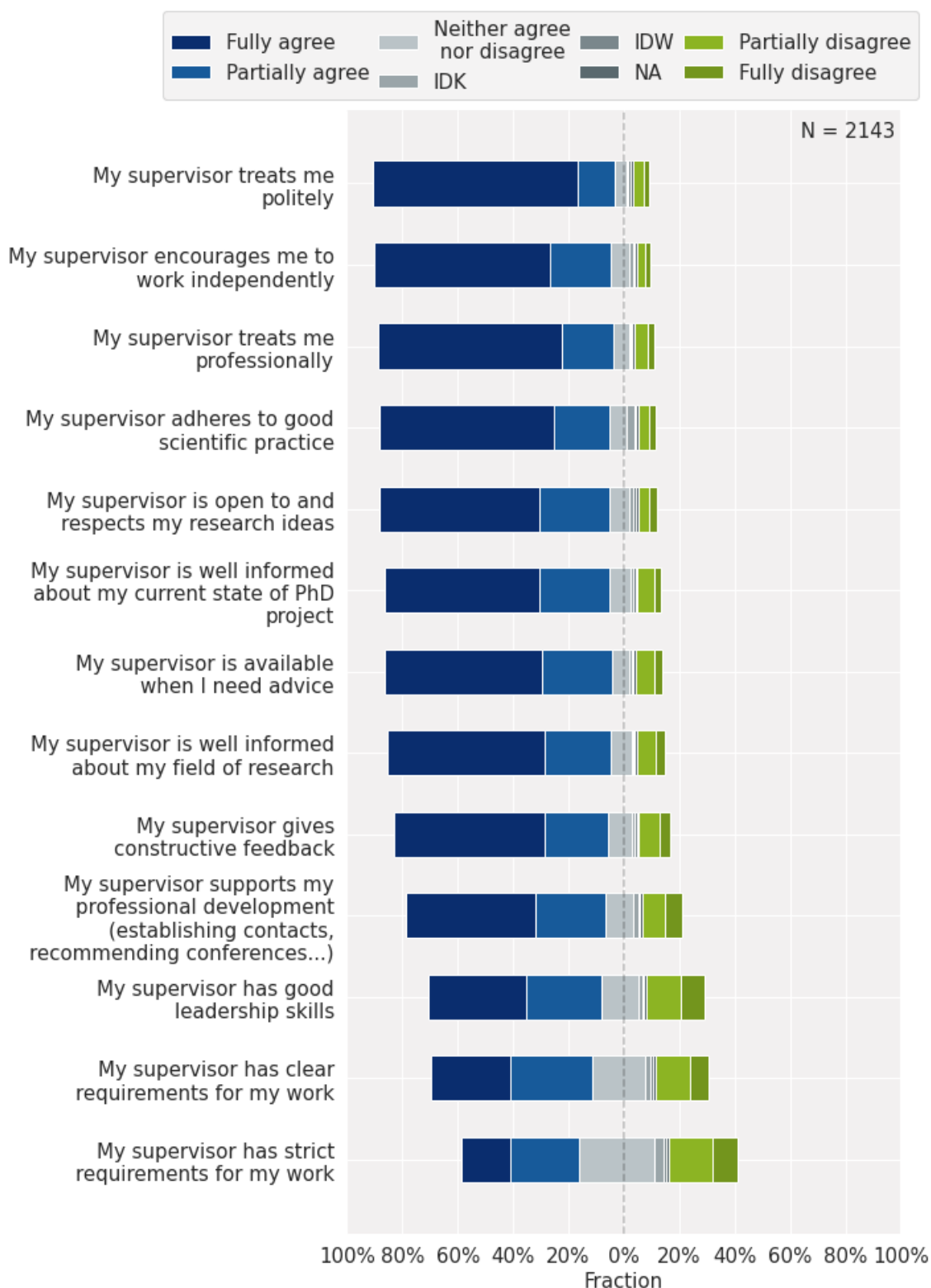
**Figure 6.5:** Actual (left) and desired (right) frequency of meetings with direct supervisor. Note that only participants who indicated to have a direct supervisor were taken into consideration.



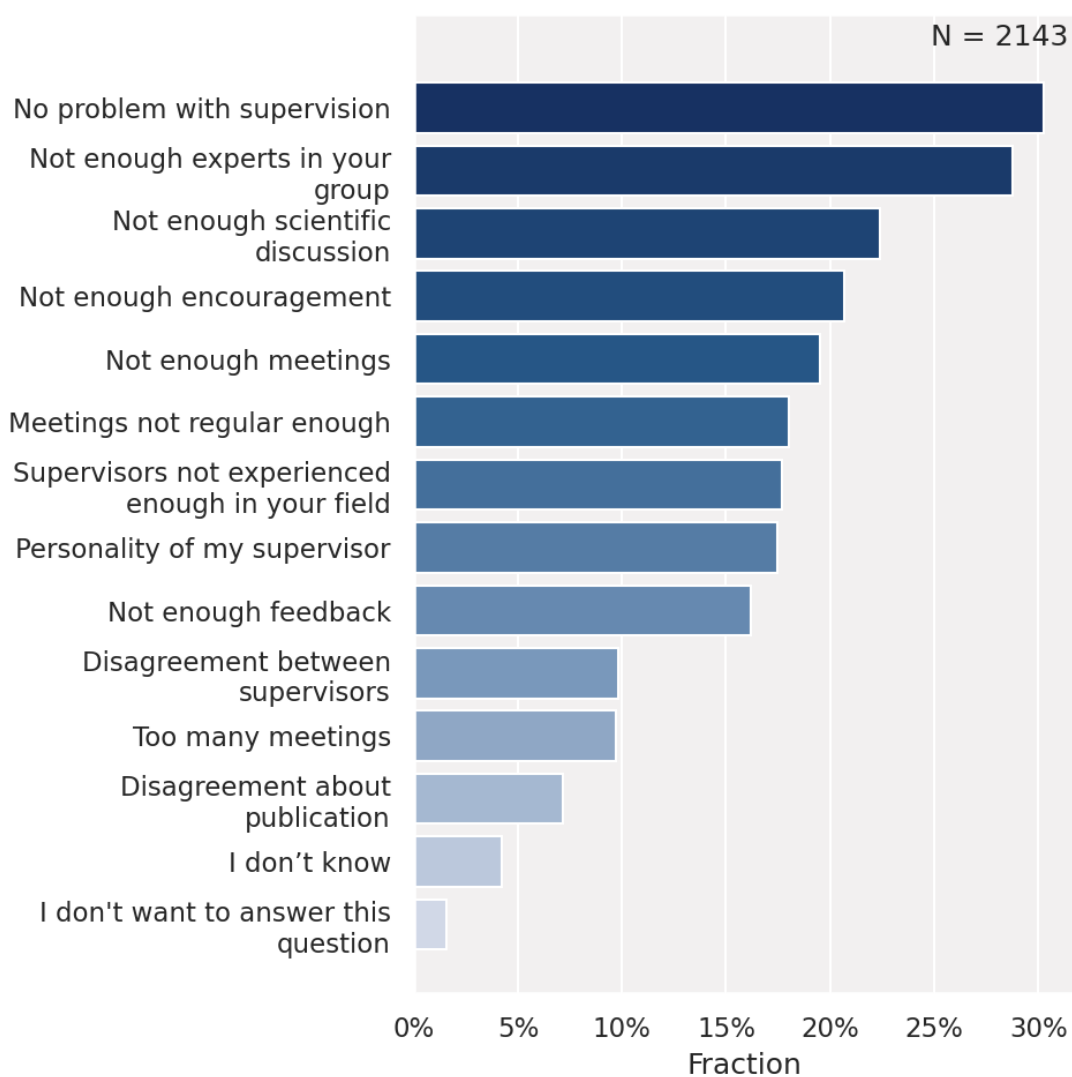
**Figure 6.6:** Actual (left) and desired (right) frequency of meetings with formal supervisor. Note that only participants who indicated to have a formal supervisor were taken into consideration.



**Figure 6.7:** Rating of supervision for formal/primary supervisor. Note that only participants who indicated to have a formal supervisor were taken into consideration. Additionally, the bars are moved corresponding to their answer direction, with neutral or not given answer possibilities (e.g. *IDK* (*I don't know*), *IDW* (*I don't want to answer*) and *NA* (*No answer*) centered in the middle. According to the left- or right-alignment of the bars, you can compare the answer tendencies of DRs.



**Figure 6.8:** Rating of supervision for direct supervisor. Additionally, the bars are moved corresponding to their answer direction, with neutral or not given answer possibilities (e.g. *IDK* (*I don't know*), *IDW* (*I don't want to answer*) and *NA* (*No answer*) centered in the middle. According to the left- or right-alignment of the bars, you can compare the answer tendencies of DRs.



**Figure 6.9:** Issues regarding supervision. Multiple answers were possible.

- *Not enough scientific discussions* (22.4 %),
- *Not enough encouragement* (20.7 %),
- *Not enough meetings or Meetings not regular enough* (19.5 %),
- *Supervisor not experienced enough in your field* (17.7 %).
- improving the project outline and having clear requirements for the doctoral project,
- improving the leadership skills of the direct supervisor.

Overall, direct supervisors were rated higher in comparison to formal supervisors. Creating (retrospective) feedback system which could allow (past) DRs to express their opinions about quality of supervision during their doctorate would help to identify the underlying problems with supervision in a more detailed manner at each center.

The Helmholtz Association already committed to establish mandatory supervisor trainings by 2030. Results collected in this section not only provide input on potential topics which should be addressed during such trainings, but also highlight their immediate necessity, perhaps even in mandatory capacity.

## 6.4 Summary open-text answers

We received 92 free open-text answers on this section. The answers can be broadly categorized into: (1) lack of leadership skills of Principle Investigators (PIs), (2) accessibility, reachability, and communication, (3) lack of implementation of existing measures, (4) bullying, and (5) sexual harassment. Also importantly, micromanagement and pressure to overwork were frequently reported.

## 6.5 Key messages

To continue improving the relationship and quality of the supervision, DRs would benefit from:

- Introduction of the Thesis Advisory Committee (TAC) and corresponding regular meetings for all DRs,
- increasing communication and regular meetings with the formal supervisor,

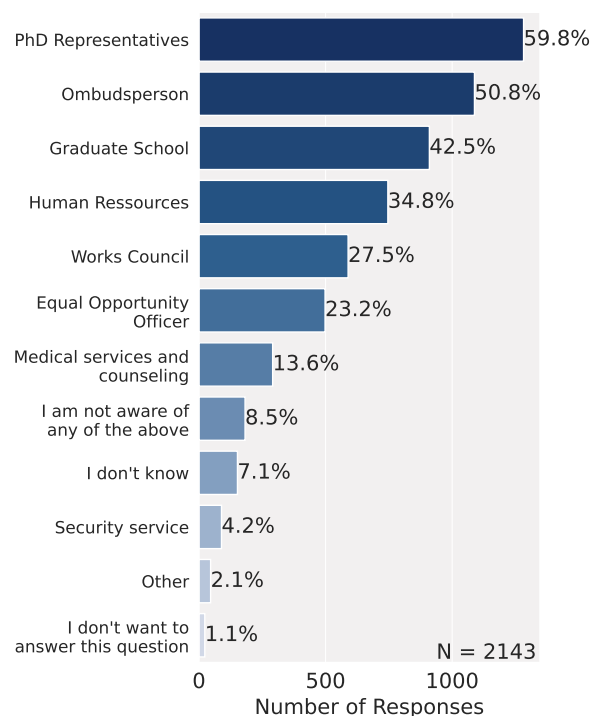
## 7 Power abuse

Various reports have shown that doctoral researchers (DRs) are often subject to power abuse due to the nature of their positions and as a consequence of the hierarchical structure of the doctoral research [35, 20]. Various forms of power abuse can be present, ranging from minor conflicts to bullying and sexual harassment. Power abuse can be in the form of minor verbal conflicts all the way up to more extreme cases of bullying and sexual harassment. Anyone, including supervisors, colleagues, and scientific/administrative staff can be a perpetrator of such unhealthy/unprofessional behavior at the workplace. Power abuse can have severe consequences for its victims, affecting their mental and physical health [9], and their career development. It is seen as long-term damage to the individual and to the scientific groups.

In this section, survey participants were asked sensitive questions, including whether they have experienced any form of power abuse, conflict, or discrimination at their workplace. Please note that these questions were posed only to participants who have agreed to answer sensitive questions. Furthermore, they were asked about the responsible authorities, the process of reporting such conflicts, and their satisfaction with the resolution at respective centers.

### 7.1 Conflicts and reporting

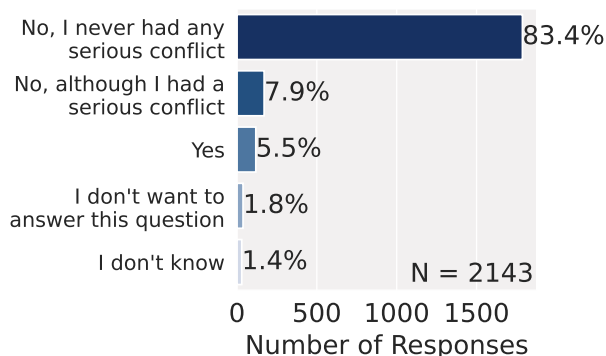
Centers in the Helmholtz Association are asked to have neutral and impartial persons of contact who can be approached by all employees in an event of any case of power abuse. For example, an Ombudsperson or Equal Opportunity Officer may be informed about a certain form of power abuse to take necessary actions. However, centers may choose to deviate from this, or DRs may not even



**Figure 7.1:** Potential points of contact in case of conflicts at work. This question was offered with multiple-choice options.

be aware of these point-of-contacts. Thus, we asked all the participants to indicate whether they are aware of such authorities at their center (Figure 7.1).

Doctoral representatives are the most well-known point of contact to the majority of DRs. Although most of the doctoral representatives do not have the necessary education to handle conflicts, they are eager to support and point to the appropriate contact persons. Overall, 1 % of participants are aware of all of the named points of contact (Figure 7.1), while 8.5 % are not aware of any of them. Although several points of contact are known to some participants, we observe that 15.6 % of the DRs are not aware of or do not know them. Raising awareness about support is essen-

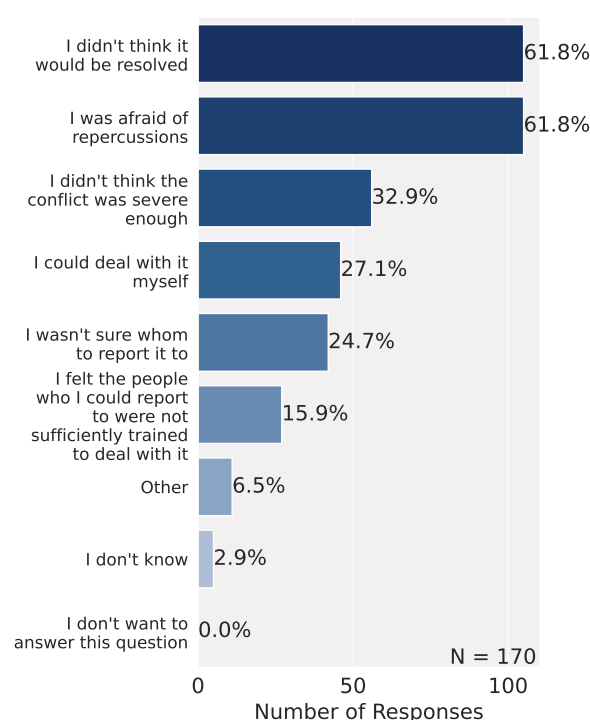


**Figure 7.2:** Reported and unreported conflicts within the Helmholtz Association.

tial and enables DRs to report and take active measures against any form of power abuse. To better understand if cases that led to conflict were officially reported, participants were asked if they reported any conflict in the past. This may also indicate how feasible it is to report such conflicts at their respective centers. For instance, if there is a higher number of unreported conflicts, DRs may feel uncomfortable or even be threatened not to report. However, since we did not ask if the person of conflict was directly approached, there might be some bias for those who did not report the conflict, as they sought a solution outside of the implemented measures. For the participating DRs, we observe that 13.5 % of them had serious conflicts, which they either reported or did not report (Figure 7.2).

From the DRs who experienced serious conflicts, 59.0 % did not report that conflict at all. This highlights the power imbalance DRs face and the potential lack of protection. The top reasons for not reporting a conflict are being afraid of the repercussions and not believing in a resolution of the issue (both with 61.8 % agreement) (Figure 7.3).

The primary opposing sides of the conflict were the *direct* (57.3 %) and *formal supervisors* (40.3 %). In this case, it is especially difficult for DRs to report a conflict as the completion of their doctorate often depends on a good relationship with both parties (Figure 7.4). Conflict resolution also seems to be dissatisfying for most DRs, as

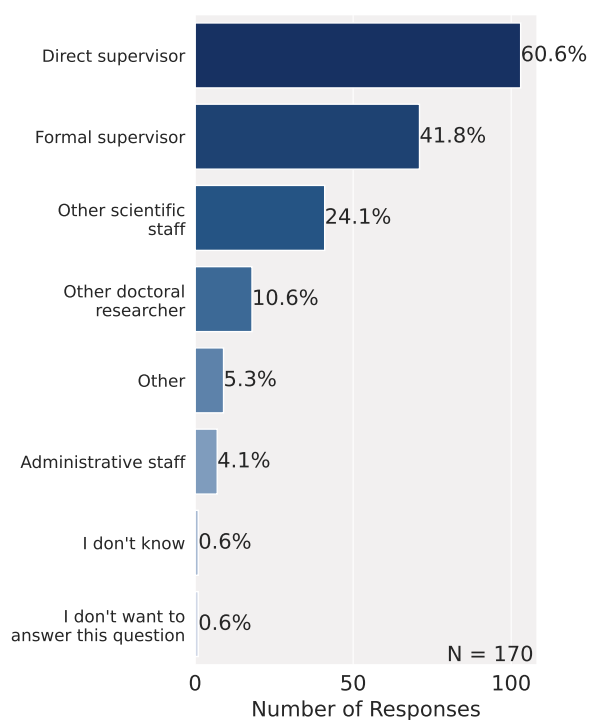


**Figure 7.3:** Reasons for not reporting conflicts. This question was only asked to DRs answering that they did have a conflict (reported and unreported) before and was offered with multiple-choice options.

