MAX PLANCK PhDnet
The doctoral network of the
Max Planck Society
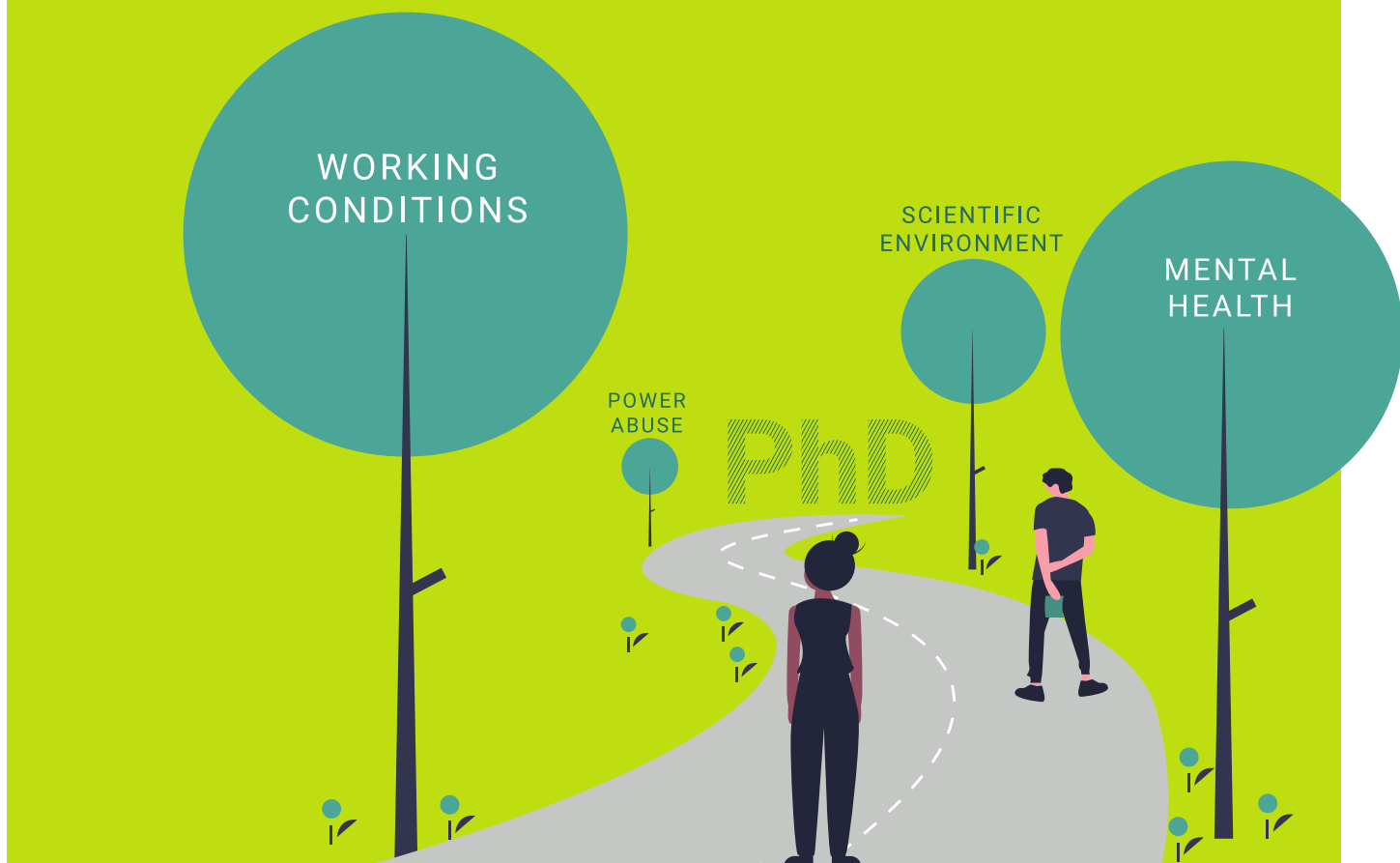
Max
Planck

P h D n e t

SURVEY
REPORT
2019

WORKING
CONDITIONS

SCIENTIFIC
ENVIRONMENT

MENTAL
HEALTH

POWER
ABUSE

PhD

Max
Planck

PhDnet Report 2019

PhDnet Survey Group

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Chapter 1

Introduction

The Max Planck Society (MPS) is one of the leading research institutions in the world [1]. With around 5000 doctoral researchers (DRs) or about 50% of scientific personnel, working at 86 Max Planck institutes, it is no exaggeration that DRs are one of the backbones of the MPS. Founded in 2003, the PhDnet is the network of DRs of the MPS, aimed at improving interdisciplinary cooperation, strengthening academic solidarity, and optimizing doctoral education & scientific exchange. To this end, the survey allows the PhDnet to represent the voices of DRs.

What is the aim of a PhDnet survey?

- The PhDnet survey makes latent issues visible, such as nationality based pay gap (Figure 2.2) or mental health issues (see Section 5.1). The survey helps gain insights into the most pressing challenges faced by the DRs, thereby enabling the PhDnet to work closely with the MPS general administration for short term and long term solutions. The survey also assists in translating qualitative human factors into more comparative measures, quality of supervision being one such case.

- The PhDnet survey helps in understanding the efficacy of the previously implemented improvements. For instance, in the PhDnet survey 2018, only 39% of the DRs reported being satisfied with the amount of contractually granted holidays [21]. After the change to 30 days of contractually granted vacation and the possibility to transfer holidays over to the next year [2], the current survey saw an enormous increase in satisfaction levels, with 83% of the DRs reportedly being satisfied with their vacation days (Figure 2.7).

- Power distance in a supervisor–DR relationship [5] might induce apprehensions in a significant number of DRs to voice their concerns openly, more so with international DRs from high power distance cultures [24]. Therefore, the anonymous nature of the PhDnet survey provides an ideal platform for DRs to voice their opinions discretely and offers a chance for this valuable feedback to be heard.

- The PhDnet survey gives a unique opportunity to inspect equality of working conditions and work satisfaction across demographics such as gender, nationality, and research area. Despite efforts from the general administration and individual institutes to lower inequalities, there are instances which remind us of George Orwell's famous adage, *"All are equal, but some are more equal than others"*. One such example is DRs working in a Humanities discipline, earning considerably less than their counterparts (Figure 2.2). Another such example is lower monthly income for female DRs compared to their male counterparts (Figure 2.2), which is not only driven by under- or over- representation of female DRs in sections of the MPS that generally earn more or less respec-
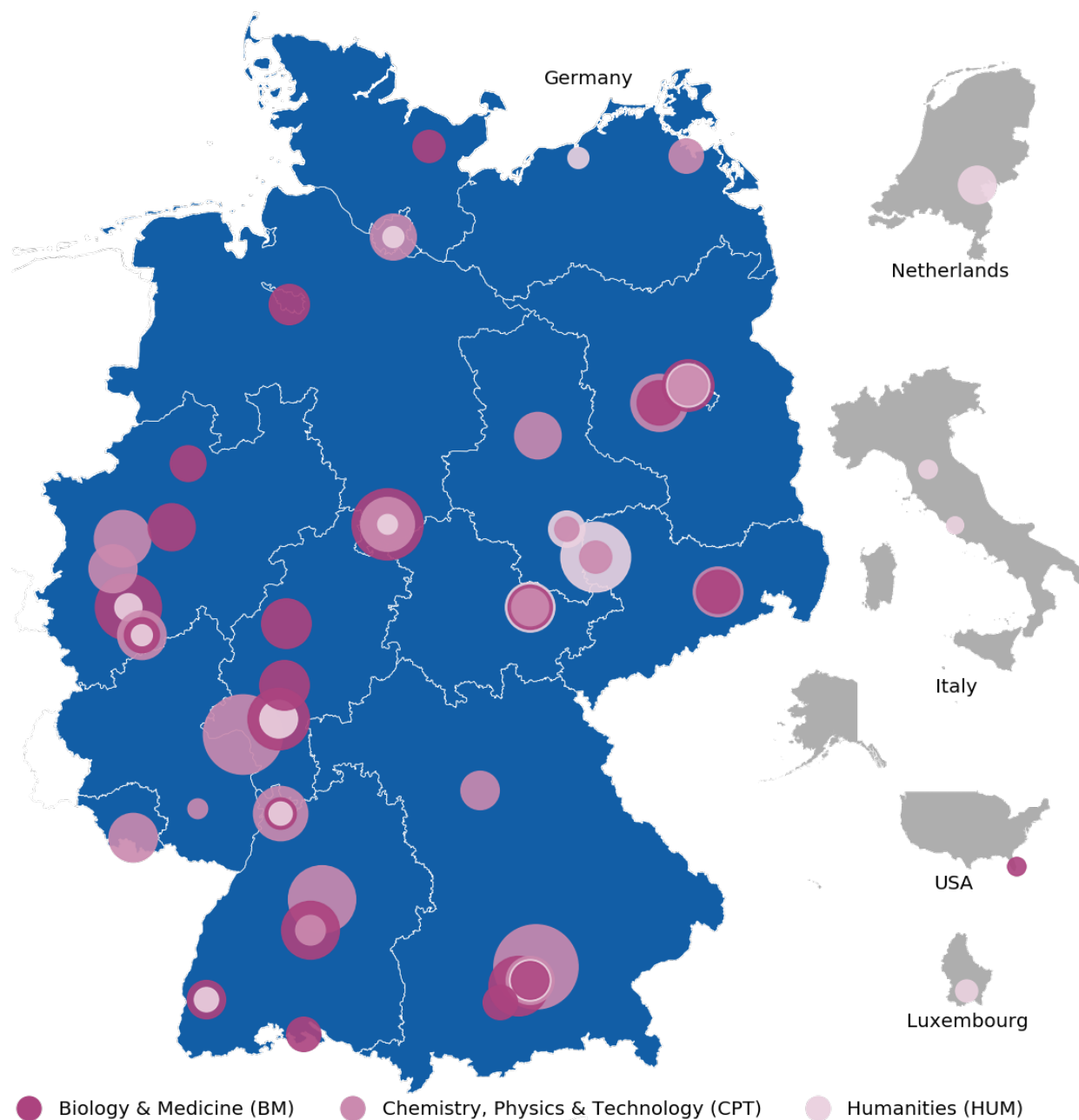
Figure 1.1: "Which Max Planck Institute are you associated with?" Distribution of responses from Max Planck doctoral researchers in Germany, Netherlands, Luxembourg, USA, and Italy color coded by section. Circle sizes are scaled by the number of responses.

tively. To quote a respondent *"I think there is a lot of implicit bias towards women and minorities and I've witnessed situations that could be interpreted as taking women less seriously, etc. [...]"* The numbers don't lie; the PhDnet survey divulges inherent unintentional biases, so that they can be addressed.