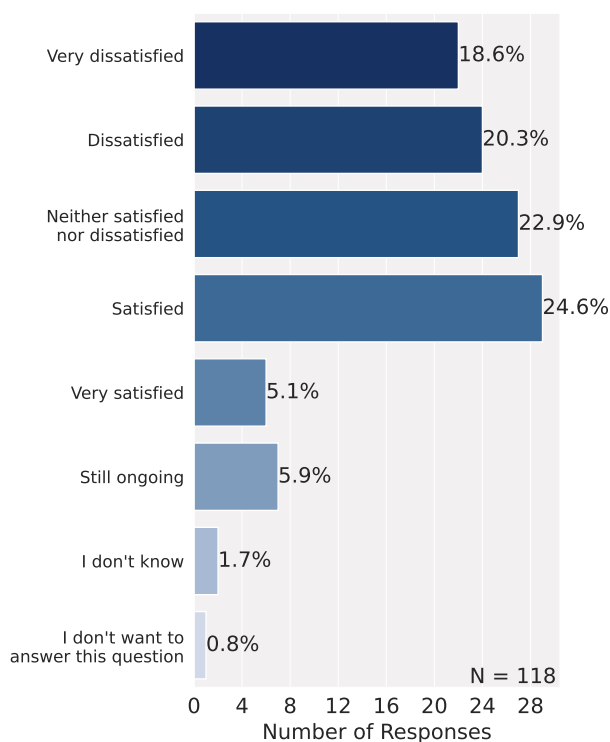
38.9 % of DRs who reported a conflict are rather dissatisfied with its resolution compared to 29.7 % who are rather satisfied (Figure 7.5).

## 7.2 Sexual harassment

We asked our participants if they have been subjected to any form of sexual harassment at their workplace in the past. We find that 142 (6.6 %) of the participating DRs have experienced unwanted behavior that they would call sexual harassment. Although the prevalence may not be significantly high, still, the 6.6 % who did are a non-negligible portion and every single case is one too many. Such serious issues should be brought to everyone's attention and preventive measures must be taken [21]. To raise awareness for different forms of sexual harassment and offer victims the chance to further specify it, multiple-choice options were offered. The most common form of sexual harassment is *unwanted verbal remarks of sexual*



**Figure 7.4:** Opposing side in both reported and unreported conflicts. This question was only asked to DRs answering that they did have a conflict (reported and unreported) before and was offered with multiple-choice options.



**Figure 7.5:** Satisfaction with the resolution of reported conflicts. This plot was filtered for those DRs who had reported their conflict to their center's authorities.

*nature or obscene gestures* (65.5 %), followed by *intrusive/unwanted looks and non-physical forms of harassment* (31.7 %) and *unwanted touching and physical contact* (23.2 %) (Figure 7.6).

The DRs who reported experiencing sexual harassment most frequently indicated that it occurred *occasionally* (43.7 %) or *only once* (35.2 %) (Figure 7.7). The most common perpetrators were *other scientific staff* (43.7 %) or *other DRs* (28.9 %) (Figure 7.8).

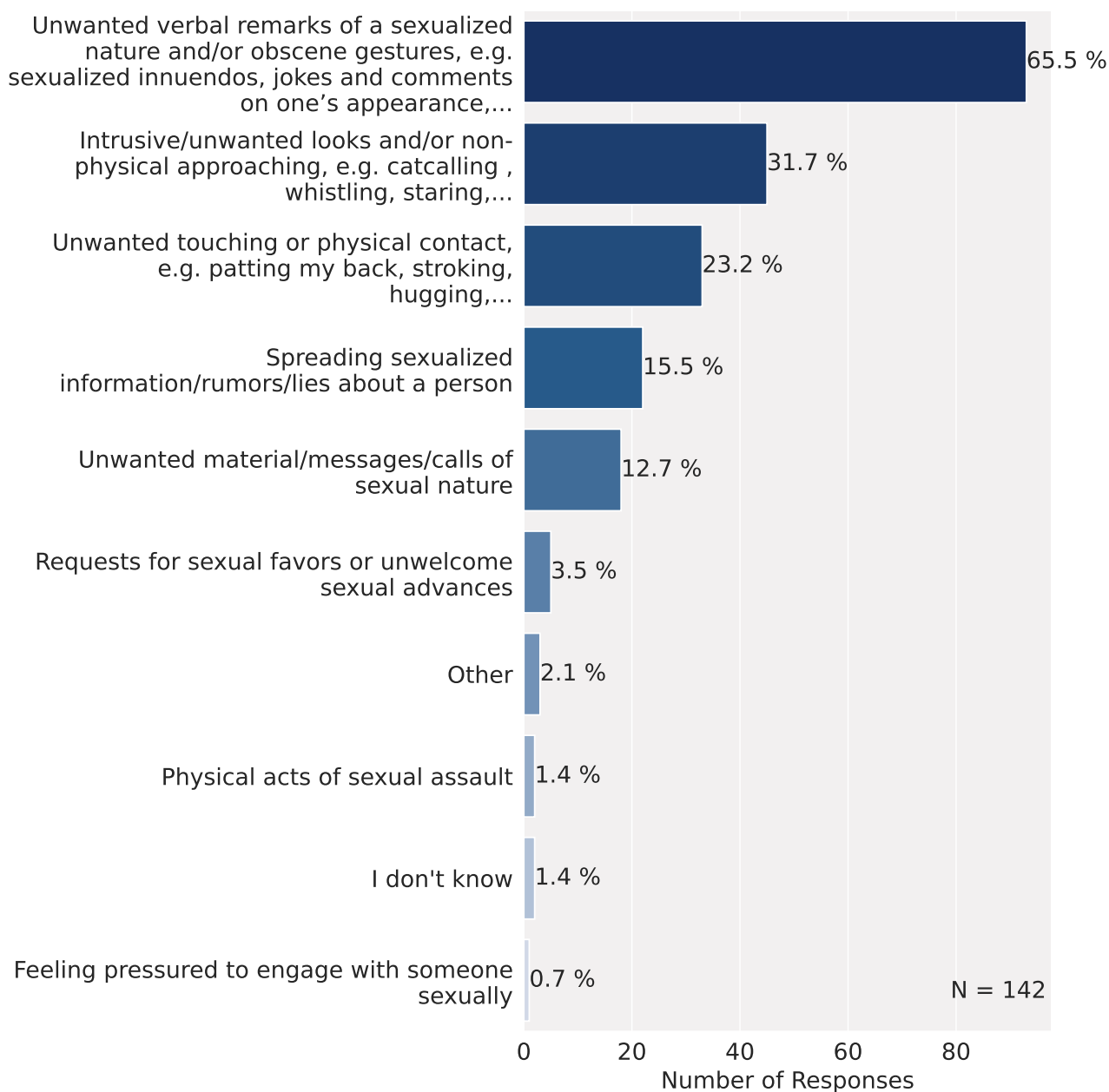
When analyzing sexual harassment by gender and citizenship, we see that especially female and diverse DRs are subject to sexual harassment. 13.7 % of all diverse DRs and 12.3 % of all female DRs report having been sexually harassed, whereas only 1.4 % of male DRs do (Figure 7.9, left). Citizenship does not seem to make a big difference, as 7.7 % of German, 7.2 % of EU- and 4.8 % of non-EU citizens report experiencing sexual harassment (Figure 7.9, right). However, there appears to be a difference in answering *I don't know* or *I don't want to answer this question* regarding citizenship. Non-EU citizens have a higher percentage in these answer categories (4.7 % vs. 1.6 % German and 1.0 % EU citizens).

Apart from experiencing sexual harassment, we further asked whether DRs have witnessed sexual harassment. Although, the numbers for *yes* and *no* align with the number of experienced sexual harassment (Figure 7.10), we see a big discrepancy in the answer categories of *I don't know* or *I don't want to answer this question*. Here, more people don't know whether they actually witnessed sexual harassment (8.1 %). This could be an indication of insufficient awareness of sexual harassment. DRs are not aware of which actions constitute sexual harassment and potentially abstain to answer due to inadequate knowledge.

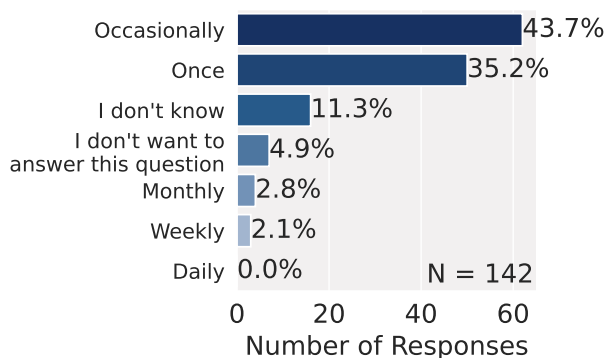
## 7.3 Bullying

Within our survey, 463 (21.6 %) DRs have reported they have been subject to bullying. Although this incidence may not be significantly higher than the 17.1 % reported in the general

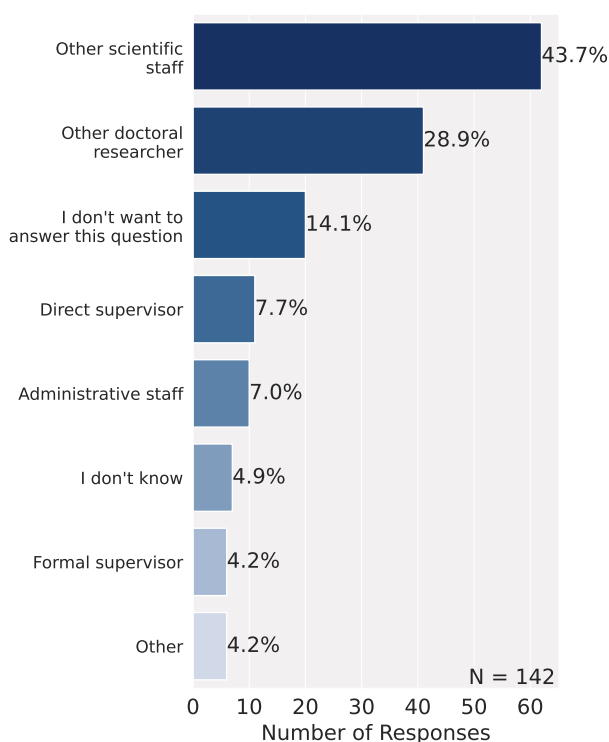




**Figure 7.6:** Reported forms of sexual harassment. To ease readability, DRs who said that they did not experience any form of sexual harassment have been excluded here.



**Figure 7.7:** Frequency of experienced sexual harassment. Filtered for DRs reporting any kind of experienced sexual harassment before.



**Figure 7.8:** Perpetrators of sexual harassment. This question was filtered for DRs who reported having experienced any form of sexual harassment and was offered with multiple-choice options.

German work force [26], it still constitutes a significant percentage within an international research organization, which should strive to provide a professional and safe environment to its employees. The most common forms of reported bullying are *destabilization* (i.e., *failure to give credit*) with 49 %, *pressured overwork* with 45.6 %, and *indirect bullying like spreading rumors* with 39.3 % (Figure 7.11).

The most commonly reported perpetrators were other scientific staff (35.9 %) followed by direct supervisors (34.3 %), and other DRs (30.7 %) (Figure 7.12). Furthermore, the majority of victims reported that by far the most common perceived reason for mistreatment was the perpetrators' position of power (Figure 7.13), highlighting the importance of this issue in the context of power abuse.

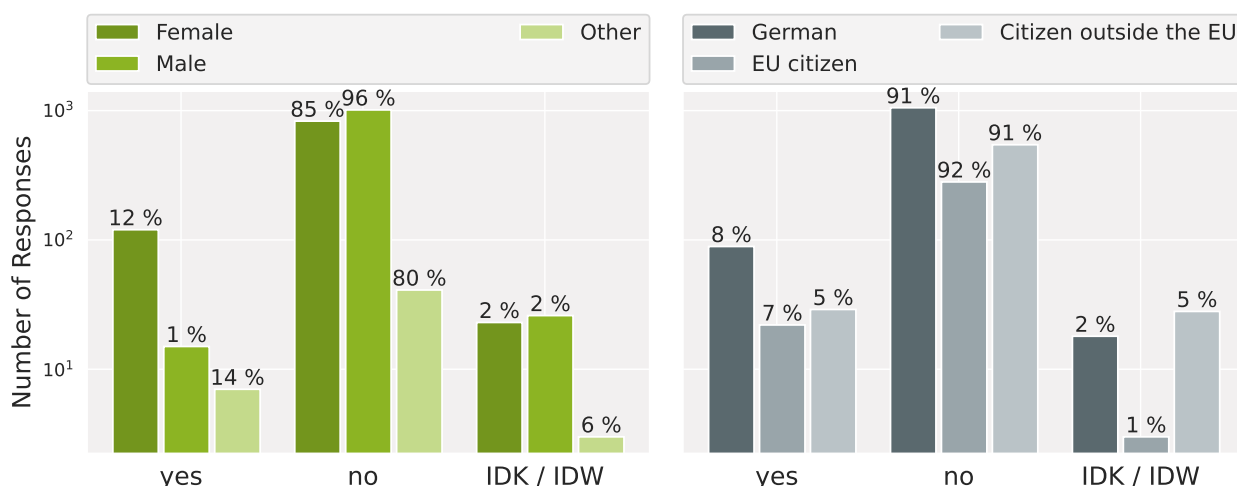
There is a gender difference in victims of bullying, with women and diverse DRs experiencing proportionally more bullying at 28 % and 36.5 %, respectively (Figure 7.14, left). On the other hand, citizenship seems to have less distinct association with bullying (Figure 7.14, right). A higher vulnerability for females to be bullied and a more complex relationship of citizenship was also reported in a survey in other academic research organizations [43].

Similar to sexual harassment, the portion of experienced and witnessed bullying is comparable (Figure 7.15). We did not ask, how many participants stood up to the perpetrators, which might be important for future surveys and should be included in mandatory trainings on the matter.

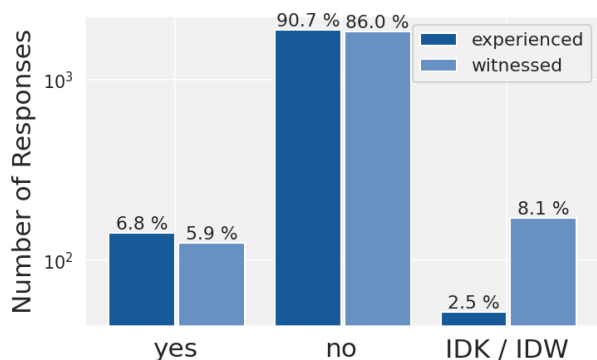
## 7.4 Discrimination

DRs with different backgrounds, age, and gender could also be subject to discrimination at their workplace [43]. Hence, we asked the participants to indicate if they have had such experiences in the past. It is imperative that even a single case of discrimination of any form is unacceptable and must be proactively prevented from occurring.

Most cases of discrimination have been re-



**Figure 7.9:** Experienced sexual harassment by gender (left) and citizenship (right). Note that the number of participants is presented on a log-scale to ease readability, and percentages are presented per group.



**Figure 7.10:** Experienced and witnessed sexual harassment.

ported for nationality, gender identity and ethnicity, followed by mental health and age (Figure 7.16).

To further investigate the latent structure present behind discrimination, the following paragraphs will cover cases of discrimination based on different demographic subgroups of the participants. Looking at the DRs feeling discriminated against based on their nationality, these are predominantly non-EU citizens (69.9 %), followed by citizens within the EU (23.2 %) and German citizens with 7.2 % (Figure 7.17).

Based on the total groups, this means that 15.3 % of all non-EU citizens, 10.2 % of all EU citizens, and 0.8 % of all the German DRs feel discriminated because of their nationality. This indicates that, especially within mostly German

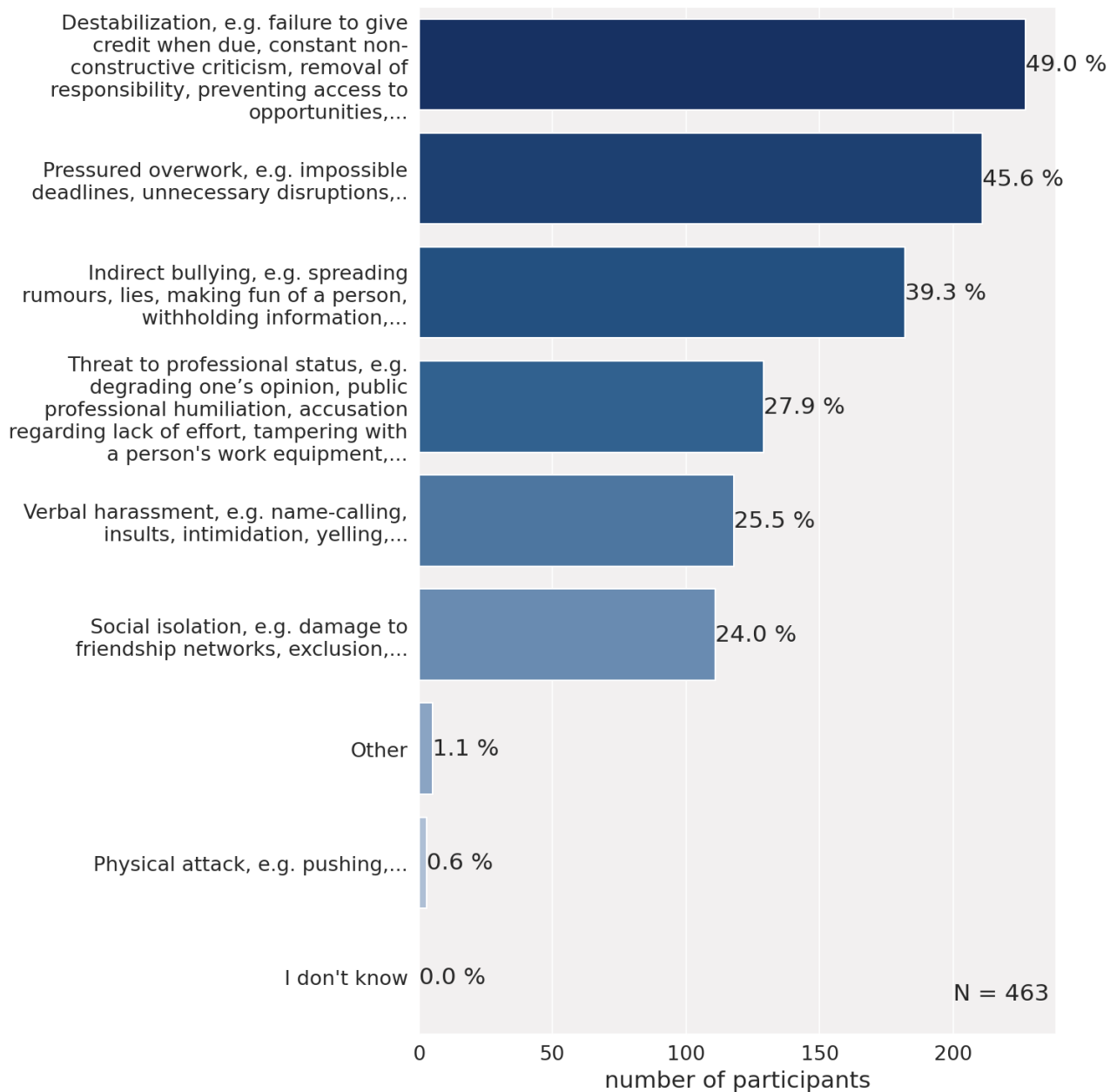
research institutes, internationals still face more difficulties when pursuing their doctorate and discrimination can be an added burden due to language and cultural barriers (see section 8).

A similar pattern can be observed for ethnicity, where the majority of reported cases fall on DRs with east or southeast Asian ethnicity (27.1 %) and south Asian (21.4 %) (Figure 7.18). In total, 10.4 % of DRs with a non-European ethnicity feel discriminated.

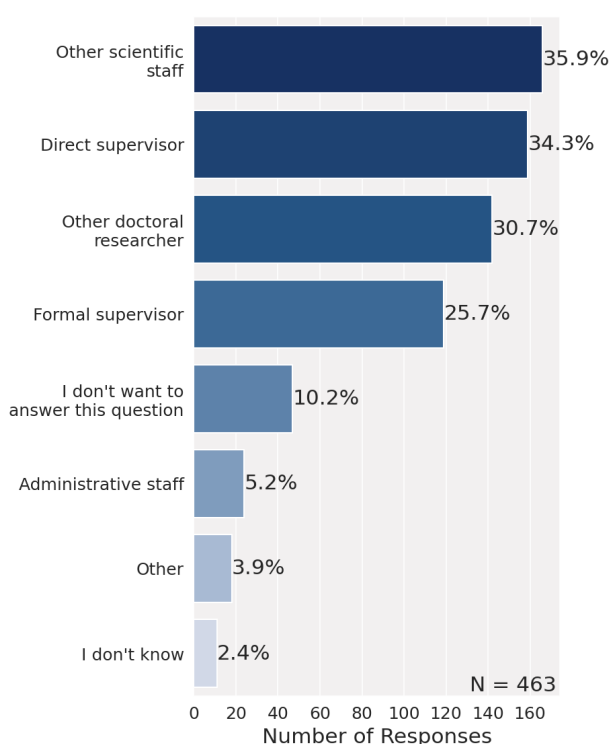
45 people felt discriminated based on their age, which is especially true for DRs over the age of 35. Due to low case numbers and anonymity, the plot is not shown here.

DRs who identify as homosexual constitute the largest portion of cases of discrimination based on sexual identity, with 47.4 % (Figure 7.19). The majority of discrimination cases (83.6 %) based on gender are reported by women (Figure 7.20), leading to a total of 11.2 % of female DRs feeling discriminated due to gender. While non-binary or other gender identities make up only a small portion of reported cases, these represent discrimination against 17.2 % of DRs self-identifying as neither male nor female. This is yet another topic which should be tackled within courses on gender-based violence and correct conduct [34].

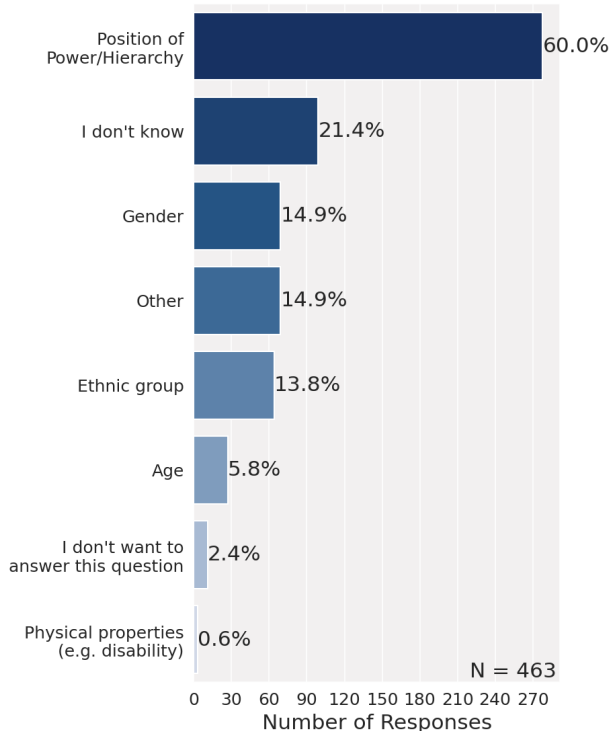
Furthermore, we asked participants about perceived discrimination based on parenthood and



**Figure 7.11:** Forms of bullying DRs. Of note, only DRs who have reported being subject to bullying are shown here for readability. The question was offered with multiple-choice options.



**Figure 7.12:** Perpetrators of experienced bullying. This question was filtered for DRs reporting experienced bullying and offered with multiple-choice options.



**Figure 7.13:** Perceived basis for experienced bullying. This question was filtered for DRs reporting experienced bullying and offered with multiple-choice options.

pregnancy. Out of 169 parents, 10.7 % of them feel discriminated because of it. Looking only at female parents to assess discrimination based on pregnancy and motherhood, this number rises to 27 % of all female parents. Together with tight monetary and timing restrictions, this perceived and sometimes probably also witnessed discrimination might add to the low number of parents within DRs.

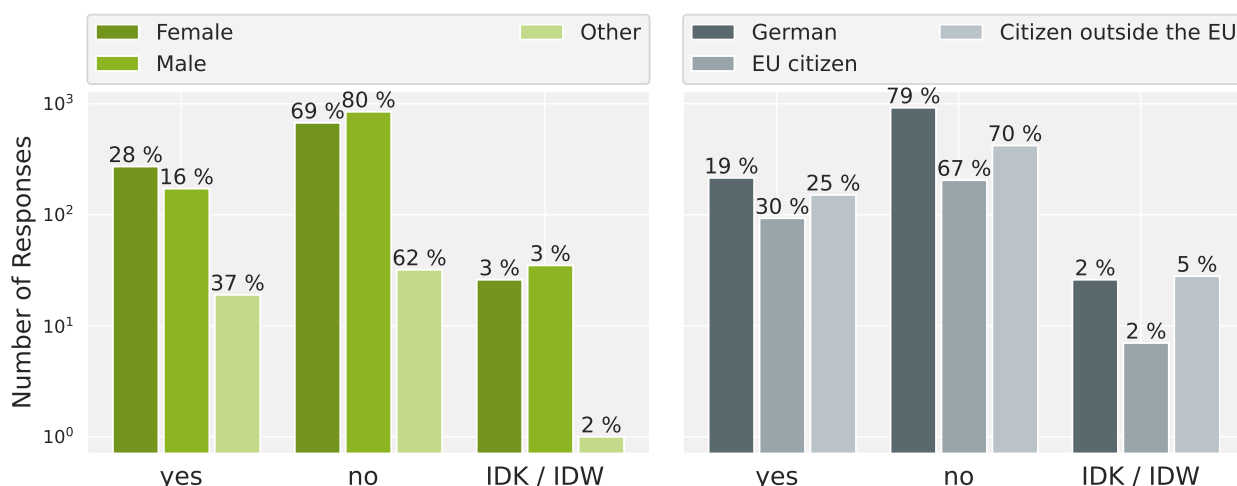
In the area of physical and mental health, out of 33 disabled participating DRs (officially recognized or not), 7 DRs feel discriminated because of this, which amounts to 21.2 % of that group.

In addition, 54 DRs feel discriminated because of their mental health. Most of these cases are in the spectrum of mild or moderate depressive syndrome (Figure 7.21).

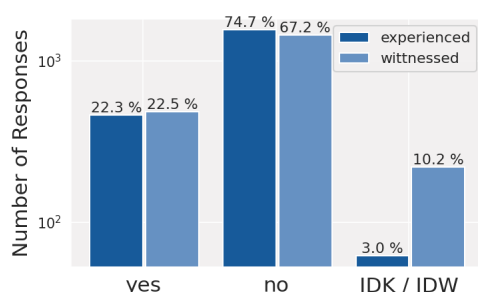
## 7.5 Summary open-text answers

From the 102 open-text answers we have received, it seems that DRs feel helpless when faced with harassment, power abuse, and bullying. Participants have also experienced among others sexism, racism, xenophobia, homo-, bi-, and transphobia. Such treatment can lead to mental health issues. The importance and severity of such discrimination seems to be systemically and institutionally downplayed, while sick leave based on psychological issues is deemed as academic suicide.

Multiple DRs have reported that Ombudspersons, Works Council, or HR have been ineffective in alleviating such circumstances. Either the hands of these entities are tied, due to lack of codes of conduct or established procedure, or they are not able to act completely independently. Some Ombudsperson are selected by senior scientists of the institute and thus may feel unable to be completely impartial. On the institutional level, it appears that the undue influence that supervisors have on DRs is often overlooked, especially when the supervisor has considerable recognition in their field. This is true even if that supervisor is recognized as being a problem within the institute.



**Figure 7.14:** Experienced bullying by gender (left) and citizenship (right). Note that the number of participants is presented on a log-scale to ease readability, and percentages are presented per group.



**Figure 7.15:** Experienced and witnessed bullying by participating DRs.

Increasing workload, toxic atmosphere, lack of appreciation for scientific contributions, and unprofessional behavior are mentioned as not conducive to maintaining a healthy work-life balance.

Moreover, DRs report that it was implied that issues of power abuse should be handled on their own. On top of that, many DRs mention that they were scared about the consequences of reporting such problems and that they were sometimes even blamed for such circumstances. It is clear that DRs are scared of the consequences of coming forward. As a result, they prefer an internal and informal solution to their situation, while their institutes offer only official and public ways of coming forward.

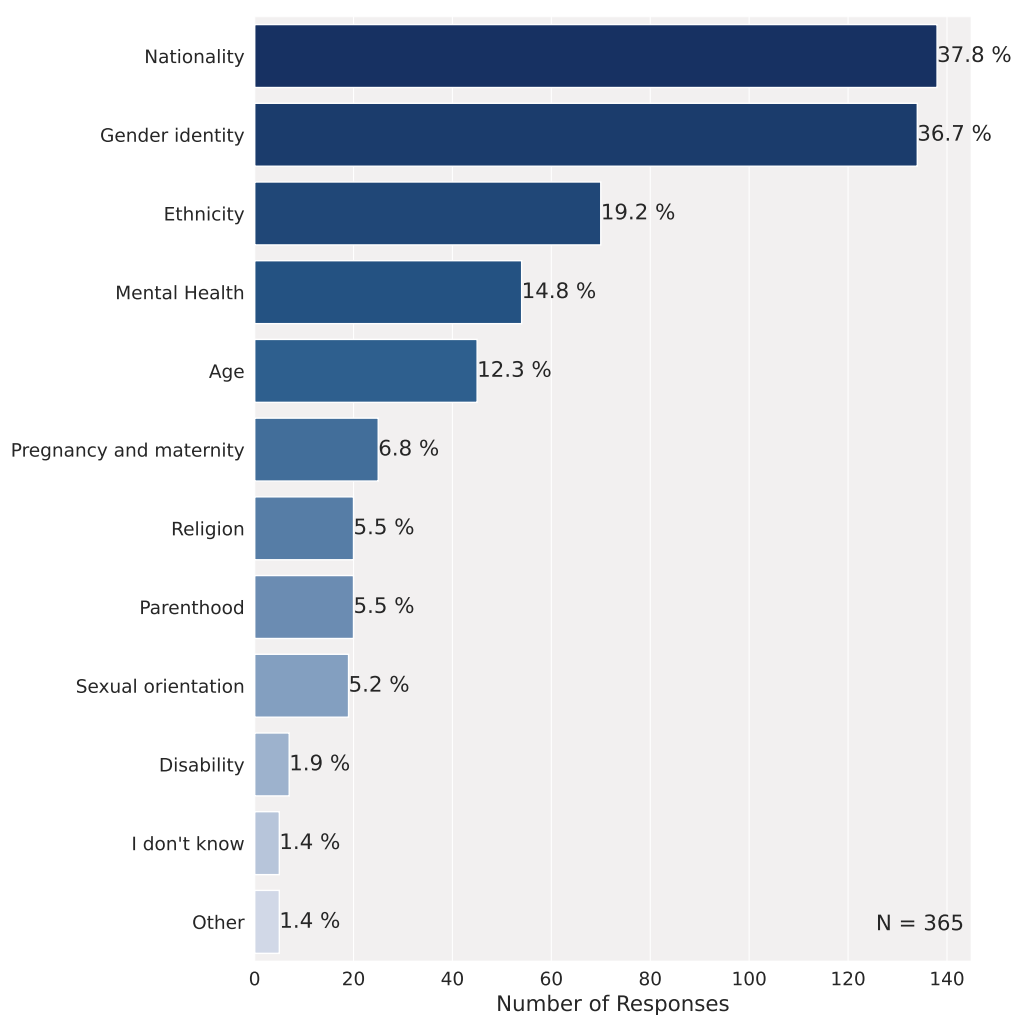
Importantly, international DRs have reported their isolation and feeling of exclusion due to how "exclusively" German their institutes are. Their

answers ranged from official meetings that should be available for all employees being held only in German, to institute taking cases reported by German DRs seriously but not for international ones. It becomes apparent that even DRs who really want to integrate into the life of their institute find it impossible due to the language barrier.

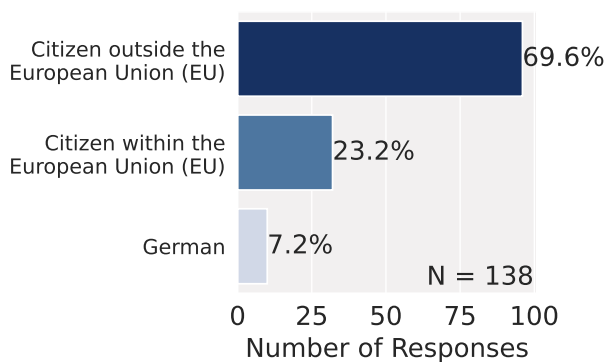
## 7.6 Recommended trainings

In the survey we had reports of unresolved conflicts, sexual harassment, bullying, and discrimination. While all these can happen in any workplace, we still intend to highlight the specific problems for DRs, who are dependent on their supervisors and their institute's support. This becomes even more extreme for international DRs, who might not be familiar with specific legal protections offered by German law and whom to contact when they need help.