The earlier PhDnet surveys in 2018 and

2017, focused on studying the DRs' working conditions, supervision, career development, good scientific practice, and family planning. In the present edition of the PhDnet survey, for the first time this extensively, we turned the spotlight on mental health and power abuse related issues. Another salient feature of the current survey is the collaboration with the DR networks of the Helmholtz

and Leibniz associations wherein all the institutions ran the same survey questionnaire. This allows for a direct comparison, indicating the areas where MPS is faring well and aspects where MPS is falling behind vis-à-vis for other institutions.

1.1   Demographics

Of the contacted 4928 DRs, 2490 or 51% participated in the current survey providing us with invaluable data to gain statistically relevant and representative insights (Figure 1.2). The respondents include DRs from all institutes of the MPS, the distribution of respondents over the different institutes is shown in Figure 1.1. Of the total respondents, 41% identified themselves as female, 54% as male, and <1% of participants identify themselves with other gender representations. Gender proportions are significantly different in the three sections Humanities (HUM), Biomedical (BM) and Chemistry, Physics and Technology (CPT), as shown in Figure 1.3.
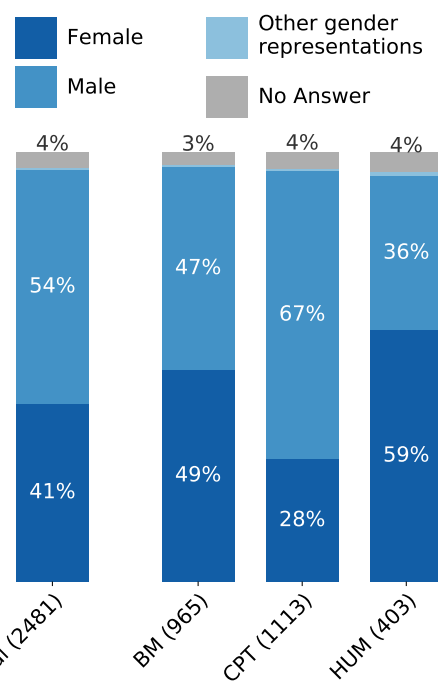
Figure 1.3: "To which gender do you identify most?" Relative response rates are grouped by section. The total number of responses is shown in brackets.
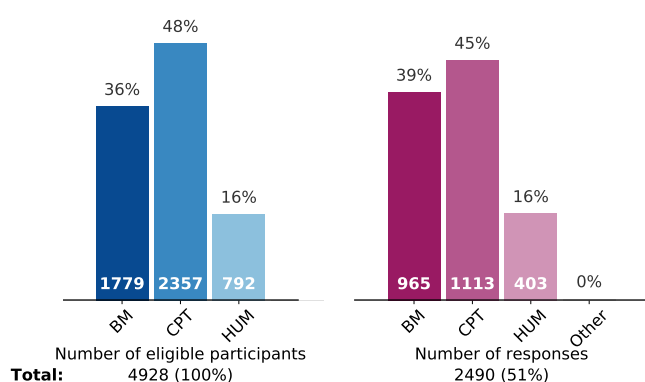
Figure 1.2: "Eligible participants and responses per section"

The average age of DRs at the start of their PhD is 26 (Appendix Figure A.1). Figure 1.4 provides the breakdown of the citizenship of the DRs. There are no major changes in the demographics as compared to the PhDnet survey 2018.

Figure 1.4: "What is your citizenship? Should you have multiple citizenships, please select the one you feel best represented by." Relative response rates are grouped by section. The total number of responses is shown in brackets.

Chapter 2

Working Conditions

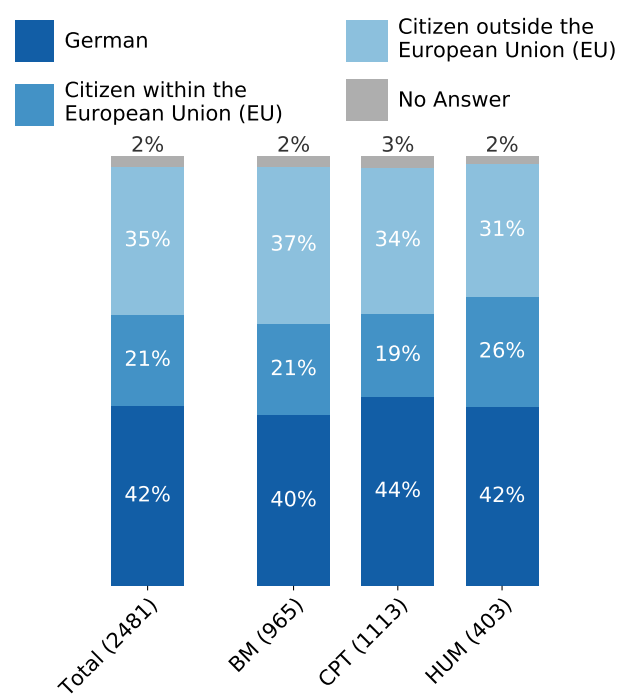Doctoral researchers (DRs) play a vital role in research production in the Max Planck Society (MPS). Ensuring adequate working conditions helps DRs to focus on their research and increases productivity [23]. In this chapter, we take a look at their working hours, work environment, and additional services offered to them and their impact on satisfaction.

2.1 Contracts and Salaries

The majority of DRs (90%) are employed through contracts (Figure 2.1), continuing the positive change from stipends to contracts seen over the last few years [7], [3], [21]. The Chemistry, Physics and Technology (CPT) section has the highest percentage of DRs on contracts (93%), followed by the Biomedical (BM) section (89%) while the Humanities (HUM) section falls behind (83%) partially due to the highest percentage of DRs that work unpaid (4.3%). It should also be noted that non-EU citizens are more likely to be paid by a stipend (11%) than EU and German citizens (4.5 and 4.3%, respectively). The income is typically oriented on the income categories of the public sector (TVöD/TVL level 13). Common salaries correspond to a 50% or 65% position, only a small minority is paid full time. The different types of contracts translate into substantial variations in monthly salary (netto) which can be seen in Figure 2.2, as well as different access to benefits, such as bonus payments
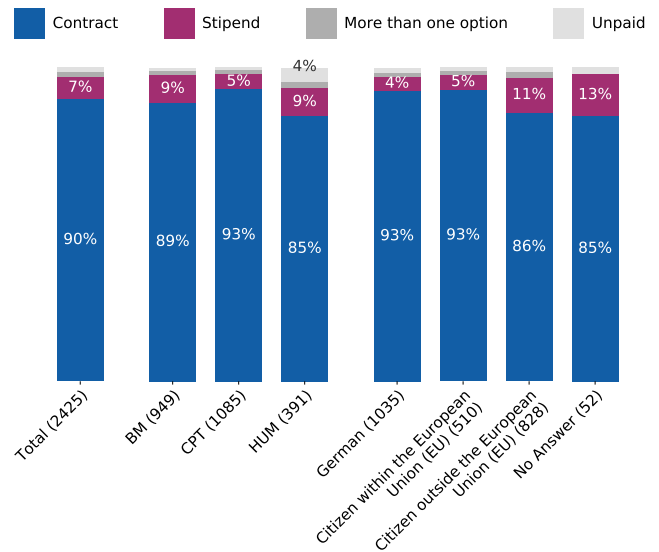
Figure 2.1: "Type of employment grouped by sections and nationality." The total number of responses is shown in brackets.

and additional vacation days. A bimodal pattern can be observed in the BM and CPT sections, representing the two most abundant income groups (50% respectively 65% of a TVöD/TVL, Appendix Figure A.5).

The sections have significantly different incomes (netto) compared to each other. The DRs in the CPT section earn more than those in the BM section[1]. The HUM section earns significantly less than both the CPT[2] and BM[3] sections. Consistent with results from previous years, there is a statistically significant gender pay gap, with female DRs earning 93€ less per month than their male col-

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[1] $t(2003) = 5.76$, $p < .001$
[2] $t(1456) = 8.65$, $p < .001$
[3] $t(1325) = 5.50$, $p < .001$

Figure 2.2: "Right now, what is your monthly net income for your work at your research organization? Net income is the amount of money transferred to your bank account every month." Y-axis shows the number of responses relative to each section and gender. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines.

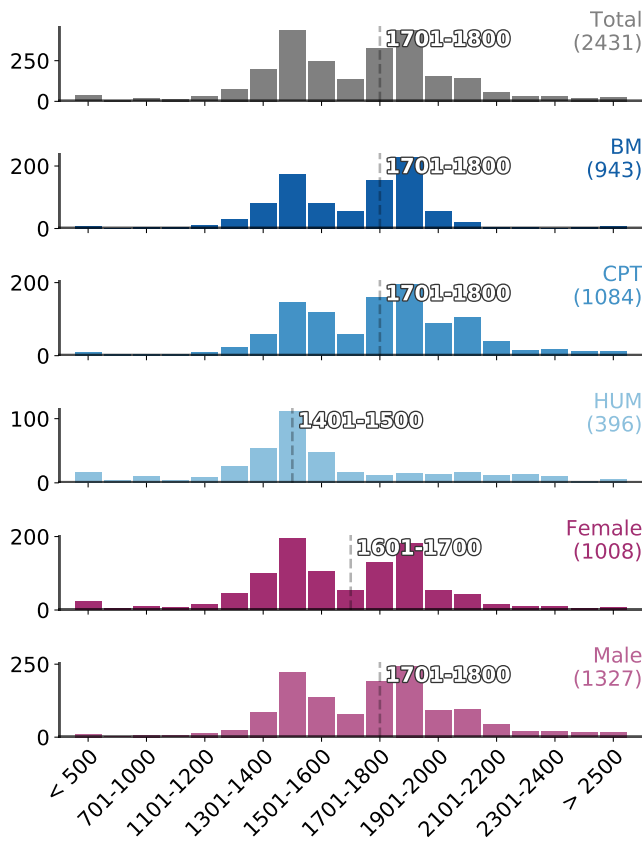leagues[4]. This effect persists even when correcting for the over-representation of women in the HUM section (59% vs 49% in BM and 28% in CPT) (Figure 1.3). Even within one of three sections, the CPT, a female DR earns 106€ per month less than her male counterparts[5] (the differences inside the HUM (72€ less)[6] and BM (18€ less)[7] section are not significant) and this is reason for concern.

Not only is there a discrepancy between male and females DRs, a striking difference is found between non-Europeans DRs and European/German DRs. Non-Europeans DRs

earn 70€ less per month compared to European/German DRs[8], while no significant differences are found between German DRs and Europeans DRs[9]. This difference is partially explained by the fact that a higher percentage of non-Europeans DRs are on stipends, but even when DRs receiving stipends are excluded from the analysis, a smaller but still significant difference is found[10]. Equal treatment independent of nationality should be aimed for in the future.

Approximately one in five DRs (23%) rely on external financial support (Appendix Figure A.8). DRs with lower net incomes are more likely to receive financial support (Appendix Figure A.9). The most common source of external support are parents (12%) followed by partner (7.6%), with females more likely to rely on support from a partner than males (12% to 4.3%, respectively).

The income inequalities observed in monthly income directly result in an inequality of what people are able to spend or save after rent is subtracted (Appendix Figure A.6). DRs of each income group spend a similar amount of money on rent (including utilities) independent of their income, allowing DRs with higher incomes more financial flexibility.

2.2   Security of Contracts

Short-term contracts are all too common in science and insecurity about the stability of contracts has been shown to negatively impact mental health [6]. The MPS recommends DRs are provided with a contract for the normal duration of their PhD (36 months [16]).

Currently 73% of DRs have received a contract of 25 months or longer providing stability throughout the PhD. However, shorter term contracts (6 months - 24 months) are

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[4]$t(2305) = 6.63, p < .001$
[5]$t(1024) = -5.02, p < .001$
[6]$t(366) = -1.60, p = 0.11$
[7]$t(904) = -0.95, p = 0.34$

[8]$t(2347) = 4.87, p < .001$
[9]$t(1515) = -1.01, p = .31$
[10]$t(2192) = -2.87, p < .004$
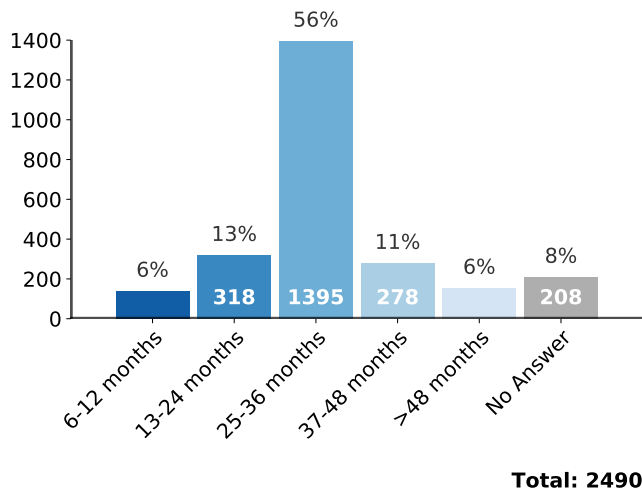
still quite prevalent (19%) (Figure 2.3).

Figure 2.3: "What was or is the longest duration of your contract or stipend related to you PhD project?" Y-axis shows number of answers.

Additionally, we find that the longer a DR has been working on their project, the longer they think they will need overall to complete their PhD (eg. in the first year only 18% estimate they will need more than 3 years, compared 26% of second-year DRs). For the majority the initial 3 years is not enough, with a duration beyond 4 years being a common phenomenon (18% in 3rd year expect to need more than 4 years (Figure 2.4 and Appendix Figure A.13). The change in self-reported finish time highlights the importance of clear on-boarding procedures to honestly outline how long a PhD takes and for clear project management to prevent unnecessary delays.

The ability to extend a contract in specific situations is another level of security that can be provided to DRs. Currently the process to get an extension is not very transparent and reliable, providing an unnecessary base for disagreements and struggles. DRs indicate that when more time is needed to complete a PhD project or a wrap-up phase is required after a PhD, 82% and 65%, respectively, are aware of the possibility to extend. Surprisingly only 46% of the DRs indicate that it is possible for them to extend their PhD contracts due to parental leave. DRs with children or expecting children report
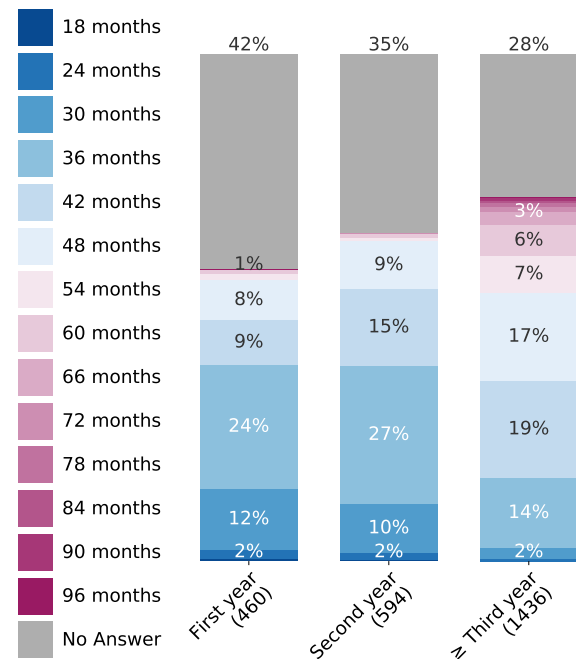

Figure 2.4: "Expected duration until submission of thesis based on self-reported finish time"

higher but still rather low (58%) awareness of this possibility (Appendix Figure A.10). Non-European DRs are significantly less informed than German/Europeans DRs about the ability to extend because of parental leave[11]. Anyone who pauses their PhD project to start a family should be able to extend their PhD and everyone should be aware of this. There is room for improvement of this information flow.

2.3 Working Hours and Holidays

On average, DRs work 46-50 hours per week (Figure 2.5) and 83% of the DRs work more hours than specified in the contract (Appendix Figure A.14). Comparing the different sections, in line with the results from 2018, DRs in the BM section work more hours than those both in the CPT[12] ($\approx$ 3 hours more) and HUM[13] ($\approx$ 5 hours more) section. This year we also found that DRs working in the CPT

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[11]$t(1070) = -9.25$, $p < .001$
[12]$t(2004) = 7.013$, $p < .001$
[13]$t(1319) = 8.57$, $p < .001$

section on average worked more hours than those in the HUM section[14]. Additionally we found that male DRs in the CPT and BM sections work approximately 1 hour more per week than their female counterparts[15].
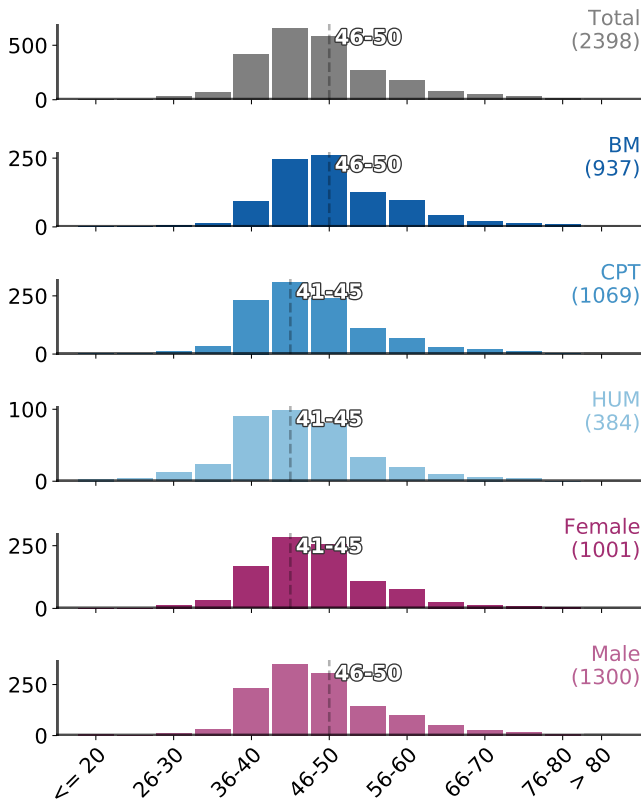

Figure 2.5: "On average, how many hours do you typically work per week in total? Working time – that is both for your dissertation and all other tasks you have to perform at your institute or university, for instance project work or meetings (in your office as well as at other places) and teaching." Y-axis shows the number of responses relative to each section and gender. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines.

It is also interesting to note that the working hours do not significantly differ when comparing TVöD/TVL 50% with 65% contracts[16], so even though some DRs get paid 30% more than other DRs and sometimes even have different amounts of contractually specified working hours, they actually work the same hours (Appendix Figures A.11

and A.12).