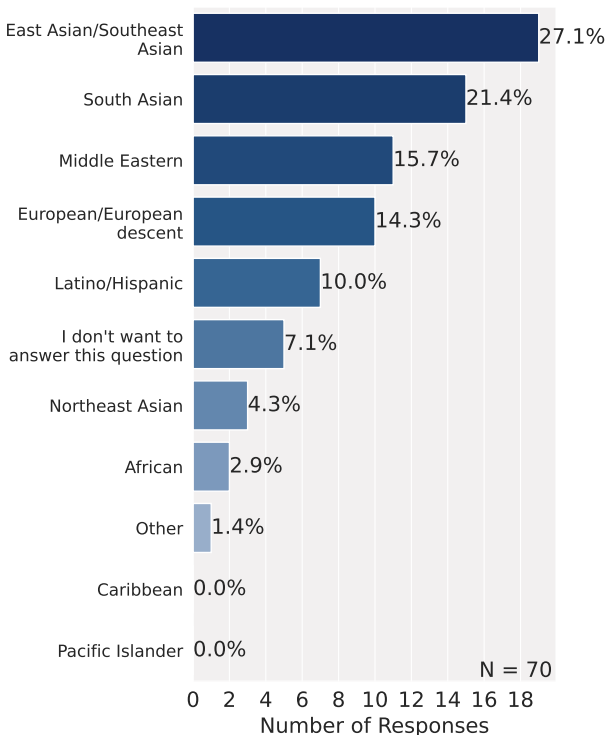
We recommend offering training on recognizing bullying and power abuse that would be mandatory for both DRs and supervisors, perhaps for all the employees, since even company doctors are mentioned as abusers. From many open-text answers, it is visible that in some cases it can be hard for DRs to identify what exactly is bullying or power abuse if it happens so frequently that it is basically part of their daily reality. Additionally,



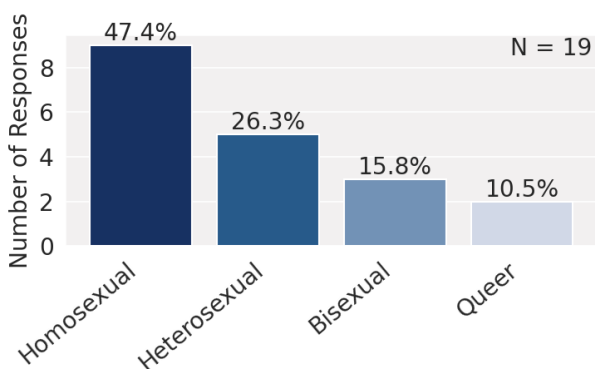
**Figure 7.16:** Discrimination and perceived basis for that toxic behavior. This question was asked in a multiple-choice format, as participants could feel discriminated based on multiple reasons.



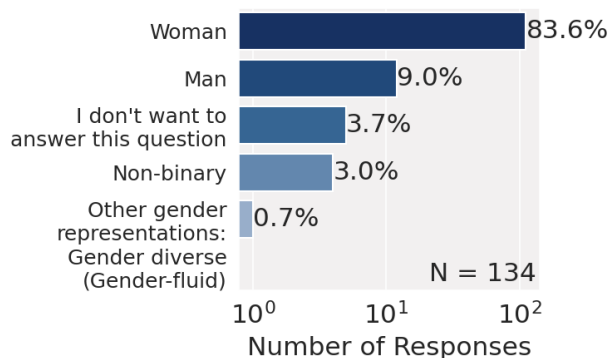
**Figure 7.17:** Cases of discrimination based on citizenship divided by demographic groups.



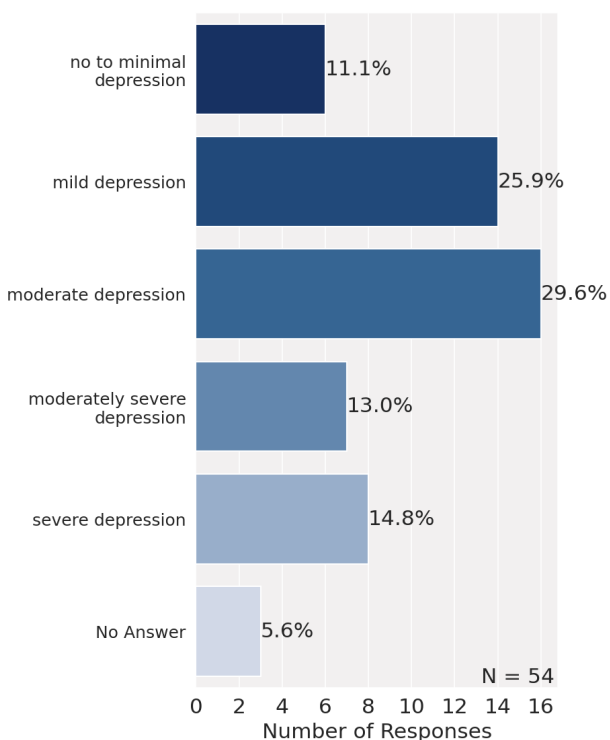
**Figure 7.18:** Cases of discrimination based on ethnicity divided by demographic groups.



**Figure 7.19:** Cases of discrimination based on sexual identity divided by demographic groups.



**Figure 7.20:** Cases of discrimination based on gender identity divided by demographic groups.



**Figure 7.21:** Cases of discrimination based on mental health divided by categories of depressive syndrome.



such trainings should include bystander intervention guidance which would raise awareness about everyone's capability to support prevention of violence and harassment at work.

## 7.7 Key messages

- 13 % of DRs experience conflicts during their doctorate; however, only 41 % of them report these to the authorities.
- The main reasons for not-reporting are the fear of repercussions and missing trust in an actual resolution. This highlights that the protection of victims needs to be guaranteed and better definitions for conflict resolution must be made available.
- 7 % of DRs experienced some kind of sexual harassment, and there appears to be an insufficient knowledge on which actions count as sexual harassment.
- 22 % of DRs experience bullying. The main reason for this mistreatment seems to be the position of power of the perpetrators.
- Most participants report discrimination based on nationality, gender identity and ethnicity.
- We propose a mandatory course on various forms of power abuse for all new DRs (and also for all the employees) to tackle these toxic behaviors.

## 8 Integration

Atmosphere at work plays a key role in integrating Doctoral Researchers (DRs) and empowering them to contribute to their new environment. Successful integration builds communities that are stronger scientifically and more inclusive socially and culturally. Nevertheless, the journey towards integration is often fraught with difficulties, such as language and cultural barriers. This holds especially true for international DRs who not only face the challenges of their doctoral research project but are also adapting to a new culture, going through unfamiliar administrative hurdles, and would like to feel accepted and welcome at their center.

### 8.1 Support at the beginning of doctorate

DRs were asked about the support that is provided at their centers regarding: university enrollment, application to a graduate school, finding accommodation, registering at the local resident registration office, visa for their residency, translation of working contracts, and relevant documents. While many DRs receive help from their centers, our results suggest that DRs, especially international ones, would benefit from more support in the following aspects:

- *university enrollment* (non-EU citizen: 31.2 %, EU citizen: 38.9 %, German: 22.2 %),
- *finding accommodation* (non-EU citizen: 37.5 %, EU citizen: 32.8 %, German: 5.6 %),
- *translation of working contracts and relevant documents* (EU citizen: 26.8 %, non-EU citizen: 23.8 %, German: does not apply).

Moreover, DRs from outside of the EU would need additional support with the acquisition of a visa for their residency, and processes at the immigration office. This shows that though support is given, it is not yet adequate for the needs of international DRs (Figure 8.1).

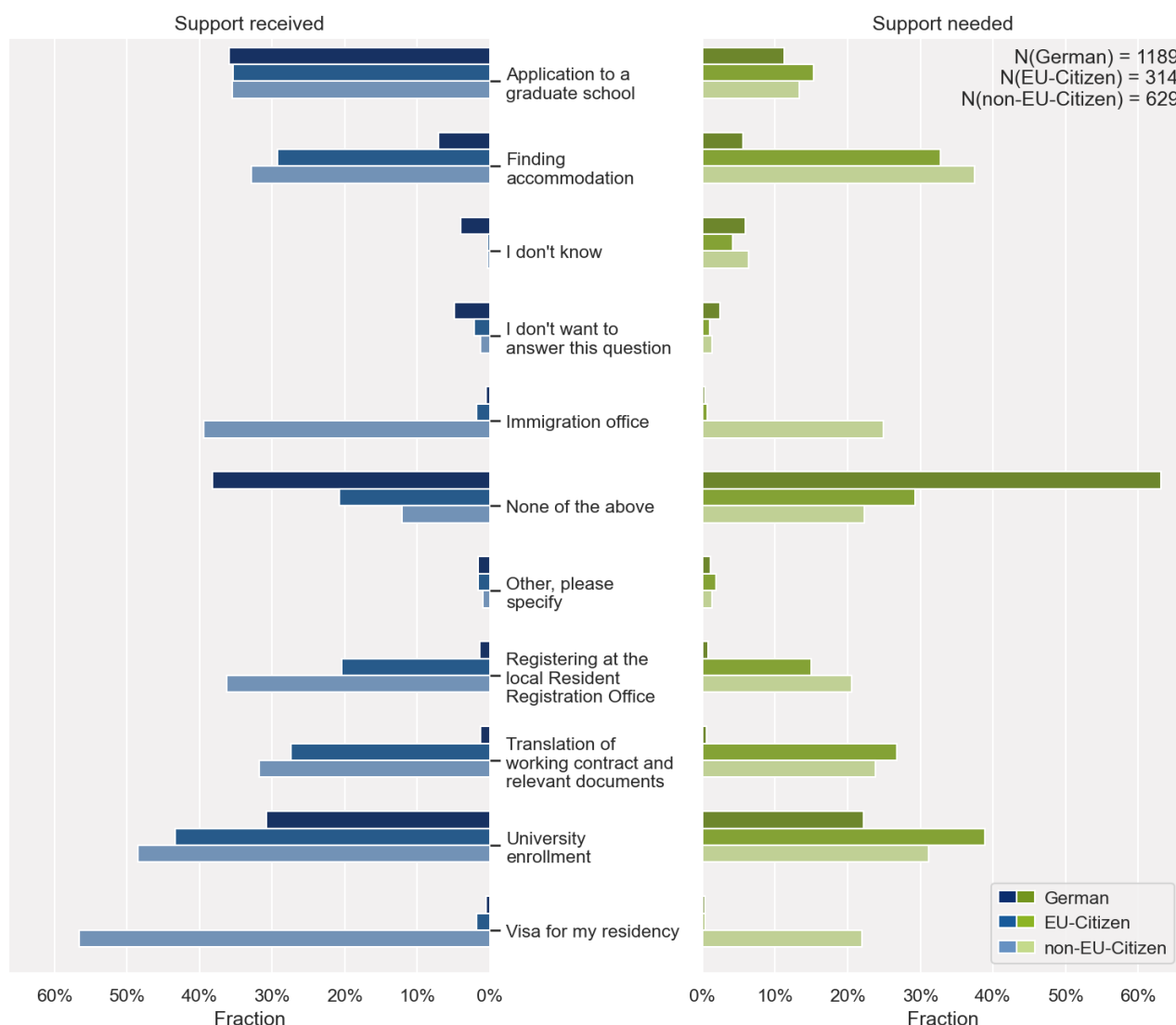
### 8.2 Language barrier

One of the main barriers that an international DR has to overcome in their professional and personal life while living in Germany is language. The results show that a considerable percentage of the participants are international DRs for whom the language barrier becomes an obstacle for a successful integration and communication at their work place.

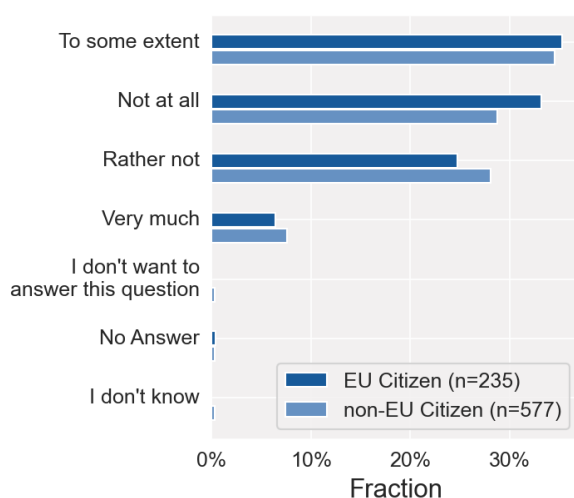
In the survey, participants were asked to grade their language fluency in German:

- *none* (EU citizen: 11.5 %, non-EU citizen: 22.9 %),
- *beginner* (A1-A2) (EU citizen: 33.4 %, non-EU citizen: 42.8 %),
- *intermediate* (B1-B2) (EU citizen: 29.6 %, non-EU citizen: 25.4 %),
- *fluent* (C1-C2) (EU citizen: 11.5 %, non-EU citizen: 7.2 %),
- *native* (EU citizen: 13.7 %, non-EU citizen: 1.1 %).

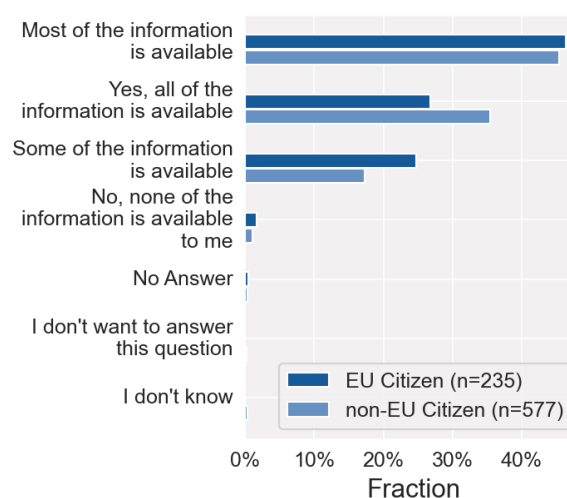
Of note, German citizens were not presented with the respective question.



**Figure 8.1:** Support received (left) and needed (right) from centers by DRs.



**Figure 8.2:** Exclusivity of the German language as an obstacle to successful integration. Native speakers and fluent participants are excluded.



**Figure 8.3:** Accessibility of work-related information (group internal, administrative, contract/stipend) in English.

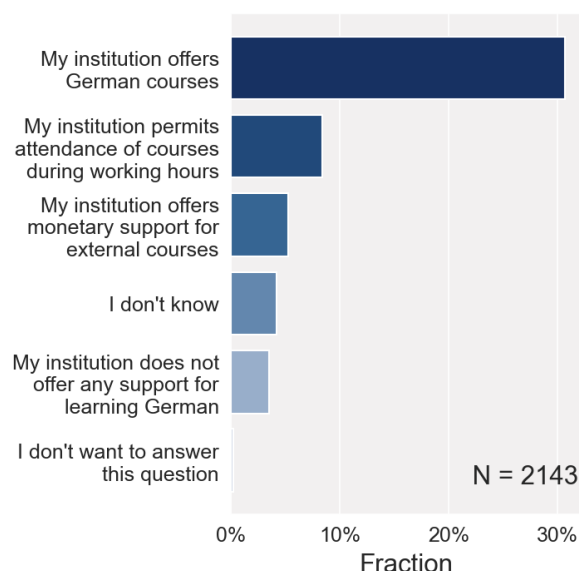
We posed follow-up questions to the participants who stated their comprehension of the German language as *none*, *beginner*, or *intermediate*. When asked to what extent is the lack of German an obstacle for communication at work, more than 40 % of the participants answered *very much* or *to some extent* (Figure 8.2).

78.2 % of the DRs who are not fluent in German find all or most of the important information related to group internal, administrative, or contract/stipend communication in a language they understand, while 20.9 % find some or none of the information in a language they understand (Figure 8.3). Consequently, it is suggested that the different Helmholtz centers try to tackle this issue in order to ensure the best possible means of communication for international DRs within the Helmholtz Association.

Especially international DRs need additional support to get settled into their new environment and everyday life in Germany. Not only offering German language courses is of utmost importance, but also making DRs aware of their availability is crucial. Only 30.7 % of participants have indicated that German courses are offered at their center, and 5.3 % reported that their center offers monetary support for external courses (Figure 8.4). Though institutes are providing some assistance for learning German, more still needs to be done to improve general communication and particularly accessibility to important information.

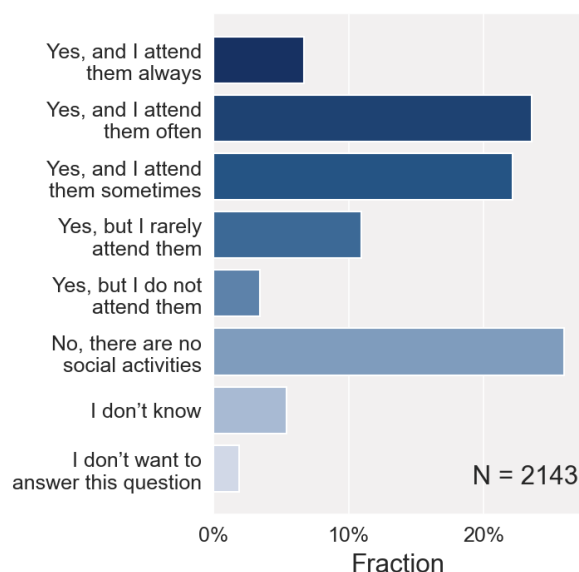
### 8.3 Social events and integration

Besides the language barrier, social integration in a group of peers remains highly important. Almost 67 % of the DRs state that regular social activities take place in their group or at their center. The majority of the DRs attend these social activities; 6.7 % attend them always, 23.6 % attend them often and 22.2 % attend them sometimes. At the same time, 10.9 % attend these activities rarely and 3.4 % do not attend at all. Despite the overall positive response on the attendance of social events, 25.9 % report no social activities taking



**Figure 8.4:** Support to learn German offered from the centers of the Helmholtz Association to the DRs.

place in their group or at their respective centers (Figure 8.5).



**Figure 8.5:** Social events occurrence and participation by DRs.

### 8.4 Summary open-text answers

In this section we have received 136 open-text answers. Most of the answers were related to the topic of social activities and events. COVID-19

put a halt to all in-person meetings and most of the participants reported few or no social activities since the start of the pandemic. Social activities depend highly on the research group with some reporting that their group organizes social activities while others feel left out since their group is not very active. If social activities happen, they are reported to be very irregular and hard to attend for DRs with family responsibilities.

Regular social events from the institutes mostly include a summer and a Christmas party. Even so, some DRs reported exclusion from social events due to different funding or different location away from the main campus.

COVID-19 did not only interfere with social activities but also increased the need for support. Some DRs reported that they did not receive any support from their institutes during this time. It was also reported that if DRs received help for bureaucratic topics, it was not from their institutions but from colleagues and friends.