Accommodating all these working hours, DRs report working on weekends or public holidays regularly, most commonly twice per month (26%), although 10% report working every weekend and 18% report working at least three times per month. In contrast, only 4.1% report never working during weekends or holidays (Appendix Figure E.30).
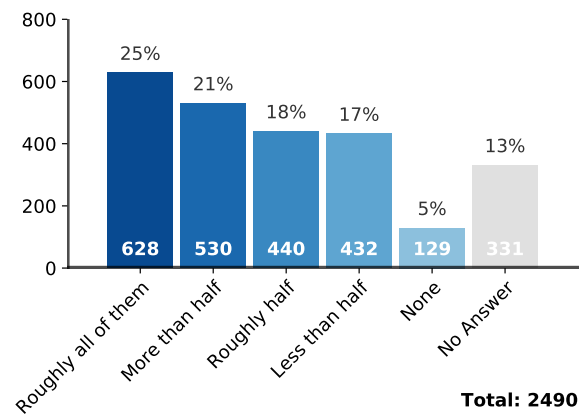

Figure 2.6: "How many days of your entitled holidays did you take in the past year?" Y-axis shows number of answers.

Taking holidays has been shown to help with recuperation from hard work. In the beginning of 2019, an agreement was reached to grant DRs with a Doktoranden Fördervertrag 30 holidays instead of 20. Currently 78% of DRs have 29 or more holidays each year (Appendix Figure E.16). A quarter of the DRs use roughly all of their holidays, while 5.2% do not take any of their holidays (Figure 2.6 and Appendix Figure A.15). There are no significant differences in holidays taken between the sections[17]. However, non-Europeans take significantly less holidays than Europeans and Germans[18]. Interestingly they only report feeling slightly less free to take holidays, this is mostly explained by more often saving up holidays for an extended holiday (Appendix Figure A.16).

There can be many reasons for not taking

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[14]$t(1451) = 3.54$, $p < .001$

[15]CPT: $t(1024) = 2.16$, $p = .031$, BM: $t(902) = 2.31$, $p = .021$

[16]$t(1475) = -0.78$, $p = 0.44$

[17]CPT vs BM $t(1826) = 0.54$, $p = 0.59$, CPT vs HUM $t(1310) = -0.16$, $p = 0.87$, BM vs HUM $t(1158) = -0.53$, $p = 0.60$
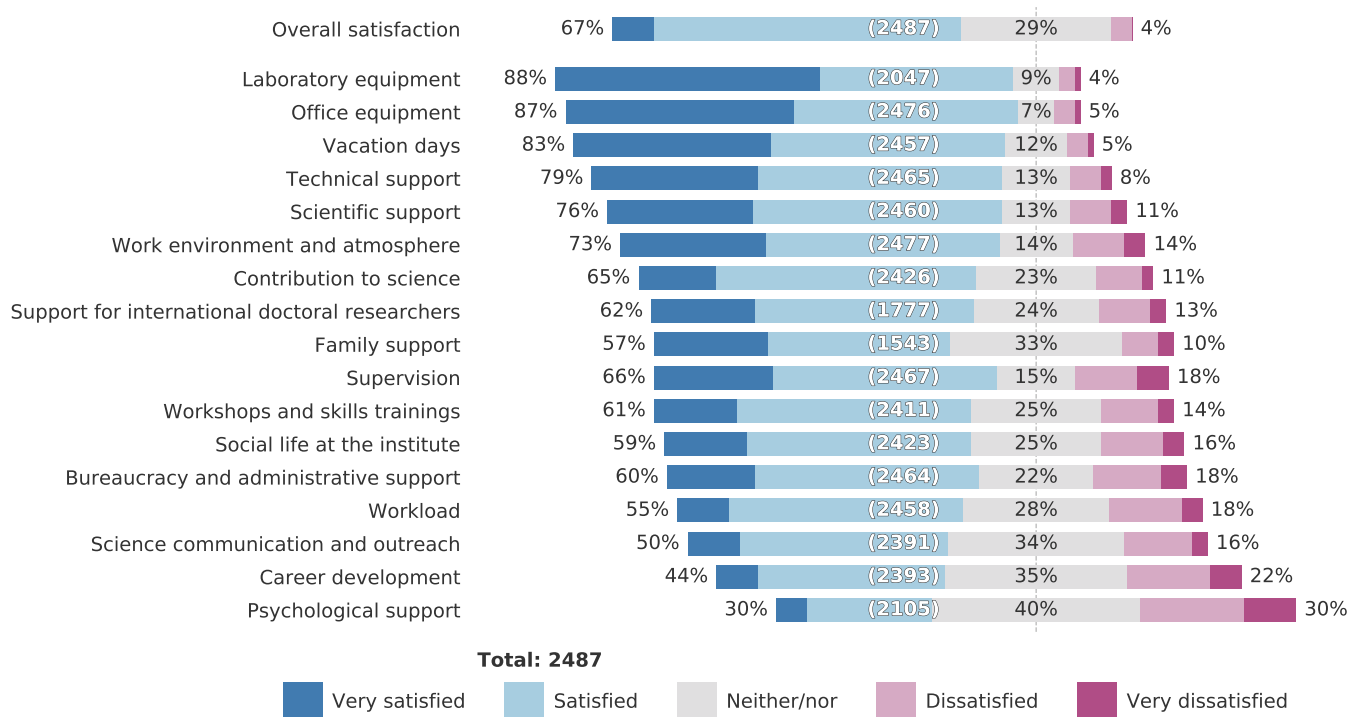
[18]$t(2106) = -4.55$, $p = < .001$

Figure 2.7: "If you think about your own situation as a doctoral researcher, how satisfied are you with the following aspects?"

holidays, the most common one (31%) being the pressure from the high workload (Appendix Figure A.16). More than half of the DRs (63%) feel free to take their holidays, however, 9.0% indicate that pressure from their supervisors reduces their freedom to use their holidays.

Even though not all DRs feel free to take all their holidays, DRs feelings of satisfaction regarding their holidays have increased strongly since the implementation of 30 days of vacation[19] from 39% in 2018 [21] to 83% in 2019 (Figure 2.7).

2.4 Satisfaction

As already mentioned, DRs are largely satisfied with their vacation days. Other areas of high satisfaction are laboratory equipment, office equipment, technical and scientific support (Figure 2.7).

DRs are the most dissatisfied about psy-

chological support, career development, science communication and outreach, and the workload. This low satisfaction can be correlated with the shocking prevalence of at least mild mental health problems among the MPS DRs described in section 5. This is also clearly supported when DRs are asked what aspects of their work they would like to be improved (Figure 2.8), where both career development (85%) and psychological support (74%) make it to the top three aspects that should be improved, after salary and benefits (86%).

Compared to the recent data from NACAPS (a study of more than 20.000 DRs in Germany), MPS DRs express similar to slightly higher levels of satisfaction with supervision. From NACAPS [12], 54.6% of the DRs are satisfied with their general supervision and 63.2% are satisfied with their main supervisor. This survey revealed similar finds; 66% of MPS DRs are satisfied with their supervision (Figure 2.7).

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[19]30 holidays press release

2.5 Quitting

Quitting your PhD is a difficult choice that 34% of DRs at the MPS have considered either "often" or "occasionally" (Appendix Figure A.18). Female DRs have considered giving up more often than male DRs, 40% and 28% respectively. Additionally, the closer DRs are to finishing their PhD, the more often quitting is considered (Appendix Figure A.19). Only slight differences were found between sections, and no clear pattern was observed for different income groups (Appendix Figure A.17).

"A student must be payed till the day of their defense. It is not only a financial problem, but as an international student, it creates major problems for extending the visa. Students are working on unemployment money, which is simply wrong. Also if a student is struggling to generate sufficient data for a PhD, the supervisor should also be held accountable."

(Anonymous respondent)

"The contract is three years which is not enough to finish the Ph.D. We have to struggle for the extension of the contract and visa which is tiring and distract us from research."

(Anonymous respondent)

"PhDnet effort to get 30 days of holidays for all students was great but the number of days is not the issue at my institute. Ensuring people actually use those days is. This is very discouraged due to workload and institute culture."

(Anonymous respondent)

2.6 Key Findings

- DRs in the HUM section earn significantly less than both the CPT and BM section. Additionally, there is a statistically significant gender pay gap, with female DRs earning less than male colleagues, even when correcting for different gender proportions in the sections. Lastly, non-Europeans DRs are more likely to be on stipends (11%) and earn significantly less than Europeans, while no differences are found between German DRs and European DRs.

- Shorter term contracts (6 months – 24 months) are still quite prevalent among DRs (19%) even though against recommendation of the MPS [16].

- PhD projects with a duration beyond 4 years are a relatively common phenomenon (18% in 3rd year expect to need more than 4 years).

- Awareness of the ability to extend due to parental leave is surprisingly low.

- DRs feelings of satisfaction regarding their holidays have increased considerably.

- DRs are satisfied overall, especially with scientifically relevant categories, like equipment and technical/scientific support. However, lacking psychological support, career development and training contribute the most to dissatisfaction.
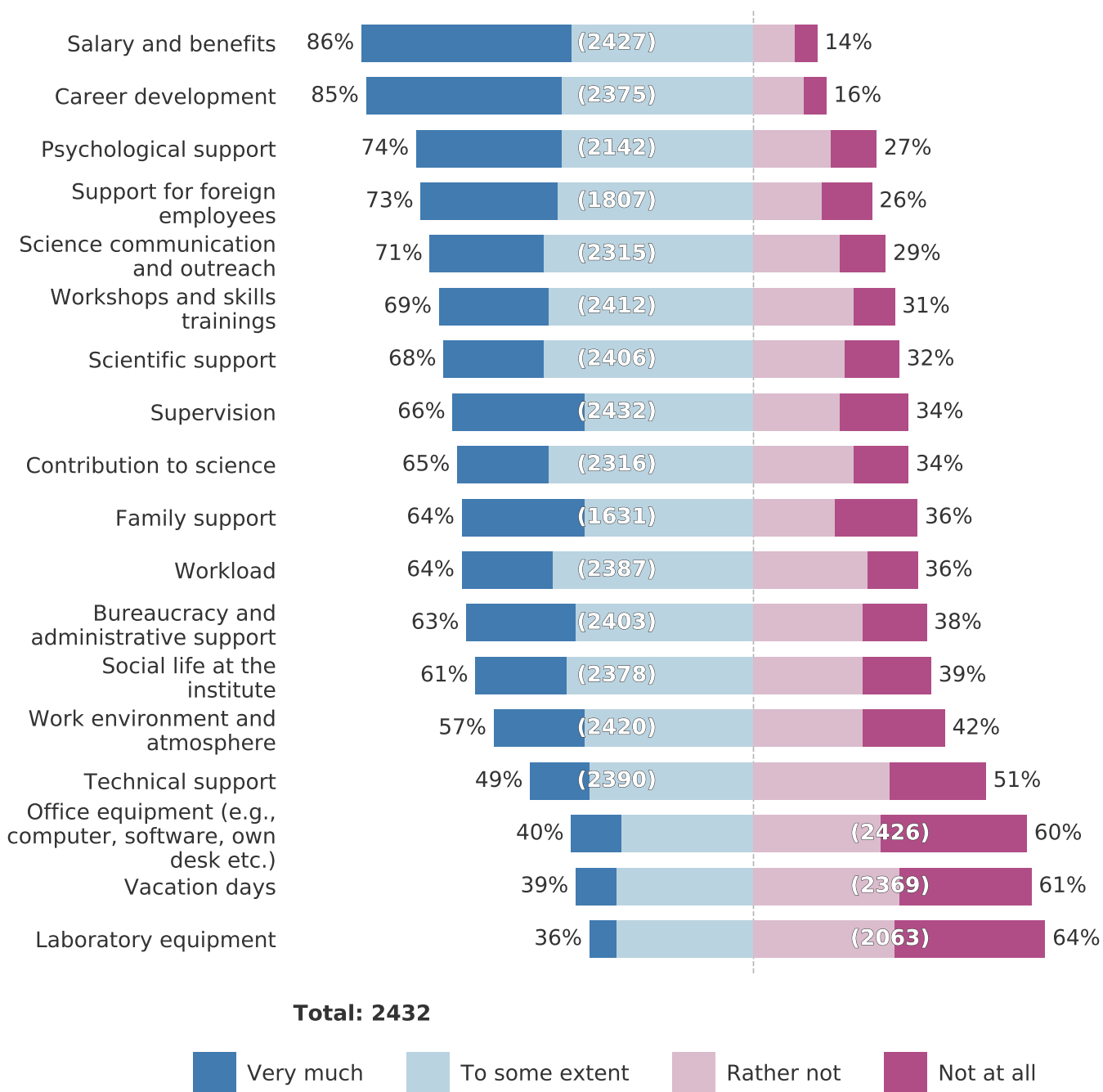
Salary and benefits	86%	(2427)	14%
Career development	85%	(2375)	16%
Psychological support	74%	(2142)	27%
Support for foreign employees	73%	(1807)	26%
Science communication and outreach	71%	(2315)	29%
Workshops and skills trainings	69%	(2412)	31%
Scientific support	68%	(2406)	32%
Supervision	66%	(2432)	34%
Contribution to science	65%	(2316)	34%
Family support	64%	(1631)	36%
Workload	64%	(2387)	36%
Bureaucracy and administrative support	63%	(2403)	38%
Social life at the institute	61%	(2378)	39%
Work environment and atmosphere	57%	(2420)	42%
Technical support	49%	(2390)	51%
Office equipment (e.g., computer, software, own desk etc.)	40%	(2426)	60%
Vacation days	39%	(2369)	61%
Laboratory equipment	36%	(2063)	64%

Total: 2432

Very much   To some extent   Rather not   Not at all

Figure 2.8: "Which of the following aspects of your work as a doctoral researcher would you like to be improved?"

Chapter 3

Scientific Environment & Support Structures

3.1 Availability of Scientific Support Structures

In order to provide a framework for doctoral education, the Max Planck Society (MPS) has commissioned guidelines [10] which encourage institutes to establish support systems for doctoral researchers (DRs). These include Thesis Advisory Committees (TACs) as well as support and supervision agreements. In this chapter, we analyze the prevalence and efficiency of those systems, as well as other measures contributing to a good scientific environment. Definitions of those instruments can be found below[1].

Figure 3.1 indicates that less than half of the DRs are aware of the PhD Guidelines. In addition, we observe that both TACs and supervision agreements are in place only for less than two-thirds of DRs in the MPS, with
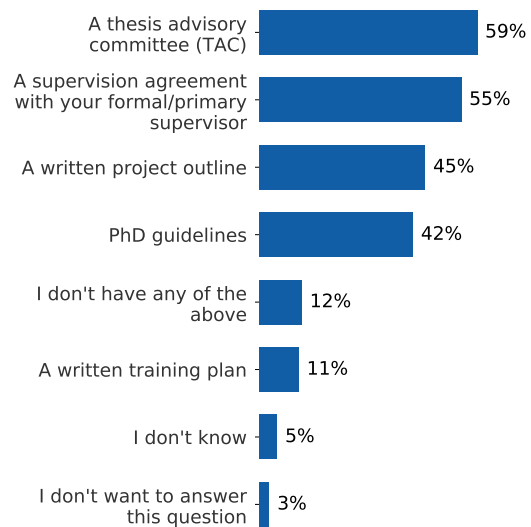
Figure 3.1: "Do you have one of the following? " Definitions of all instruments were given in the question. *I don't have any of the above* includes also the training plan.

[1]*PhD supervision agreement:* This is a written agreement between the formal/primary supervisor and the doctoral researcher outlining their responsibilities from the beginning of the PhD project until the completion of the doctoral thesis. *Project outline:* This is a preliminary project plan defining the objectives of the PhD project as well as the methodology to achieve them within the given time frame of a doctoral research project. *Training plan:* This is a plan detailing the courses mandatory for the completion of your PhD. *Thesis advisory committee:* A thesis advisory committee or TAC is a group of two or more independent researchers (including your formal/primary supervisor) who you meet on a regular basis, give you advice on how to progress and successfully complete your PhD project.

the PhD Guidelines themselves known only by every second DR. These facts point out a substantial gap between intended structures and their actual implementation. Though the fraction of DRs with a TAC is much higher than usual in Germany, where only 20% of all DRs have more than 2 supervisors [12], there is still a substantial gap between intended structures and their actual implementation. Interestingly, supervision agreements are less prevalent in the MPS compared to the average in Germany (62% vs 75%). Instruments going beyond a super-

vision agreement, such as project or training plans, are established in a few places but still very rare. Furthermore, we find that 74% of respondents are members of a graduate school (Appendix Figure E.59), providing a structured framework for doctoral studies. This is twice as common to the average DR in Germany (37%) [12].

3.2   Effects of Scientific Environment

In order to better understand the effects of the above listed support instruments, we summarized in this paragraph how they influence satisfaction and the supervision of doctoral researchers. The first important finding is, that all measures improve the overall satisfaction, and having none of them decreases satisfaction by 3.7 percentage points. When, comparing the instruments listed in Figure 3.1, the biggest effect on satisfaction is induced by having a training plan (3.0 percentage points – Figure 3.2), followed by knowing the PhD guidelines (2.5 percentage points), a supervision agreement (1.5 percentage points), and a project outline (1.2 percentage points). The fact that, knowing the PhD guidelines has a big impact could be an indication that providing DRs with clear information is key to their satisfaction. In combination with the finding that only 47% receive this kind of information, we conclude there is a communication deficit, as at least the MPS guidelines are in place for all DRs in the MPS – in addition to potential local regulations.

Interestingly, TACs being the most abundant instrument, have the smallest effect (0.7 percentage points), but there is a strong dependency of their impact on supervision, based on how frequent DRs actually meet their committee (Figure 3.3). This could be an indication, that by now TACs are a widely recognized necessity, but if they are not functioning properly, they do not have
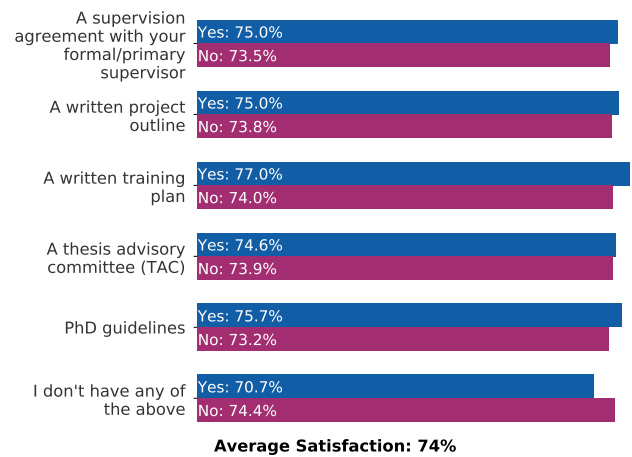
Figure 3.2: Effect of support instruments on overall satisfaction Red respectively blue bars represent DRs not having / having the indicated support. The values represent the overall satisfaction score on a scale from 0%=very dissatisfied to 100%=very satisfied, see also method section.

the intended effect. Our data reveal that meeting TACs at least once a year has a positive correlation with the satisfaction about supervision.

Another perspective is provided by the question, whether DRs encountered problems with regard to different aspects of their supervision: Those having no scientific support instruments are substantially more likely to encounter problems (Figure 3.4). This was especially pronounced for those not having project outlines or supervision agreements. Additionally, deficits occur in this group in the frequency of meetings, scientific expertise in the group, and feedback/encouragement. The positive impact of the listed instruments is further supported by the direct question: Do you believe you profit from enrollment in your graduate school? (Appendix Figure E.60). Therein 68% agree with this statement, whereby only 20% say they do not profit from it. Also among those, who are not in a graduate school 41% believe they would profit from being in one, with only 23% saying they would not expect to profit (Appendix Figure E.62).