Language was another factor that came up in the open-answer section. Some DRs reported exclusion due to others only speaking German or a preference for German-speaking individuals. One participant labeled this as *structural racism*. Such practice is highly problematic in institutions where administrative help is only offered in German and there are institutes where no English translation of contracts is offered.

Several DRs reported that German courses are offered by their centers, but not frequent or advanced enough to learn a rather complicated new language, such as German, within 1.5 hours per week. We strongly encourage centers to increase their language courses to offer more frequent courses, maybe even intensive learning units and also courses for more advanced learners, which might be considering a future in the German academic system in a long-term.

sistance for finding accommodation.

- 42 % of DRs answered that to some extent and very much the lack of German remains a barrier at work.
- We suggest that centers within Helmholtz Association communicate internal, administrative, and contract/stipend information in English.
- 30 % of DRs reported their institution offering German classes. It is recommended that more awareness of German course offerings should be made within Helmholtz Association.
- Social events are to achieve crucial to feelings of integration and inclusion, but 26 % of DRs reported no social activities in their respective working groups.

## 8.5 Key messages

- 35 % of DRs (German, EU, and non-EU citizen) reported that there should be more as-

## 9 Career development

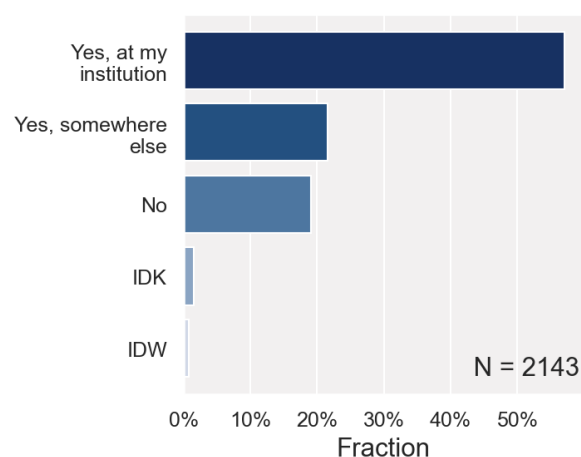
After completion of the doctorate many career paths open up. Choosing the right one is a multifaceted challenge [29]. Doctoral researchers (DRs) face difficult questions: *Do I stay in academia?, do I want to find a job in industry?, or should I explore less traveled paths (e.g. science management, starting my own business, teaching, etc.)?* The sheer number of possibilities demonstrates the importance of offering guidance in career planning. Career counseling is increasingly offered within the Helmholtz Association for both DRs and supervisors.

### 9.1 Graduate school enrollment

Graduate schools offer supplementary training and are often specifically designed for DRs in one research field. The majority of participants (78.7 %) is enrolled at a graduate school at their institution or somewhere else (Figure 9.1). Note that this percentage is comparable to the N<sup>2</sup>-Survey 2019 (81.2 %). We observed no significant differences of graduate school enrollment with respect to gender or citizenship (data not shown).

### 9.2 Future career plans

When asked about the field DRs like to work in after completing their thesis, the most obvious choice for most participants (75.1 % *yes* or *rather yes*) is non-academic scientific research (Figure 9.2). However, still a large portion of participants indicate they want to stay in academia (51.3 % *yes* or *rather yes*). Furthermore, 40.3 % / 45.0 % of DRs consider working in a private / public sector science-related job. Notably, 30.1 % of all participants express the wish for an ex-



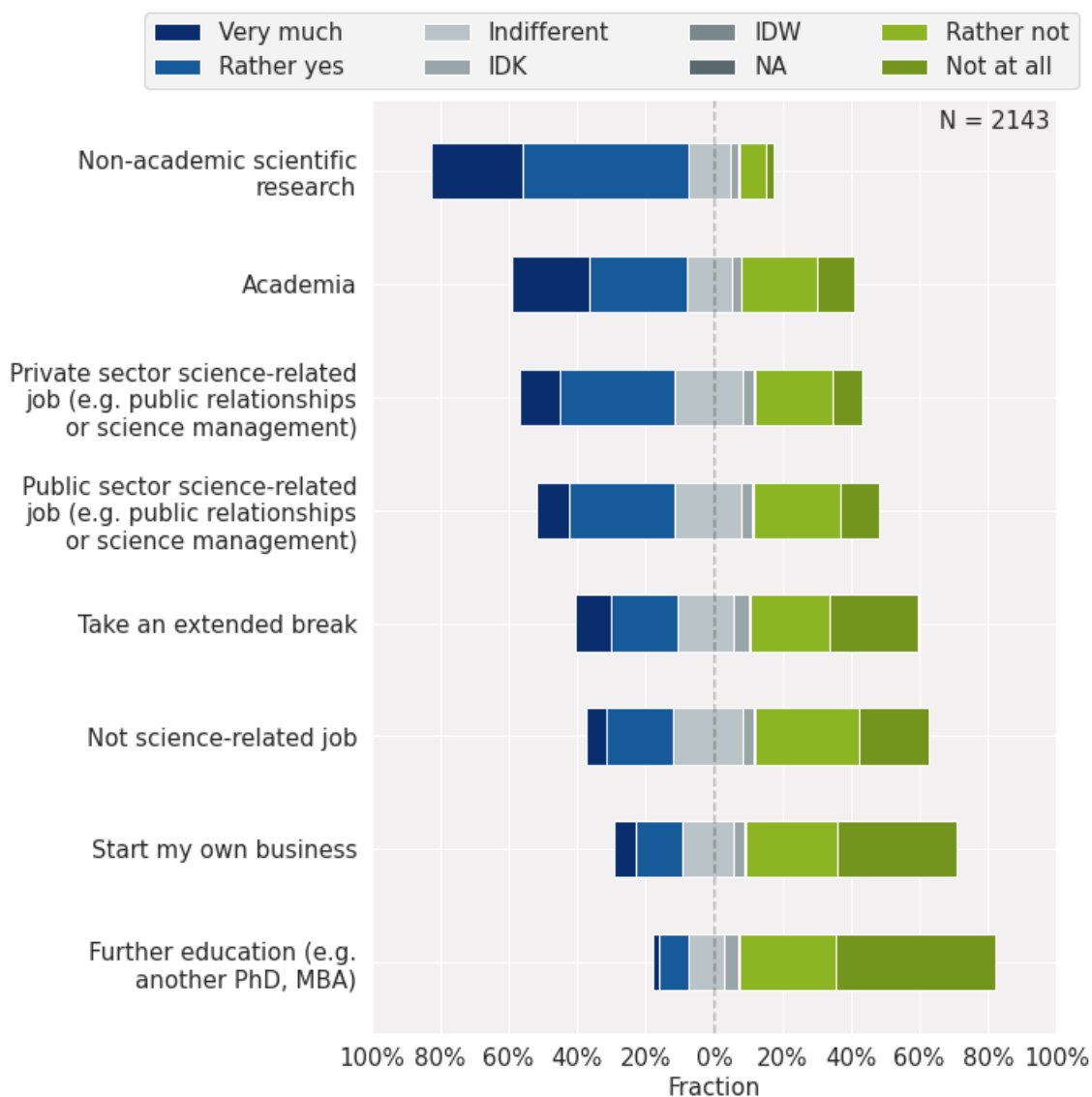
**Figure 9.1:** Enrollment of DRs in graduate schools (single-choice format).

tended break. The number of DRs who would like to start their own business is 20.1%.

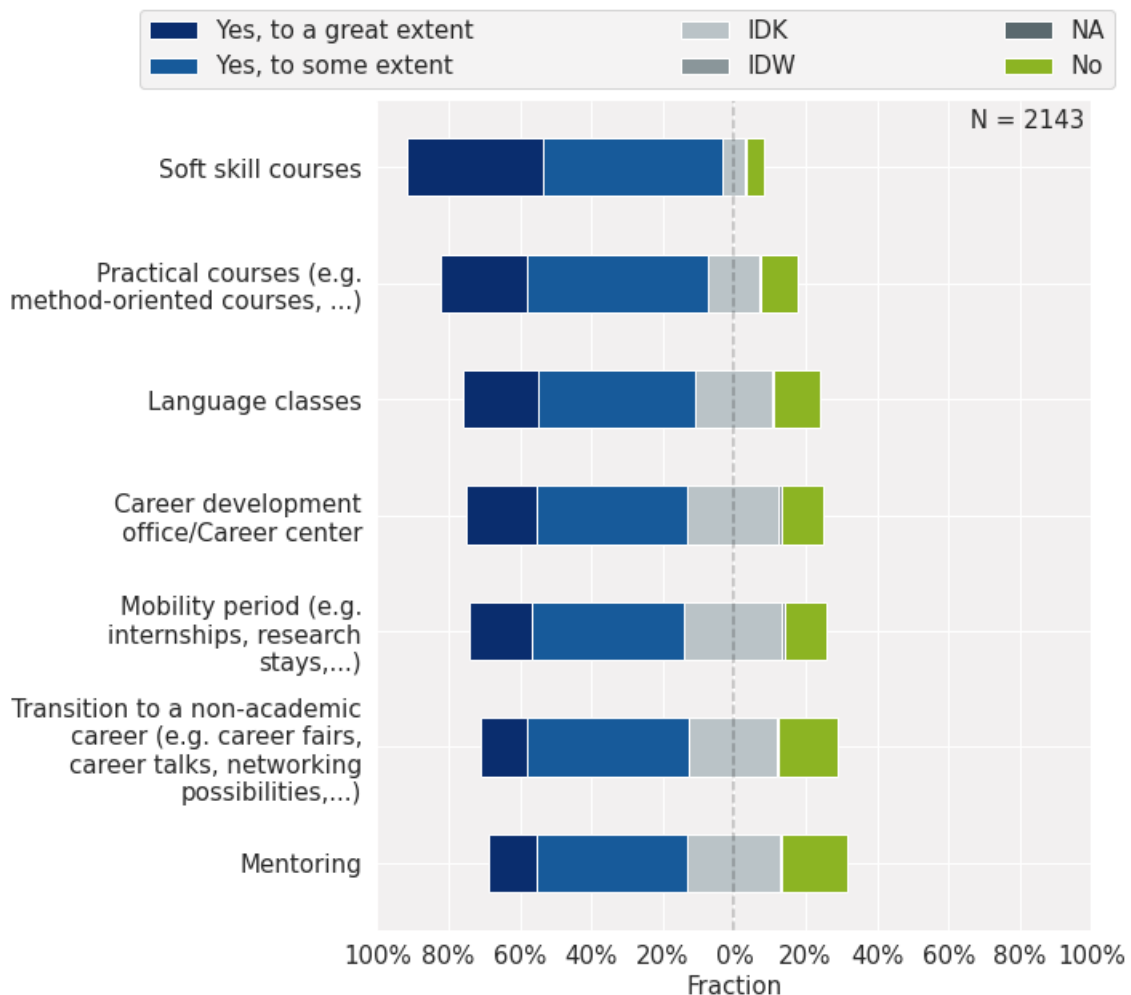
We took a closer look on the prospect to stay in academia. When comparing for the year of the doctoral project, one can see that the wish to stay in academia slightly decreases towards later stages in the doctoral project: 61.6 % of the participants who started in 2021 indicate *yes* or *rather yes*; for participants who started in 2019, 2018, or 2017 we observe lower percentages (46.1 %, 46.1 %, 49.3 %, respectively).

### 9.3 Career development offered within Helmholtz Association

Participants were asked if their center offers guidance for career development on the basis of seven measures (Figure 9.3). The offer of courses is rated the best: 87.6 % of the participants indicate that their center offers soft skill courses to a great or some extent, similarly 73.6 % is indicated for practical courses, and 65.9 % for language



**Figure 9.2:** Field of work in which DRs would like to work after graduation. This plot presents fractions of agreement of participating DRs for each career option. Each bar represents 100 % of DRs and is filled according to their answer levels. Additionally, the bars are moved corresponding to their answer direction, with neutral or not given answer possibilities (e.g. *IDK* (*I don't know*), *IDW* (*I don't want to answer*) and *NA* (*No answer*)) centered in the middle. According to the left- or right-alignment of the bars, you can compare the answer tendencies of DRs.



**Figure 9.3:** Offered career development measures. This plot presents fractions of agreement of participating DRs for each career development measure. Each bar represents 100 % of DRs and is filled according to their answer levels. Additionally, the bars are moved corresponding to their answer direction, with neutral or not given answer possibilities (e.g. *IDK* (*I don't know*), *IDW* (*I don't want to answer*) and *NA* (*No answer*) centered in the middle. According to the left- or right-alignment of the bars, you can compare the answer tendencies of DRs.



classes. Notably, these numbers are similar compared to the Helmholtz N<sup>2</sup>-Survey report 2019 (85.6 %, 77.9 %, 67.7 %).

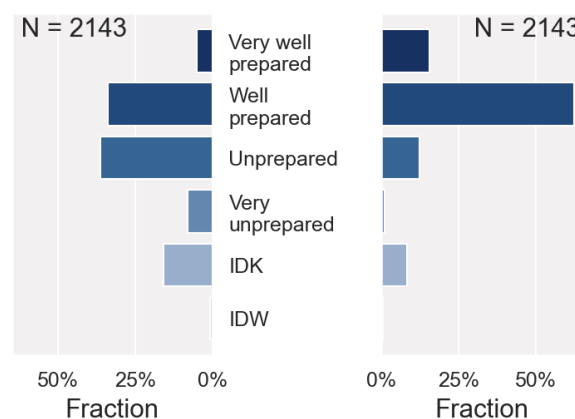
According to the response of the survey participants, career development is well supported by their centers. For the 11.9 % of participants who answered that their center does not offer career development, it cannot be determined to what extent the university's career development service is available for DRs instead. On the other hand, the offer of a mobility period (59.9 % *yes, to a great extent* or *yes, to some extent*), support for the transition to a non-academic career (58.7 %), and mentoring (55.3 %) leave room for improvement.

Highlighting the latter, we think that mentoring has a lot of potential to not only support career development, but also enhance personal growth as it gives support from an external perspective. In Nature's 2022 global graduate-student survey, 40 % of participants indicated that they think mentoring is important to establish a satisfying career [47]. Mentoring programs have been already established in graduate schools and/or research associations [2, 4]. Here, the task of graduate schools, career centers, and institutes is to provide better information on current mentoring programs.

## 9.4 Perceived preparedness for later working life

Many DRs look forward to a new start after the completion of their doctorate, but for many DRs this transition period is also associated with fear and the uncertainty of not being trained well enough. We found that the majority of DR feels more prepared for a job inside academia (15.5 % *very well prepared*, 62.4 % *well prepared*) than outside academia (5.1 % *very well prepared*, 34.0 % *well prepared*), compare Figure 9.4. Notably, 15.9 % of the participants do not know if they were prepared for a job outside academia, which indicates the need to support career development and to provide orientation for jobs outside academia.

Major gender differences for preparedness



**Figure 9.4:** Perceived preparation for later working life outside (left) or inside (right) science/academia (single-choice format).

inside and outside academia were observed: 51.9 % of female DRs indicate to feel *unprepared* to *very unprepared*, whereas only 36.9 % of male DRs feel the same way. This is in line with studies of sex differences in job preparedness and highlights the importance to support and shift the self-perception, especially of females [27].

The preparedness for a job inside academia tend to increase with the year of the doctoral project. 72.2 % of the participants who started in 2021 indicated to feel *very well prepared* or *well prepared*. In contrast, for participants who started in 2020, 2019, 2018, and 2017 we observed higher percentages (77.1 %, 78.6 %, 82.3 %, 78.4 %, respectively).

## 9.5 Summary open-text answers

For our section on career development, we received 59 open text answers about the topic, which can be categorized in two problems:

- Language courses (especially German) are not frequent or advanced enough. We further discuss this aspect in the summary of open-text answers section 8,
- Skill courses are available but participation is not encouraged or even actively prevented from supervisors.

A doctorate is defined as an educational period, hence courses to further extend research or soft skills, should be included in the curriculum. As such, attendance of courses, which would also further strengthen the research of the respective DRs, should be encouraged.

## 9.6 Key messages

- 79 % of the participants are enrolled at a graduate school.
- 51 % of the participants wish to continue working in academia, whereas larger percentages of participants consider to work in non-academic scientific research. The stronger agreement for a transition away from academia after the doctoral time may be due to numerous reasons [6]. It is a fact that many post-doctoral positions remain unfilled and PIs are often struggling to find suitable candidates [47, 25]. Therefore, it must be a goal to make academia an attractive option where work and effort are valued and recognized [48].
- 44 % of the participants feel either *very unprepared* or *unprepared* for a job outside of science. Especially, female compared to male DRs feel less prepared. We think that mentoring programs targeted for women in science could have a great potential to improve this.

## 10 Family

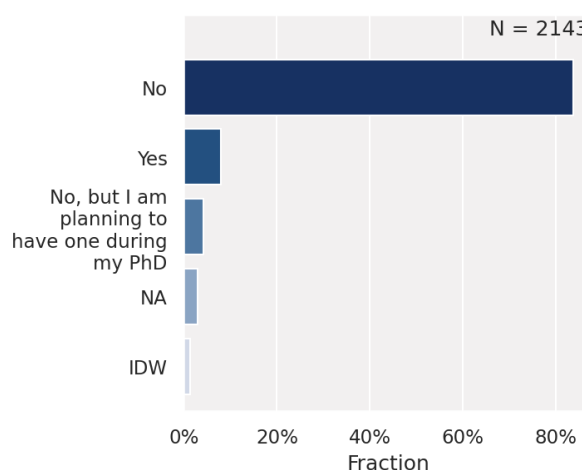
This section contains questions related to family life while conducting the doctoral project. We are interested in whether the Doctoral Researchers (DRs) have children and how DRs are supported in their caring responsibilities within the Helmholtz Association in terms of childcare, care for the elderly, and organizational and financial aspects.