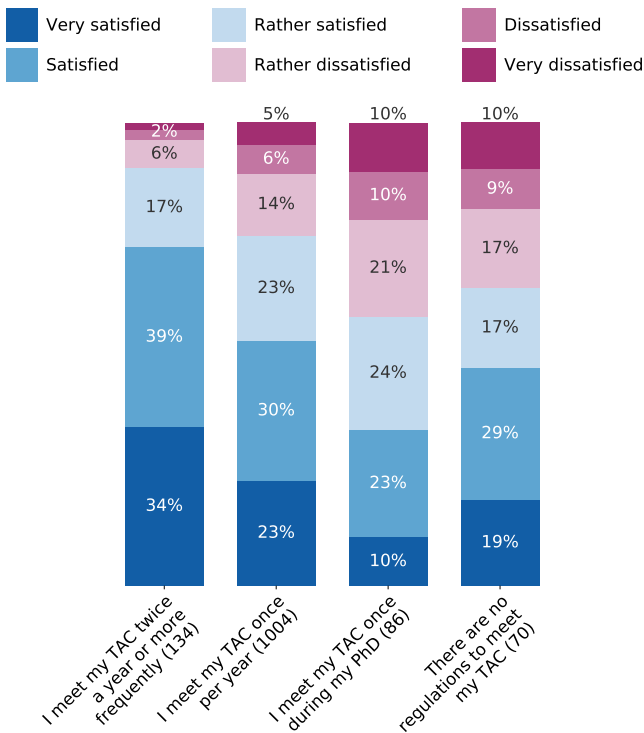A key aim of project plans is certainly to help DRs critically evaluate their progress and

Figure 3.3: How satisfied are you with your PhD supervision in general? Responses grouped by frequency of TAC meetings.

potentially also finish in a shorter time, because they know what tasks to prioritize. Figure 3.5 shows that those having a project plan are able to critically judge the status of their project. Interestingly, 58% indicate that they are behind or far behind their outlined progress. This could be an indication that project plans fail to assist DRs in finishing their project in the initially agreed time frame. On the other hand, with the uncertainties in science, it can also be interpreted as those having a project plan making realistic assumptions about their progress. To evaluate more precisely the effects on the time needed for graduation, better information about the PhD duration is needed. This could be delivered at the time of the defense by exit polls or statistics about the extended time.

Summarizing this paragraph, we have demonstrated that all of the discussed instruments for a more structured doctoral project help to improve the satisfaction as

well as the quality of supervision. But we also find, that the pure fact of having installed such measures does not fulfill the purpose. This becomes clear with TACs and project outlines: only their proper implementation (frequent meetings respectively realistic time estimates) result in a successful improvement of doctoral education.

3.3 Support for International Scientists

Starting doctoral studies in itself is challenging but these challenges can be further compounded by moving to a new country, adapting to a new culture, and learning a new language. Another challenge especially for non-EU nationals can be differences in power distance[2] coming to a German working environment. This may be a reason for special challenges arising for supervision. These are just a few of the hurdles international DRs have to face.

What is the MPS doing to support international DRs and are these measures adequate? Between 40 and 60% of the respondents received support in the categories included in the survey, as shown in Figure 3.6. However, they also reported needing more support in all of the categories. Especially finding accommodation, university enrollment and translation of work-related documents. This shows that though support is given, it is not yet adequate to the needs of the international DRs. Additionally, such support is not exclusively helpful to international researchers, but also those moving within Germany. This is especially true for finding accommodation: 35% of all DRs indicated needing more support in this area (Appendix Figure E.65). Overall 62% of internationals would have needed more support as compared to 44% of all DRs. This highlights the need for more support for all DRs

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[2] "Power distance" here refers to different concepts and perceptions of hierarchy [24]
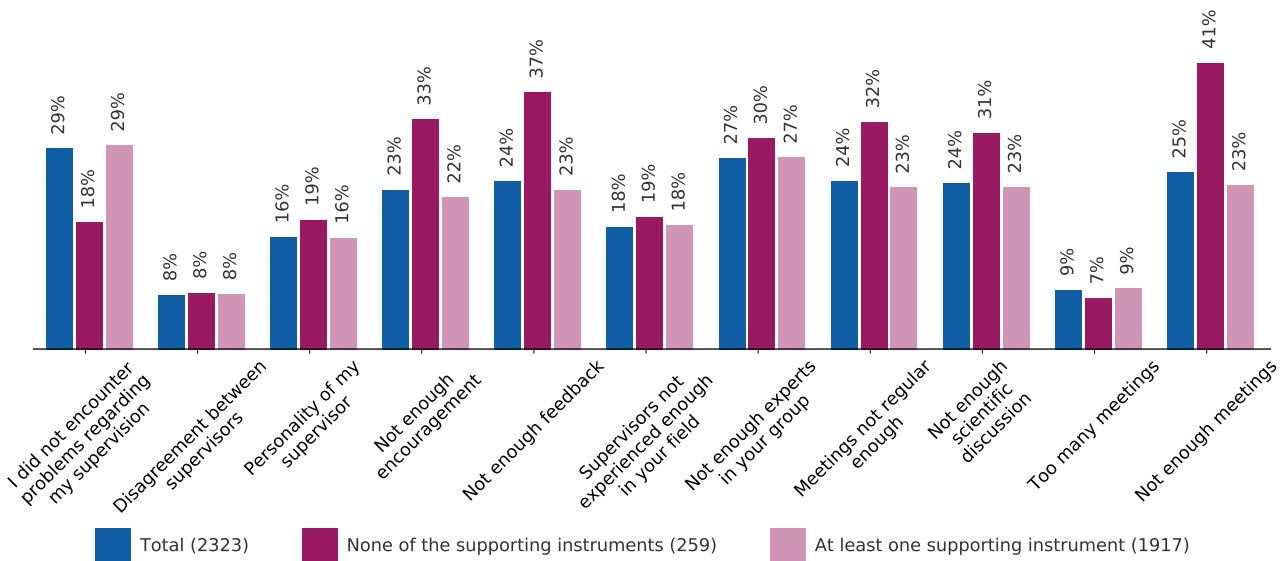
Figure 3.4: Did you ever encounter problems regarding your supervision? Answers are filtered for having at least one and not having one of the above scientific support instruments. Answers to the question were selected based on significance of of the induced difference.
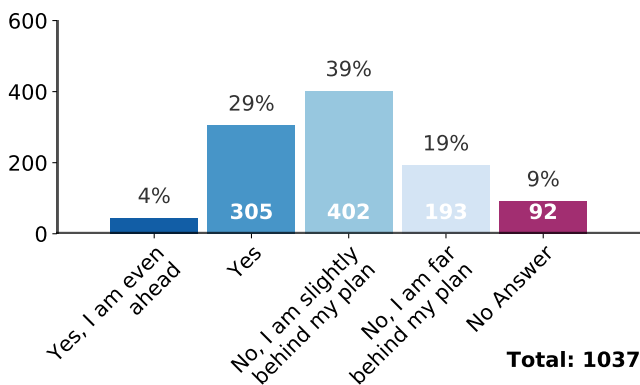

Figure 3.5: Is your project progress according to your (reviewed) project plan? Filtered by DRs having a project outline.
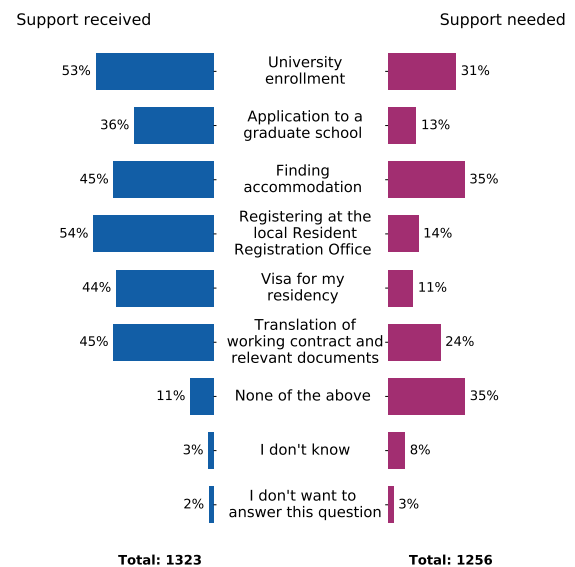

Figure 3.6: For which of the following aspects did you receive support from your institute? (blue bars) For which of the following aspects would you have needed more support from your institute? (red bars) Responses filtered for non-Germans only.

and especially for internationals integrating into the MPS.

Another barrier faced by international DRs to varying degrees is language. About half of the respondents state that language is an obstacle for communication with people at their institute (Appendix Figure 3.7). Critically, 37% report that important information is not available to them in a language they understand (Appendix Figure A.21). International DRs have taken steps to personally address this by taking language classes offered by their institute and elsewhere (33% – Appendix Figure A.22) however, 3.3% don't

receive support by their institute to attend language classes (Appendix Figure E.78). Though institutes are providing some assistance with learning German more still needs to be done to improve general communication and particularly accessibility of important information.

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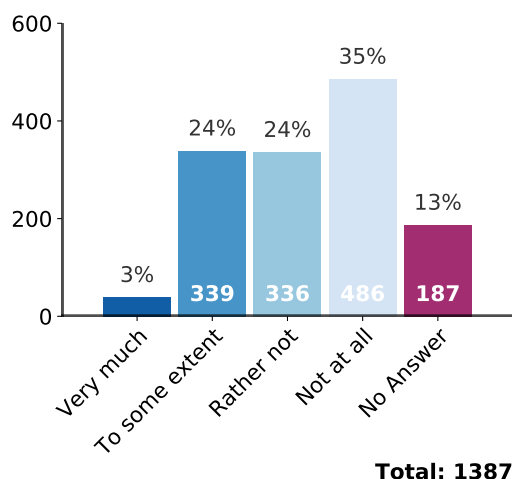
Figure 3.7: Is language an obstacle for communication with people at your center/institute? Responses filtered for non-Germans only.

3.4　Career Development

Career paths of DRs after graduation are diverse. In our previous reports [3] [21] we identified a gap between career wishes and realistic expectation. Updated results can be found in the Appendix (Figure E.75-E.79), summarized briefly: In general 45% of DRs do not feel prepared for a job outside of academia, which holds true, independent from where they wish to pursue their career (Appendix Figure A.20). Reasons could be that many institutes do not offer career development offices (58%), structured mentoring programs (32%), and support for a transition to a non-academic career via career fairs (32%) for example (Appendix Figure E.77). Scientific research in non-academic and academic positions is the most attractive career option for DRs (Figure 3.8). Non-scientific jobs or working in the science related industry are less favored, but play a bigger role in the realistic expectations. Still 19% like the idea of starting their own business, but only 10% believe this option will materialize.

> *"I love science and I have to make up my mind to fight in the system if I want to do science"*

(Anonymous respondent)
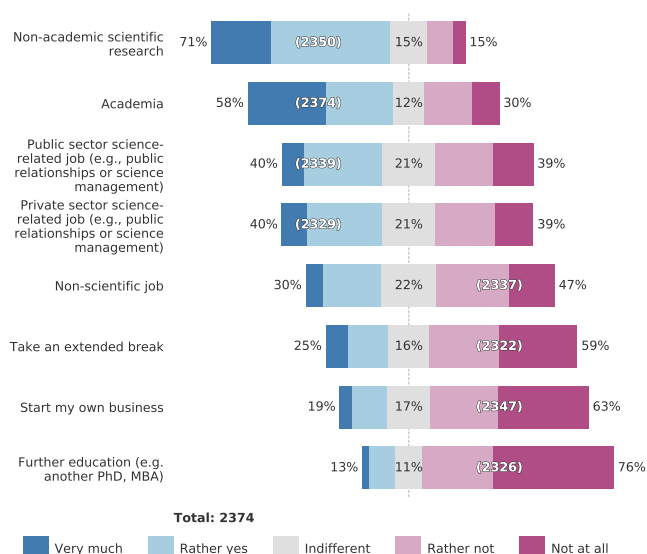
Figure 3.8: Which field would you like to work in after completing your PhD? The percentages at the end of the bars represent the sum of "very much" and "rather" on either side. Responses indicate wishes, comparison to expectations can be found in the Appendix Figure E.75.

3.5　Family Planning

Overall, 7.8% of Doctoral Researchers in the Max Planck Society have children (Appendix Figure E.80). This is not only significantly less than average female academics in Germany (12% for women aged 25-29; 42% for women aged 30-34) [20] [4], but also less than the mean number of parents among doctoral researchers in Germany (16.8%) [12]. Furthermore, this number has not changed in the last 10 years [7] [3] [21], according to published Max Planck PhDnet reports. Interestingly we find, that DRs working in the Humanities section (HUM) are three times more likely to have children (16%) than those in the other sections (5.9% in Biomedicine (BM) and 6.4% in Chemistry, Physics & Technology (CPT)). This pattern has been reported before [12]. Our data suggest that this difference may be attributable to a significant age difference with HUM DRs being significantly older (30.2 years) than their colleagues in the CPT (27.8)[3] and BM

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[3]$t(1312) = 9.19$, $p < .001$

(28.0)[4] section (Appendix Figures A.2 and A.3). In line with this hypothesis we find that DRs with children are significantly older (31.3 years) than those who are not (yet) parents (28.0 years)[5].

The most frequent reasons for not starting a family are personal (42%) and non–family friendly working conditions (32% –Appendix Figure E.81). This is in agreement with our previous surveys, which found a lack of money and incompatible working conditions among the most important reasons prohibiting DRs to have children. It is interesting to see that 70% of DRs do not know what kind of support for parents exisit in the MPS and within their institute (Figure 3.9). On the other hand we find that access to daycare (76%) and financial support for this (60%), are regarded as the most helpful supportive measures for parents. They would also make use of opportunities for mobile work/home office (59%), in case they would have children (see Appendix Figure E.83). Overall DRs express, that there is too little support for raising a child, which holds true for parents (33% say there is enough support / 40% there is not) as well as the full cohort (12%/16%) (Appendix Figure E.84).

"The graduate school should have more say in the contracts of the students, to decrease the sole dependency of the student on the supervisor. The dependence of the student on the supervisor both financially and scientifically make the relationship very unequal, and allows for the mistreatment and bullying of students."

(Anonymous respondent)

"The graduate school was the most helpful support network for the PhD."

(Anonymous respondent)

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[4]$t(1202) = 8.24, p < .001$
[5]$t(2128) = 9.24, p < .001$
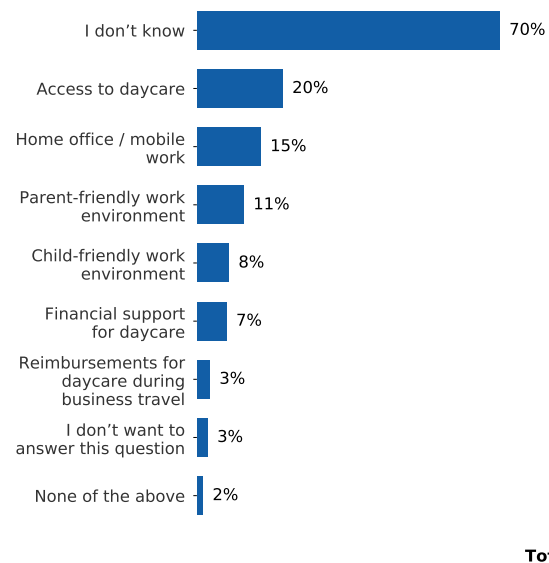
Figure 3.9: Does your institute offer support in child–care services?

3.6 Key Findings

- The majority of DRs in the MPS are part of a structured PhD program (74% are in a graduate school, 59% having TACs). Nevertheless, especially the number of DRs having a TAC is still quite low, given TACs are officially recommended by the MPS [16].

- About half of the DRs have a written project outline or a supervision agreement but only 11% have a written training plan. This is certainly an aspect of graduate training that can be improved and will most likely also lower project durations and prevent project termination.

- DRs that have TACs and supervision agreements are in general more satisfied.

- 2 out of 3 international DRs do not receive sufficient support to settle and establish in the new environment upon arrival.

- There is wide spread support for career development, but transition out of academia is scarcely supported.

- There is no change in the fraction of parents over the last 10 years (constant 7-8%) and 40% of parents feel there is not enough support for raising a child.

Chapter 4

Power Abuse

Power imbalances are inherently a source of abusive behaviour and conflicts, especially when many dependencies are focused on one person. Accordingly, it is not surprising that in the academic system, where doctoral researchers (DRs) are traditionally instructed by a single supervisor, reports of power abuse are emerging. To better understand the prevalence of such events, we decided to asses their number and characteristics in this study, which will also make comparisons to the Max Planck Society (MPS) wide employee survey conducted in 2019 [22].

4.1 Prevalence of Power Abuse

Overall 5.1% of DRs have filed reports of conflicts with superiors (Figure 4.5). Twice as many DRs have experienced conflicts, but did not file a case with any official body. In order to capture the many facets of conflict and power abuse, we will be describing in these paragraphs the abundance of patterns that can be expressions or indicators for a hostile working environment.

This survey finds that 13% of DRs have experienced being bullied themselves by a superior at least once (Figure 4.1). Details about the recurrence of bullying can be retrieved from Appendix Figure A.28. Interestingly, more than twice (24%) as many DRs have reported witnessing bullying of others (Appendix Figure E.58). This might suggest that bullying is more prevalent than the self-reported numbers indicate. In compar-

ison the MPS survey finds 10% self-ascribed bullying [22], but these values include bullying from all levels and they report that it is predominantly horizontal bullying they are measuring. However, horizontal bullying is between colleagues of a similar position, without power dependencies. Accordingly, we find a substantially higher prevalence of bullying than the report of the MPS. This highlights the importance of having data from multiple approaches to asses such hard to quantify phenomena like bullying or power abuse.

Furthermore our analysis reveals substantial variations in exposure to bullying across sections, nationality, and gender (Figure 4.1): Women are almost twice as likely to experience bullying as compared to men. The gender spectrum that is most affected by bullying is those that identify with a different gender representation than male/female: 1 in 4 reported bullying by a supervisor. Interestingly, DRs working in the biomedical (BM) section report most bullying cases (17%). This is higher than the humanities section (13%), which has a higher share of women and other gender representations (section 1.1). Accordingly, there must be other factors than gender that result in a higher prevalence of toxic relationships between supervisor and DRs in the BM section. Results from other sections of this survey provide indications for what these factors could be: higher average working hours in the BM section (Figure 2.5) point to higher general pressure, which could promote such

negative behaviour.

Moreover, we find non–Germans are exposed more to bullying of superiors than their German colleagues, with non–EU citizens experiencing most cases in relative terms (15%). Similar trends were observed in the MPS employee survey [22], but again the herein reported abundance of bullying is substantially higher.

Total (2261)   Male (1276)
BM (886)   Other gender representations (13)
CPT (1007)   German (993)
HUM (368)   Citizen within the European Union (EU) (489)
Female (972)   Citizen outside the European Union (EU) (779)
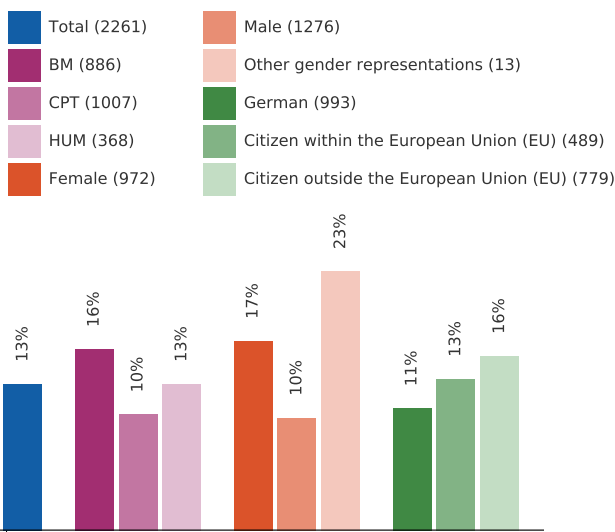
Figure 4.1: While working at your institute/center, have you at any point been subjected to bullying by a superior? Blue: Fraction over all respondents, who have at least once experienced bullying by a superior; Purple: Responses grouped by sections; Orange: Responses grouped by gender; Green: Responses grouped by nationality. Appendix Figure A.28 resolves the recurrence of this behaviour.