### 10.1 Parenthood

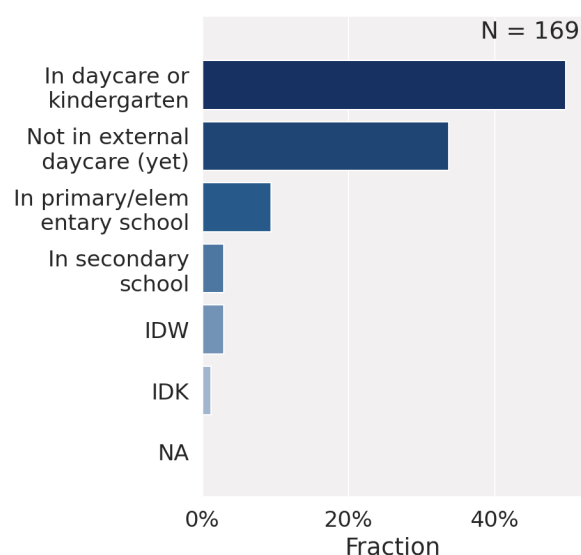
At the time and especially in the final phase of a doctoral project, DRs are at an age similar to the average age of mothers at the birth of their first child (Figure 2.5 and [10]). Both, a thesis and a family, are time-consuming endeavors, and therefore they could clash with one another as it is supported by our survey results. 84 % of the participants have no children, and only 8 % have or currently expect children (Figure 10.1). This corresponds to 169 DRs who are expecting to be or already are parents in our data set. On the Helmholtz level, this situation is within a similar range compared to previous Helmholtz Juniors surveys; 9 % and about 7 % of participants were parents in N<sup>2</sup>-Survey 2019 and Helmholtz Juniors Survey 2017, respectively.

To further put the age of the children into perspective, we asked for the care level of the youngest child. Here, for most parents their youngest child was already attending daycare or kindergarten (50 %), 34 % were not in external daycare yet, and 12 % were already attending school (Figure 10.2). The age and care attendance may come with different challenges for parents, who should be supported on every step of their child's education.

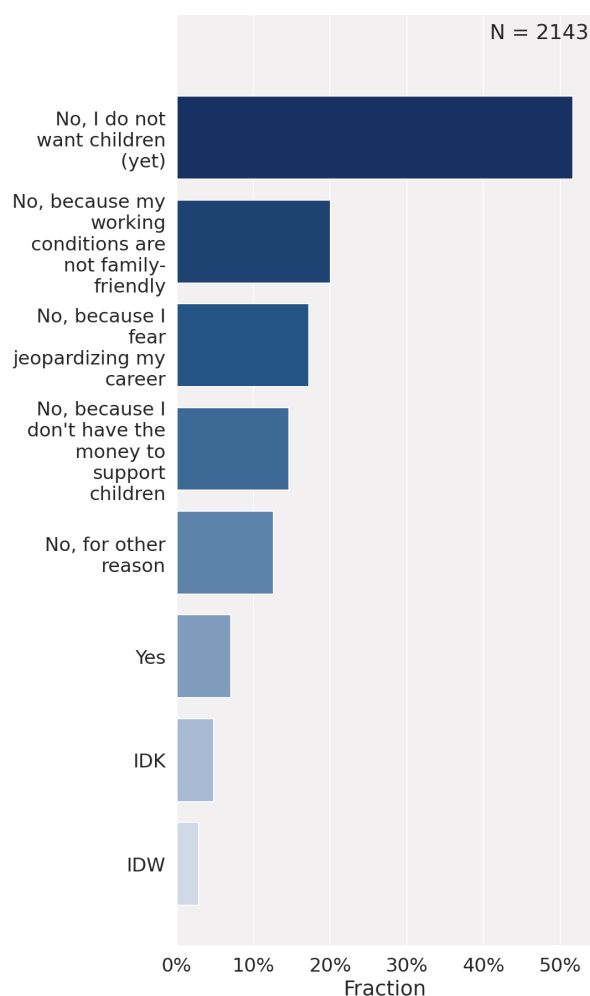
We found that only 7 % of DRs were considering having (more) children during their doc-



**Figure 10.1:** DRs who had or expected children at the time of the survey.



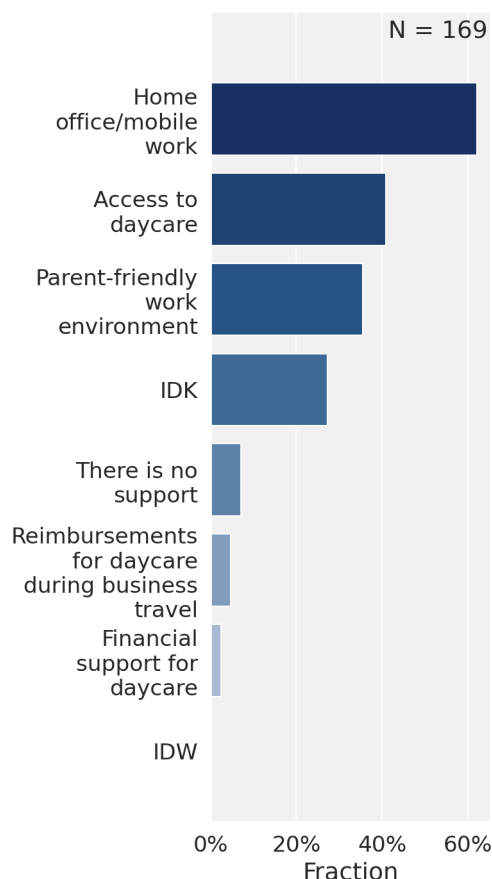
**Figure 10.2:** Level of care attendance of DRs' children at the time of the survey.



**Figure 10.3:** DRs considering expecting children during their doctoral project. Of note, reasons for not considering it were offered in a multiple-choice setting.

toral project (Figure 10.3). We were interested in whether the low portion of parents is due to personal reasons or rooted in the academic system. Figure 10.3 displays that the majority of DRs (51 %) do not have children because they do not want them or they do not want them yet. However, other reasons frequently reported included: no family-friendly working conditions (20 %), fear of jeopardizing one's career (17 %), and lack of money to support a child (14 %). Of note, the option *I do not want children (yet)* excluded the other answer possibilities.

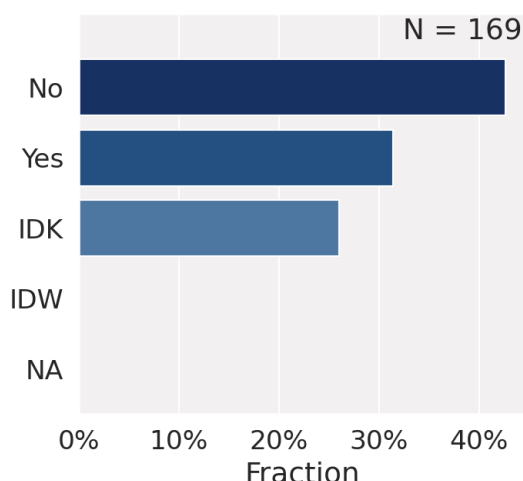
Following these observations, a decision on whether to have a family during one's doctorate can be supported by the availability of childcare services, which helps to reconcile family life with



**Figure 10.4:** Childcare services offered to the DRs at different centers within Helmholtz Association. Filtered for parents only, as other DRs might not be aware of the offered services.

scientific work (Figure 10.4). However, 27 % of DRs indicated that they do not know whether their center offers childcare services. Other survey participants state that their center offers *access to day-care* (41 %), the possibility of *home office/mobile work* (62 %), or a general *parent-friendly work environment* (36 %).

Overall, 31 % of the DRs within Helmholtz Association say that they feel sufficiently supported financially and organizationally by their center for raising children (Figure 10.5). Sadly, the majority of DRs (43 %) see this differently and say that they do not feel sufficiently supported. At the same time, 26 % say that they do not know whether they feel sufficiently supported, which could indicate that there is lack of awareness when it comes to this issue. Of note, these questions were only posed to DRs already having, expecting, or ac-



**Figure 10.5:** Agreement on whether (expecting) parents are sufficiently supported in their childcare responsibilities. Filtered for (expecting) parents only.

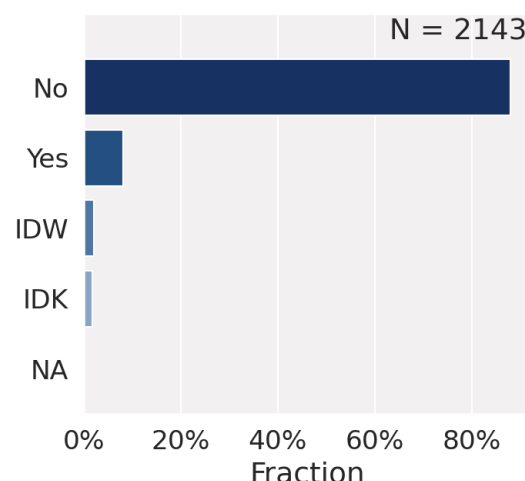
tively planning for children.

## 10.2 Sub-analyzes for parents

DRs with children or expecting parents are a unique group, and we have further investigated differences within key measures presented in the other sections.

Parents report a significantly higher expected duration of their doctorate (4.06 years vs. 3.65 years;  $p\text{-value} \leq 0.01$ ). In terms of satisfaction, they report a similar overall satisfaction (3.61 vs 3.59 for non-parents) but are significantly less satisfied with the support for families than non-parents (3.56 vs. 3.78;  $p\text{-value} = 0.02$ ). Interestingly, parents show significantly better mental health compared to non-parents in all measured categories of the depressive syndrome ( $p\text{-value} \leq 0.01$ ), state anxiety ( $p\text{-value} = 0.04$ ), and trait anxiety ( $p\text{-value} \leq 0.01$ ). This might be related to a better work-life balance, as only 50 % of the parents report working on average more than 40h per week, compared to 64 % of the non-parents (average working hours in contracts are similar between both groups).

While these hypotheses are mostly speculative, it is clear that DRs with children are an unique



**Figure 10.6:** DRs with caring responsibilities apart from children, such duties can be connected to e.g. the elderly or other family members

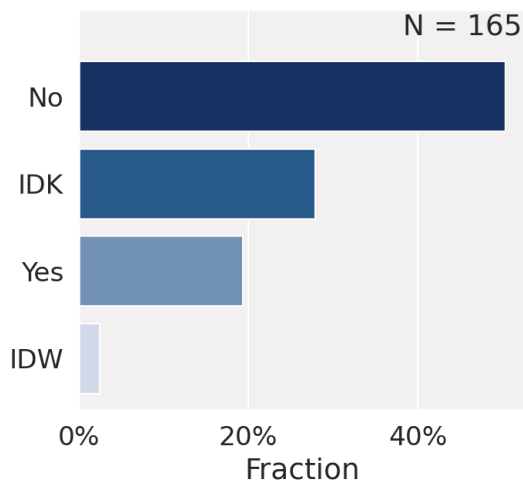
group, which should be supported in their additional challenges and might even be an example to understand the importance of sticking to contracted working hours.

## 10.3 Further caring responsibilities

To get a more complete picture, we further assessed other caring responsibilities apart from children (Figure 10.6) and observed that 8 % of DRs have these kind of responsibilities. As this might become a new challenge within our aging society, we would like to start highlighting this additional challenge not only for DRs but also for other employees as currently only 18 % of caregiving DRs feel supported by their institute (Figure 10.7), which is even less than for childcare responsibilities (31 %).

## 10.4 Changes during COVID-19

The group of caregiving DRs, for both children and others, faced further challenges during the COVID-19 pandemic. 57 % of parents reported having more caring responsibilities during this time due to closed daycare and homeschooling



**Figure 10.7:** Agreement on whether caregivers are sufficiently supported in their caring responsibilities. Filtered for caregivers only.

(Figure 10.8). This led them to work at different times of the day, for example at night (44 %), as well as to self-observed diminished work efficiency (39%), and difficulties keeping up with work in general (38%). Of note, 38 % also reported that they enjoyed the additional time they could spend with their child.

61 % of the parents expect a delay in their doctorate due to the pandemic, while only 45 % of non-parents expect a delay. This was quantified as an expected delay of their doctorate by 7.6 months on average, compared to 7.3 months for non-parents without a significant difference.

In contrast to that, the situation for most other caregivers did not change during the pandemic (49 %) and only got more demanding for 19 % (Figure 10.9). Here, 52 % report an expected delay due to the pandemic, which is lower than that of DRs with children. However, we do observe a significant difference between the caregiving DRs and all other DRs ( $p$ -value = 0.0001), with the caregivers expecting on average 8.8 months of delay in their doctoral project. Of note, there is an overlap of 24 DRs reporting to have both caring responsibilities for children and other people and the above-mentioned comparisons only acknowledge one responsibility in comparison to all other DRs at a time.

## 10.5 Reconciliation between doctorate and family

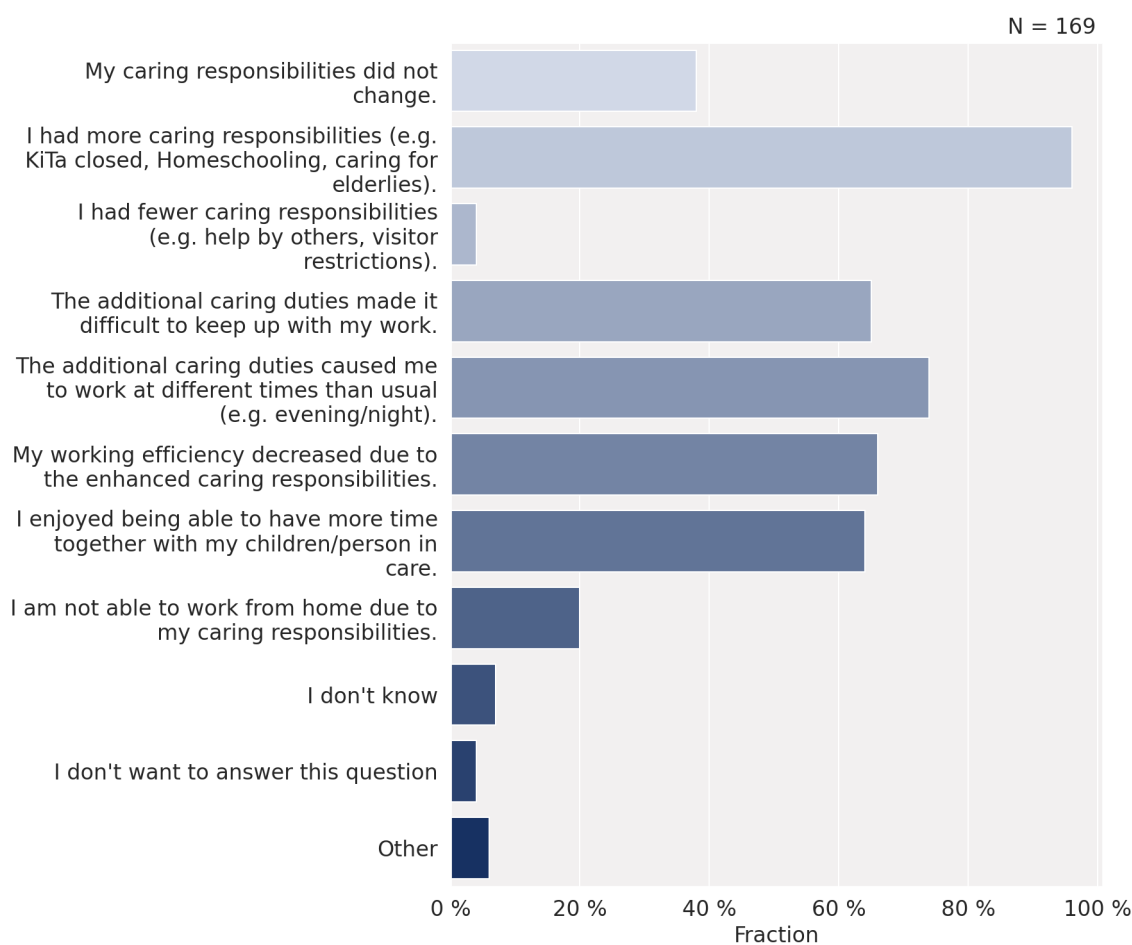
To summarize this section, we asked whether DRs felt able to unite their caring responsibilities for both children and others with their doctoral project. The majority (67 %) said that they can unite these *to some extent* or even *very much*. However, still 25 % answered *rather not* or *not at all* (Figure 10.10).

While there is still room for improvement, most DRs with caring responsibilities are able to unite these with their doctorate. Still, many DRs might have decided against having children because of possible failures within the academic system (Figure 10.3). Pursuing a doctorate and having a family are not necessarily contradictory, and already common in Scandinavian countries [32]. An improvement in working conditions and the establishment of a family-friendly environment and sufficient support structures could help to reconcile family and academia.

## 10.6 Summary open-text answers

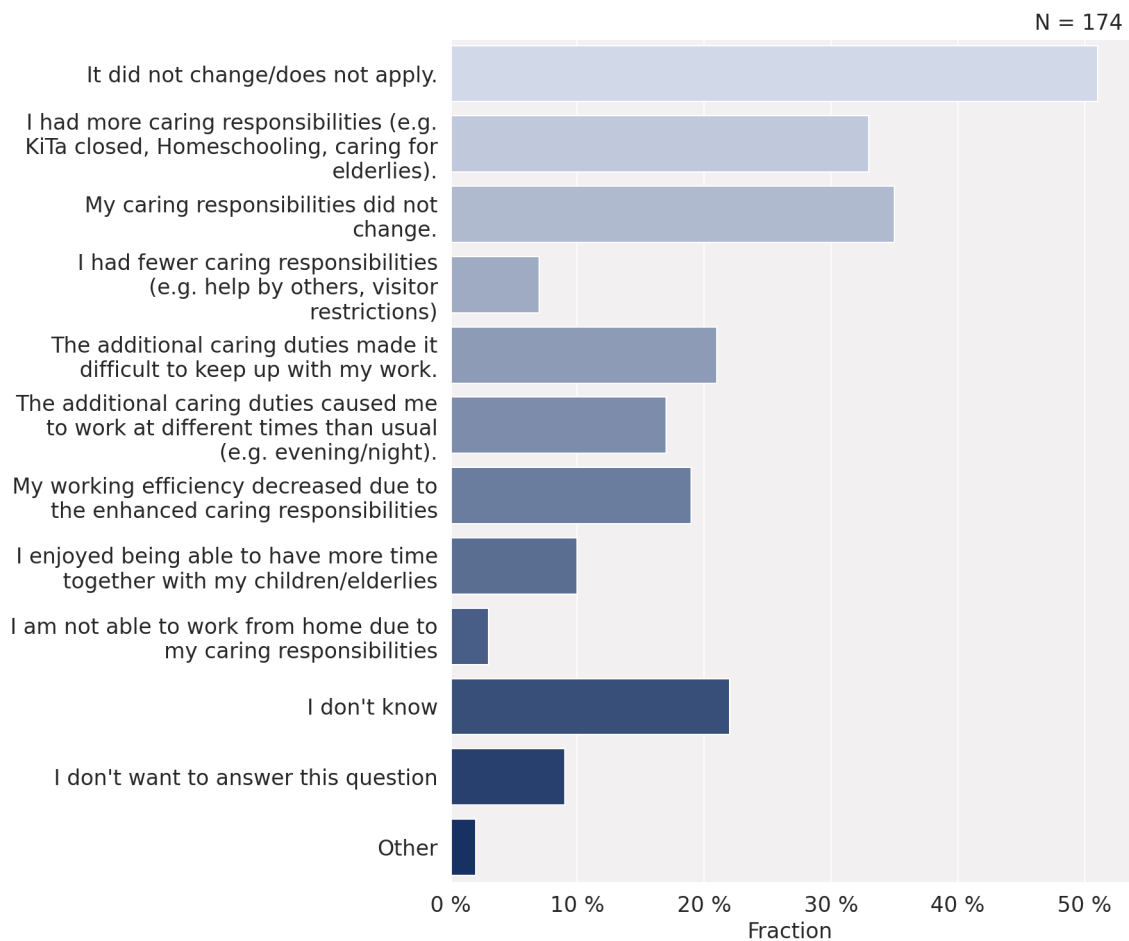
In this section we have received 57 open-text answers. While there were some mentions of DRs expecting or having children, numerous answers pointed out the problem of a difficult combination of child responsibilities and workload of doctorate project, with one answer describing academia as *as family unfriendly as it gets*. Having children involves plenty of unknowns in academia due to a lack of financial security because of temporary contracts or no guaranteed extensions in case of parental leave. Scholarships increase these concerns due to the lack of social welfare benefits. It was generally mentioned that it is hard to balance work in academia and children without any external support.

Other issues mentioned included denying the possibility of doing home office despite it being formally offered at the institute and open discrimination against women that want or have children. Responsibilities beyond taking care of children,



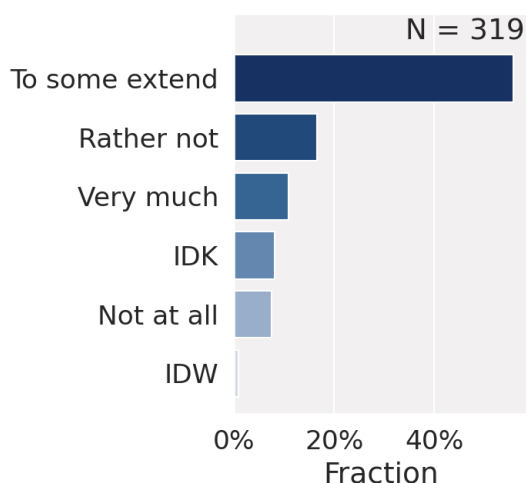
**Figure 10.8:** Expected changes in childcare responsibilities during the COVID-19 pandemic. Filtered for (expecting) parents only and offered as a multiple-choice question.





**Figure 10.9:** Expected changes in caring responsibilities during the COVID-19 pandemic. Filtered for caregivers only and offered as a multiple choice question.





**Figure 10.10:** DRs agreement with their ability to unite caring responsibilities with their doctoral studies. Filtered for present or expecting parents, as well as other caregivers.

such as caring for relatives or even pets, were also pointed out as important family responsibilities.

## 10.7 Key messages

- Only 8 % of DRs have or are currently expecting children. This is a constant trend over the past years within the Helmholtz Association.
- DRs with children are a unique group and should be supported accordingly. While they tend to take longer for their doctoral studies, they show fewer mental health issues.
- Another 8 % of DRs have further caring responsibilities apart from children, for example for the elderly or other relatives. These caring duties are not sufficiently supported at the moment and might grow more important in our aging society.

## 11 COVID-19

The COVID-19 pandemic profoundly impacted the lives of Doctoral Researchers (DRs), particularly in terms of their research progress, expected project duration, interruption of experiments, financial pressures, social and health challenges, and expectations for their future careers [39]. Especially, certain groups of researchers, such as foreign DRs, people with chronic illnesses, and those with family responsibilities might have been severely affected.

We have asked DRs (i) how they perceived the impact of the COVID-19 pandemic on their work as well as their social life, and (ii) how their research centers handled the situation.

Our results can guide further steps, necessary to mitigate the negative impact of the pandemic. Note that the results of our survey only capture a certain stage during the pandemic. At the time of the survey<sup>1</sup>, 5 % of the participants indicated to have tested positive (PCR) for COVID-19.

which might be in relation to the *accessibility of equipment, data and methods* (43 %), as well as *supervision* (40 %). Interestingly, a high percentage also see the *workload* as negatively impacted (30 %).

The far-reaching effects of the COVID-19 pandemic have caused severe delays for many projects. 47 % of the participants said they expected their doctoral project to be delayed due to the impacts of the pandemic (Figure 11.2). We asked those who stated yes about the expected duration. We observe that 24 % of all participants expect a delay of six to eleven months, 13 % at least a year, and 10 % less than five months (Figure 11.3). In short, more than one in three DRs will take longer than half a year merely due to COVID-19. These numbers must be considered when it comes to funding contract extensions.

### 11.1 Impact of the COVID-19 pandemic on DRs

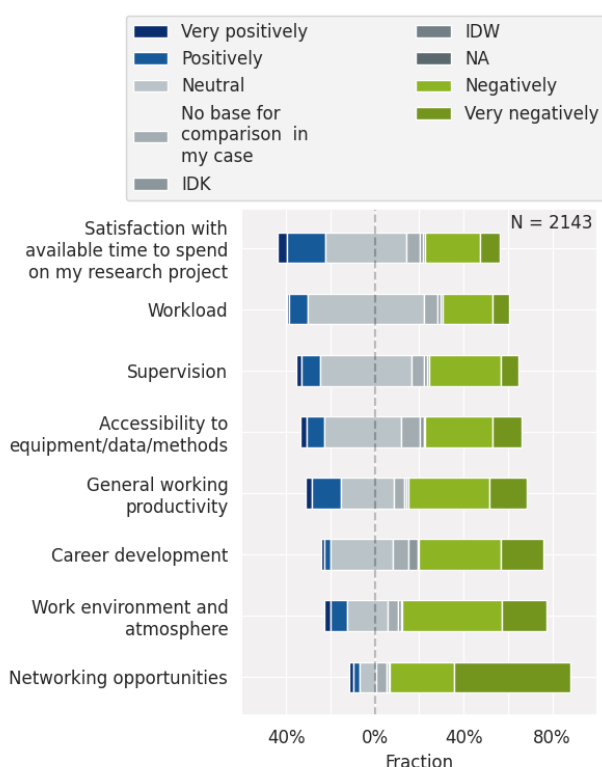
We observe that many DRs have suffered severely under the impact of the COVID-19 pandemic (Figure 11.1). Participants were asked *How do you perceive the COVID-19 pandemic to have impacted the following factors?*

In particular, the impact of COVID-19 on the *networking opportunities* was described as strongly negative (81 %). Likewise, the same was perceived for the *work environment and atmosphere* (65 %) and *career development* (56 %). The *general working productivity* was also perceived to be negatively affected (53 %),

### 11.2 Impact of the COVID-19 pandemic on private life

The COVID-19 pandemic worsened both work and private life which could lead to consequences for mental well-being [44]. Most participants rated the impact on their social contacts (friends/colleagues) and contact with relatives as *negatively* or *very negatively* (Figure 11.4) which is in line with other cross-sectional studies of the impact of COVID-19 [23]. Further main stress factors include the separation between work and leisure time, and the quality of leisure time.

<sup>1</sup>October and November 2021

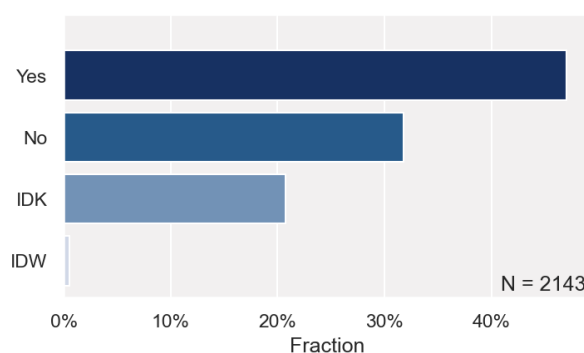


**Figure 11.1:** Impact of the COVID-19 pandemic on work-related factors such as productivity, working atmosphere, or accessibility to equipment. This plot presents how negative or positive participating DRs perceived this impact. Each bar represents 100 % of DRs and is filled according to their answer levels. Additionally, the bars are moved corresponding to their answer direction, with neutral or not given answer possibilities (e.g. *IDK* (*I don't know*), *IDW* (*I don't want to answer*) and *NA* (*No answer*) centered in the middle. According to the left- or right-alignment of the bars, you can compare the answer tendencies of DRs.

### 11.3 Home office

During the COVID-19 pandemic, especially during the lockdowns, many DRs worked from home, even though they wanted to go to their respective institutes. We asked the participants: *How was your working situation during the pandemic?* (Figure 11.5) and observed that many DRs had to work from home (13 % *always*, 31 % *often*). By contrast, we observe that a large percentage of participants wanted to go to their institute (16 % *always*, 32 % *often*).

The possibility to work from home depended on whether laboratory work was part of the doctoral

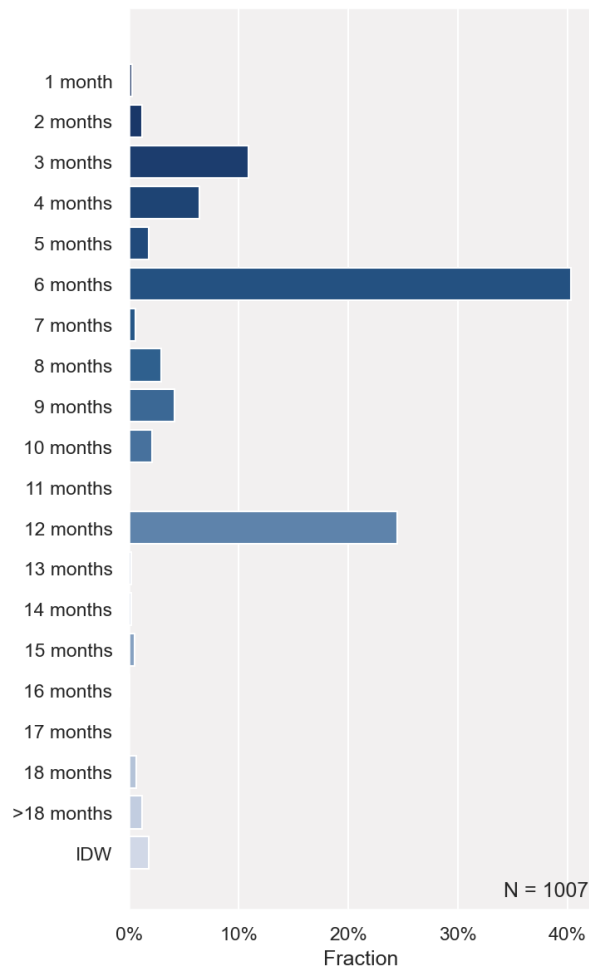


**Figure 11.2:** Expectation of a delay in DRs' projects due to COVID-19 pandemic.

project. For participants mainly working computationally, the majority could work from home (59 % *always*, 26 % *often*) and did not have to go to the institute (44 % *never*, 31 % *rarely*). On the other hand, for participants mainly working in the laboratory, fewer could work from home (18 % *always*, 30 % *often*) and more had to go to the institute (10 % *never*, 15 % *rarely*) (Figure 11.6).

At the time of the survey, we observe that 25 % of participants worked at least 12 months from home and 42 % less than 6 months (Figure 11.7). Similar to above, we observe a difference for the type of doctoral project: participants that are mainly working computationally spent much longer times working from home compared to participants that are mainly working in the laboratory (Figure 11.7).

Hybrid and flexible working hours are a fundamental part of the new working world, according to some media reports. Many companies already offer their employees remote working options. When asked about future work options, we observe that participants appreciate more flexible working options (Figure 11.9). Regarding the aspects of fewer people in the office and online conferences, equal proportions are in favor and against.

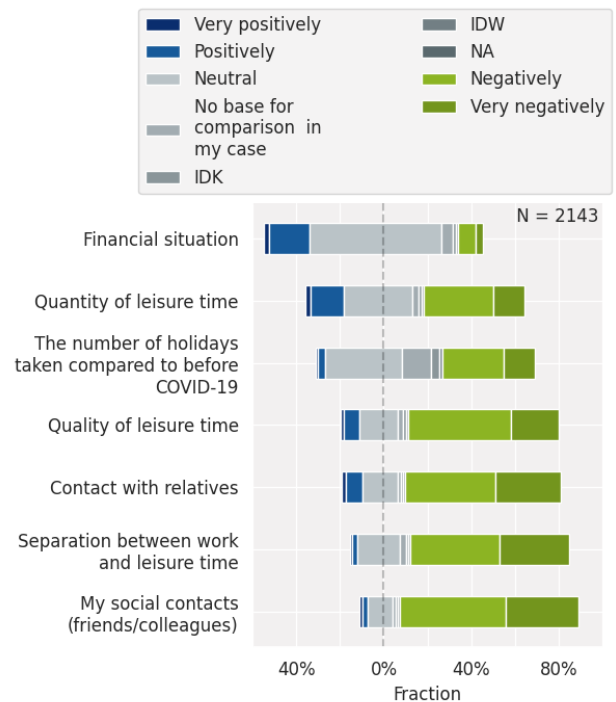


**Figure 11.3:** Expected project delays due to the impact of the COVID-19 pandemic.

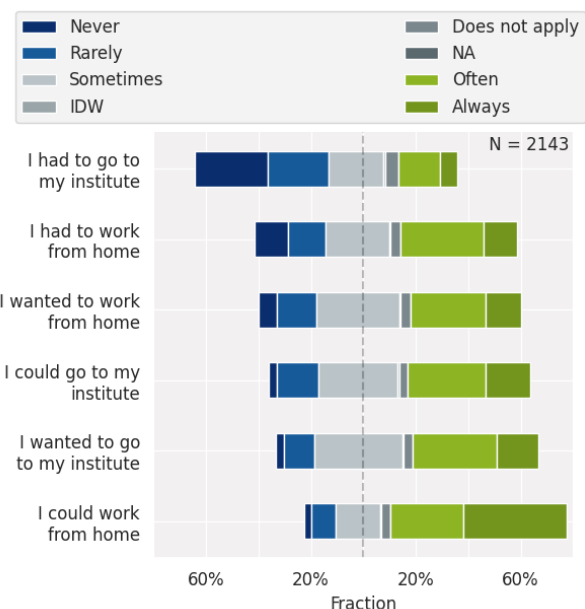
## 11.4 Response of the institute and satisfaction

The response of institutes to COVID-19 is expected to have influenced the DRs' experience and feelings of safety during the pandemic. Participants were asked if they felt safe and protected against a potential COVID-19 infection while working at the institute (Figure 11.10).

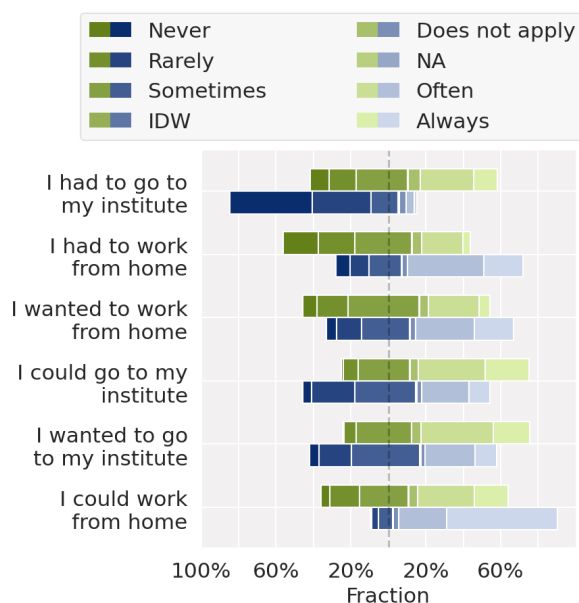
Overall, the response regarding safety from an infection at work was positive. 86 % of the participants answered that they felt safe at the institute, 9 % answered to not feel safe, 4 % said it was not applicable, and 1 % preferred not to answer the question. Note that participants were asked this at one stage of the pandemic, and we do not know how the results would change at later stages.



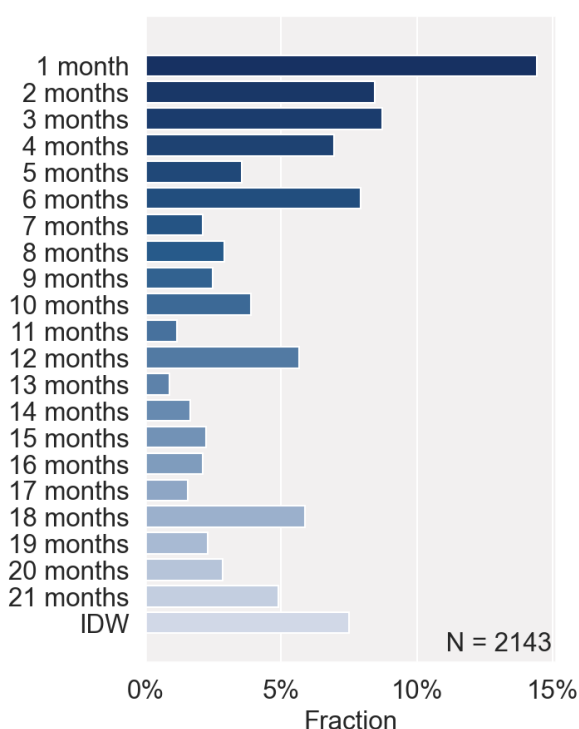
**Figure 11.4:** Impact of the COVID-19 pandemic on private and social life. This plot presents how negative or positive participating DRs perceived this impact. See Figure 11.1 for further description.



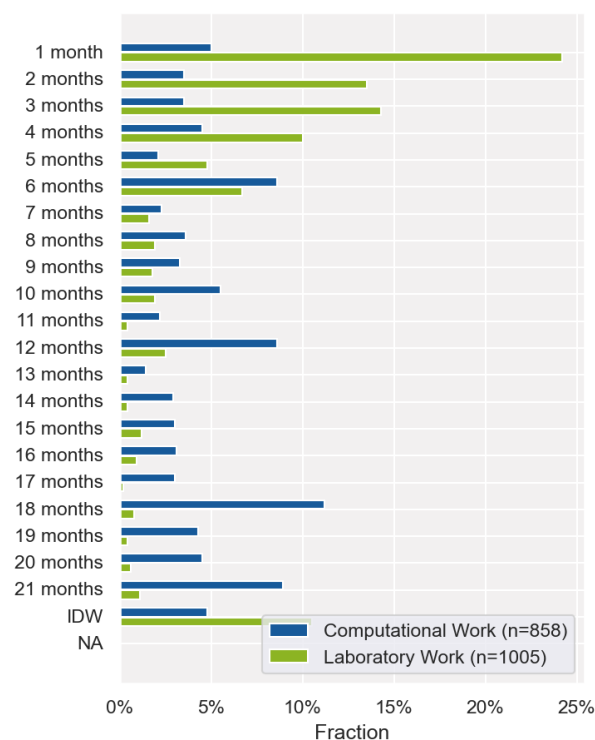
**Figure 11.5:** Working situation during the pandemic. This plot presents how often participating DRs could or had to work from home or at their institute. See Figure 11.1 for further description.



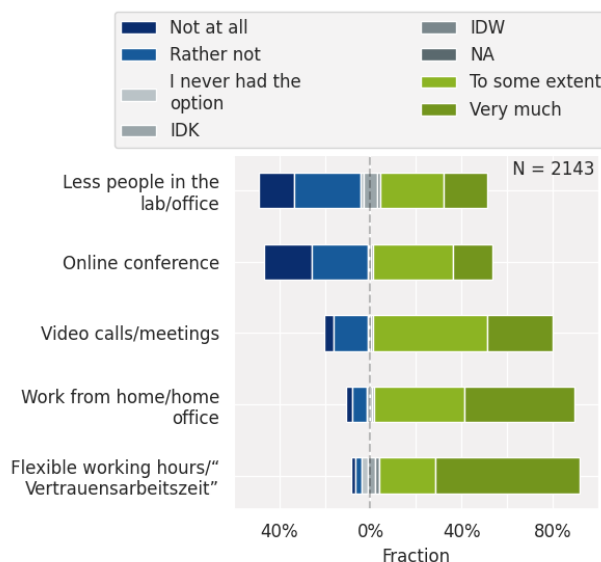
**Figure 11.6:** Working situation during the pandemic for DRs mainly working computationally (blue) and DRs mainly working in the laboratory (green). See Figure 11.5 for further description.



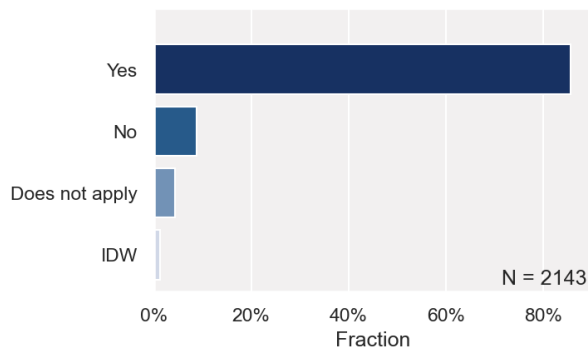
**Figure 11.7:** Months spent mostly in HO since the start of the pandemic. Note that responses to this question were assessed during the survey (August to November 2021).



**Figure 11.8:** Months spent mostly in HO since the start of pandemics for DRs mainly working computationally vs. in laboratory. Note that responses to this question were assessed during the survey (August to November 2021).

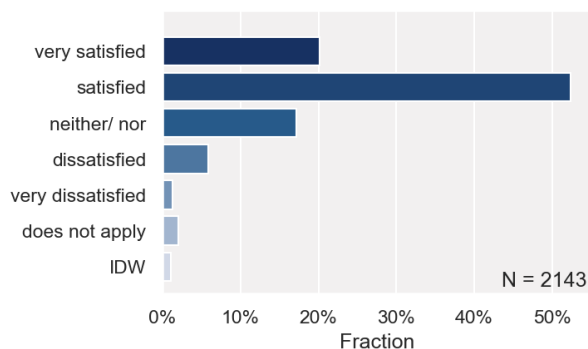


**Figure 11.9:** Wish for hybrid working options post-pandemic. This plot shows, for several aspects of working life, the degree to which participating DRs like to keep the hybrid working options post-pandemic. See Figure 11.1 for further description.



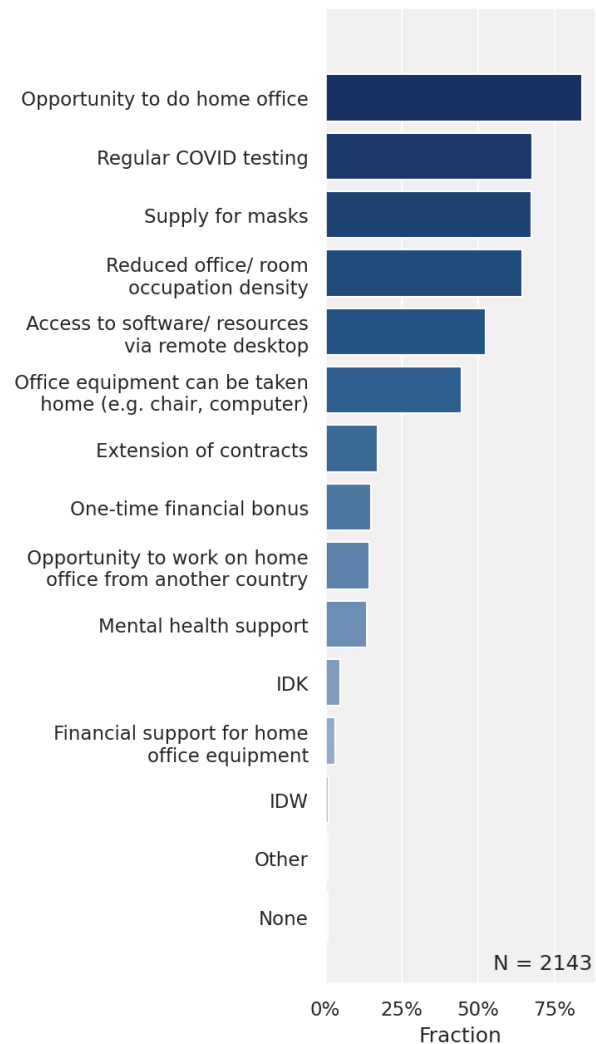
**Figure 11.10:** DRs' feeling of safety during the pandemic while working at the institute.

Participants were asked how satisfied they were with how their institute responded to the pandemic (Figure 11.11). At the time of the survey, the majority of DRs were *satisfied* with their institutes' response (52 % of the participants), while 20 % were *very satisfied*, 17 % answered *neither/nor*, 6 % felt *dissatisfied*, and 1 % was *very dissatisfied*.



**Figure 11.11:** DRs' satisfaction with the institute's responses to the COVID-19 pandemic. Note that the survey was conducted between August and November 2021.

Participants were asked what support institutes offered, which ranged from financial, over technical, to mental support (Figure 11.12). Most common answers when it comes to support were *opportunity to do home office* (84 %), *regular COVID-19 testing*, free-of-charge *supply of masks* (67 %), *reduced office/room occupation density* (64 %), and *access to software/resources via remote desktop* (52 %).



**Figure 11.12:** Support of the institutes for DRs during the COVID-19 pandemic. Note that the survey was conducted between August and November 2021.

## 11.5 Summary open-text answers

We received 114 comments for the COVID-19 section. In this section, several diverging viewpoints on COVID-19-related institute rules were shown. Some criticized the institutes' slow response, claiming that this has to be resolved and implemented immediately, while others complained that the restrictions are too severe, impeding productivity and social life. Some people found the home office requirements less productive, while others found it more efficient than performing all their work at the office. Some students questioned the home office requirement, which compels workers to work within Germany; they

said that this was discriminatory or biased toward international students.

Some DRs pointed out that sometimes office work was forced and doing home office was not in their hands. Many people have commented on the absence of social life. It is evident that the COVID-19 situation has prevented DRs from organizing and participating in social gatherings since February 2020; nonetheless, we must mobilize people as much as possible to bring them back to pre-pandemic time.

Finally, several DRs highlight the scarcity of resources available to cope with COVID-19-related concerns. Several participants pointed out that masks were not provided by the institute, even when the home office was not allowed. Furthermore, some DRs claimed that there was evident discrimination between scholarship recipients and contract-based employees, and that scholarship recipients were not eligible for monetary benefits.

- Regarding future work options, participants appreciated the more flexible working environment related to remote work. It is suggested to offer training on how to separate work from leisure time in the context of home office.
- Overall, participants showed a relatively positive response to their respective institutes' support during the pandemic.

## 11.6 Key messages

- COVID-19 had a huge impact on the lives of DRs ranging from research progress, expected project duration, and interruptions of experiments, to financial, social and health challenges.
- The pandemic worsened both work and private life and led to consequences for mental health, with many participants rating their social and familial contacts as negatively/very negatively impacted.
- Participants said that opportunities to network (81 %) and general working productivity (53 %) were negatively affected due to COVID-19.
- 47 % of participants said their expected graduation time for the doctoral project was delayed due to the impacts of the pandemic with more than one third of DRs taking longer than extra half a year to finish due to COVID-19.

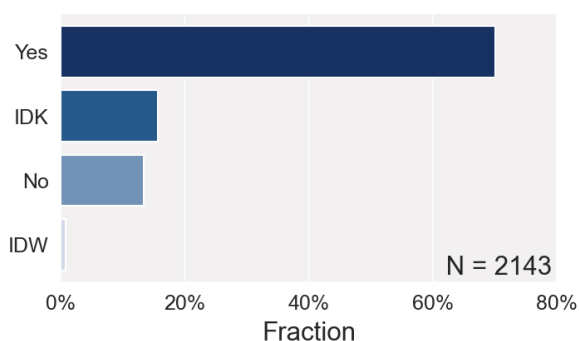


## 12 Conclusion

The presented report has covered multiple topics relevant for pursuing a doctorate within the Helmholtz Association in Germany. Participating Doctoral Researchers (DRs) have taken on average 36 min, or in total about 1250 h, to answer numerous questions and we analyzed them both descriptively and in exploratory analyzes. The goal of the biannual N<sup>2</sup>-Survey is first to provide information about the status quo of the DRs but also to highlight issues and potential areas of improvement to establish healthy working conditions. We firmly believe that healthier working conditions result in better research for grand challenges and hope that our report on the situation of DRs in the Helmholtz Association will be helpful to achieve this.

### 12.1 Last question

In a very last question, we asked DRs, whether they would recommend doing a doctoral project at their center or institute to a friend. Reassuringly, 70.1 % of participants would do so! Another 13.4 % would not and 15.6 % don't know (Figure 12.1).



**Figure 12.1:** Recommendation to do a doctorate at the own center to a friend.

### 12.2 Summary open-text answers

For our last concluding section, we received a total of 167 free-text answers to the question *Is there anything regarding the survey you would like to tell us?*. Encouragingly, 68 DRs thanked us for conducting the survey and highlighted how important it is for the situation of DRs, which we of course agree with.

The participating DRs further used the space to highlight again the most important topics for them, which covered:

- Salary: less than 100 % contracts for often more than 100 % working time are deemed as unfair and often not sufficient to cover living expenses in bigger cities.
- Supervision problems: DRs criticize the lack of accountability for poor quality of supervision and recommend mandatory supervision courses.
- Mental health issues: it was pointed out that these issues are logically arising in the very competitive research environment and that support structures are still missing especially in remote locations or were not adapted to the pandemic situation in 2021.
- DRs feel that they are not valued and report that they are only seen as cheap workforce, which was even more apparent among international DRs or stipend-holders.

Furthermore, the slow purchase processes at some centers was called out, as they hinder progress and restrict great research. It was also mentioned that the overall quality of a center or institute is highly reliant on the person at the top.



Of course, the feedback we have received was not entirely negative. There were participants who mentioned that they are very happy with their doctorate, especially in regards to either the group or the entire center.

## 12.3 Thank you!

We, the Helmholtz Juniors, and especially the survey team, want to thank all participating DRs for their time and effort spent on our survey!

We know it was long and we asked a lot of questions, but after reading this report, we hope to provide a thorough picture of doing a doctorate within the Helmholtz Association.

Now, we are working on translating our results into comprehensive initiatives for improvements in the Helmholtz Association. They will go hand in hand with proposals for each center within Helmholtz Association based on this report and individual center-specific reports, which have been sent out in November 2022. Moreover, the results from the N<sup>2</sup>-Survey 2019 can be found [here](#).

If you want to support us and become involved in the improvement of doctoral conditions, please contact our survey team ([heju-survey@listserv.dfn.de](mailto:heju-survey@listserv.dfn.de)) or your respective doctoral representation (see table below). We are always happy to welcome new active and engaged members!

**Table 12.1:** Overview of doctoral representation at the centers.

Center	Name	E-mail
AWI	DokTeam	dokteam@awi.de
CISPA	CISPA HeJu Representatives	hejus@cispa.de
DESY	DOIT	doit@desy.de
DKFZ	PhD council	phd-council@dkfz.de
DLR	ProVe	prove@dlr.de
DZNE	DZNE PhD Representatives	phd-representatives@dzne.de
FZJ	DocTeam	docteam-speakers@fz-juelich.de
GEOMAR	DokTeam	dokteam@geomar.de
GFZ	GeoGrad Reps	phd@gfz-potsdam.de
GSI	DRC (Doctoral Researchers Council)	student.Representative@gsi.de
Helmholtz Munich	DINI (Doctoral Initiative)	doktorandeninitiative@helmholtz-munich.de
HZB	DocTeam	docteam@helmholtz-berlin.de
HZDR	DocReps	docreps@hzdr.de
Hereon	PhD Representatives	phd-reps@hereon.de
HZI	DO IT (Doctoral Initiative)	doit@helmholtz-hzi.de
KIT	Promovierendenbeirat	promovierendenbeirat-request@lists.kit.edu
MDC	PhD Representatives	phd_representatives@mdc-berlin.de
UFZ	DO IT (Doctoral Initiative)	doit@ufz.de

## Authorship and Acknowledgments

We would like to acknowledge that the work on single sections was always done in a collaborative manner among members of the Helmholtz Juniors Survey Team (Table 12.2).

**Table 12.2:** Contributions of members of the Helmholtz Juniors Survey Team: data preparation (P), writing sections (W), editing and providing feedback (E), data analysis and visualization (A).

Aga Seretny (DKFZ)	P,W,E
Anna Kilanowski (Helmholtz Muninch)	P,W,E,A
Carolyn Guthoff (CISPA)	P,A
Diana Sandoval Bojorquez (HZDR)	E
Enes Senel (MDC)	P,A
Florian Hantke (CISPA)	A
Hannah Eichhorn (Helmholtz Munich)	E,A
Ilana Schiller-Weiss (GEOMAR)	W,E,A
Islam Mansour (DLR)	E
Jennifer Popp (DESY)	P,A
Johannes Krämer (FZJ)	P,W,E,A
Lydia Federmann (FZJ)	P,W,E

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Finally, our most heartfelt gratitude to the 2134 Doctoral Researchers (DRs), who filled in the N<sup>2</sup>-Survey 2021. Your effort has enabled this analysis and will help to improve working conditions for future generations of DRs.

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