Furthermore, we find that only 29% report not having encountered problems with their supervision (Figure 4.2). Most problems are due to a shortage of meetings, or lack of feedback (both around 25%), other prevalent issues are shortage of scientific expertise related to the subject, and to a smaller degree overabundance of meetings. More direct indicators of issues with power structures are that 16% are having problems with the personality of the PI, 7.8% struggling with fights between different supervisors, and 23% experiencing a shortage in encouragement.

Figure 4.3 gives more in depth details about how DRs see their supervisors. The overall picture emerging is very positive, with

Figure 4.2: Did you ever encounter problems regarding your supervision?

all categories displaying more positive than negative ratings. The most negative turnout arises from questions around transparent and clear requirements for the daily work, where almost 1 out of 3 DRs indicate that clear guidance is missing. On the other hand, this could be interpreted as scientific freedom to develop and pursue one's own ideas, which more than 80% of DRs are experiencing. More problematic is that still a significant amount of respondents deny that their PIs are treating them politely (6.0%) and professionally (7.0%).

Lastly, 16% of DRs report that their supervisor is not always available when needed, which strictly speaking is violating contractually agreed upon responsibilities of PIs as stated in supervision agreements. Accordingly, a shortage in feedback or absence of meetings could be interpreted as indicators for power abuse. We have clearly illustrated the positive effects of close interaction in this report and the complementary feedback, that not enough meetings are a wide spread problem. Interestingly, we find that some of the instruments outlined in section 3.1, like supervision agreements or project plans, may
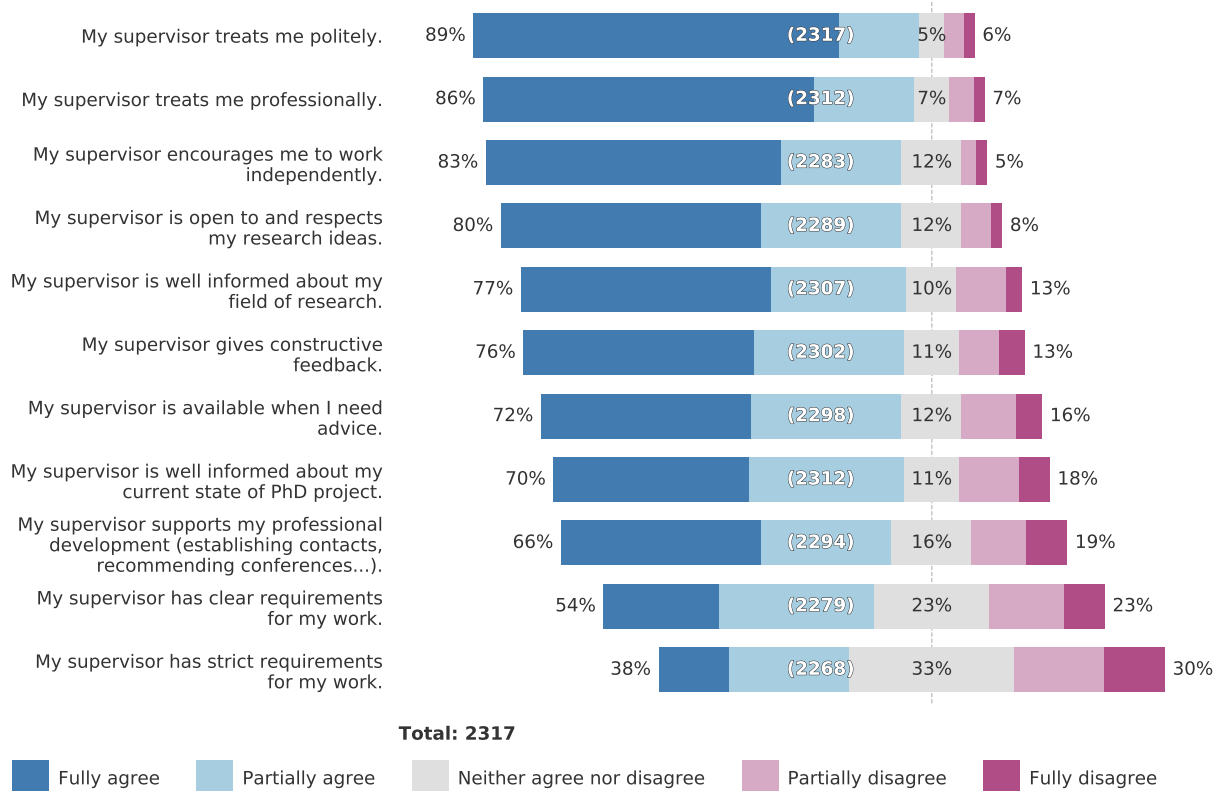
Figure 4.3: Please rate the supervision provided by your formal/primary supervisor?

lead to a reduction in instances of bullying. But the respective changes are small and may not be a direct effect of the latter (respective plots can be found in the Appendix Figure A.30).

4.2 Conflict Reporting

DRs are less aware of reporting mechanisms than average employees ([22]), which results in only 1 out of 3 conflicts being reported (Figure 4.5).

In case of a conflict at work, several support and mediation mechanisms are in place within the MPS. Awareness for each of the mechanisms among DRs is shown in Figure 4.4. Interestingly, DRs are most aware of the possibility to seek peer support through their PhD representatives (78%), which again highlights the important role of the PhDnet in facilitating the resolution of conflicts. The institute Ombudsperson as a resource to seek

conflict resolution is known to 68%, which in turn means almost one in three DRs is not aware of the dedicated institutional mechanism to resolve supervision conflicts. This is an alarming result and this lack of information should be remedied by transparent and continuous communication about conflict resolution mechanisms to all DRs. Other institutional support mechanisms such as the Equal Opportunity officer (41%) and the institute Works Council (38%) are even less known.

Alarmingly, of the 14% of DRs that report having had a serious conflict, almost 2 in 3 did not report it to any of the mentioned support and mediation mechanisms (Figure 4.5). Interestingly, we could not find a substantial difference in the sort of conflicts that are reported and those which go unnoticed: they contain the same high fractions of bullying, harassment, and supervision deficits (Appendix Figure A.26– A.29). This is another alarming indicator that insti-
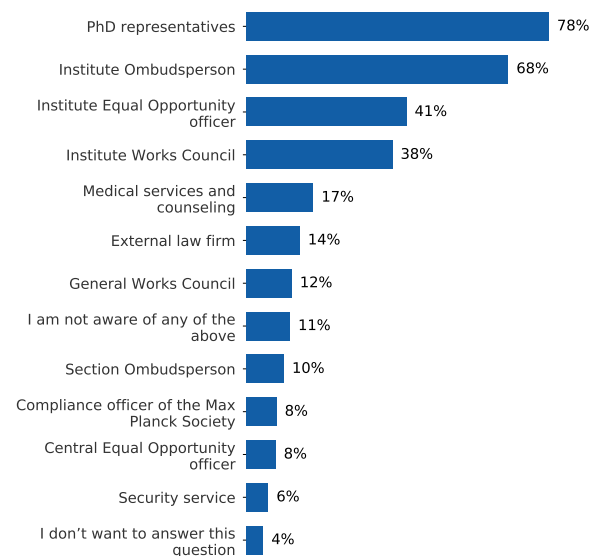
Figure 4.4: Which of the following mechanisms are you aware of that can help you in case of a conflict with a superior?

Figure 4.5: Upper bar: Did you ever report a conflict with a superior to one of the institutions above? Lower bar: Please indicate the level of satisfaction with consequences of your report? In the lower bar responses are filtered for people having reported a conflict.

tutional conflict resolution mechanisms are not known or trusted enough to be reliably used in case of a serious conflict. Of the reported conflicts, 26% of DR were satisfied with the consequences while 54% were either ambivalent or dissatisfied with the consequences of their report. Though there are many mechanisms in place for conflict resolution, the institutes are falling short at providing a safe and open atmosphere for reporting conflicts. Additionally, once conflicts are reported, more than half of them are not dealt with in a satisfactory manner. In conclusion, while there are many institutional support systems, fewer conflicts are being reported and of those, over half are dealt with in an unsatisfactory manner. This potentially leads to a lack of trust in these systems, hence the prevalence of under reporting.

4.3 Sexual Harassment

Figure 4.6 shows that 5.3% of DRs have experienced sexual harassment at least once by a superior in the MPS; 9.1% have observed sexual harassment targeting others (Appendix

Figure E.56). This is primarily a problem for women, of whom 9.5% report at least one instance, with 5.6% experiencing repeated events (details on the recurrence are shown in Appendix Figure A.27). Even more vulnerable to such behaviour are people, who identify with other gender representations, of whom 15% experience at least occasional sexual harassment. These values are in line with the MPS employee survey, reporting 8.4% of female scientists as victims of sexual harassment as investigated herein or discrimination as a milder form [22]. Similar to bullying, those working in the BM section experience sexual harassment more frequently. This even amounts to the fact that 1 out of 2 instances of sexual harassment against DRs occur in the BM section. Our analysis does not reveal a significant difference in sexual harassment for different nationalities.

It is difficult to find statistics to make direct comparisons. However, one comprehensive study finds 5.4% of women in Germany report sexual harassment taking into account all private and professional contexts integrated over their lifetime [9]. Based on this our findings are strikingly high, as we specifically asked for harassment by superiors in the work context at the MPS only. This problem seems to get only worse the higher women climb the career ladder, as was found in the MPS survey. Therein they find
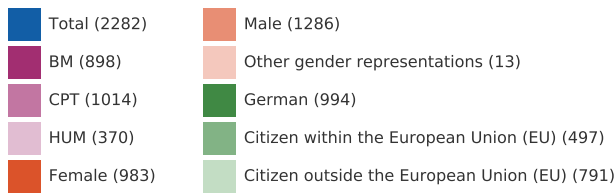
Figure 4.6: While working at your institute/center, have you at any point experienced unwanted behavior that you would call" sexualized harassment" from a superior? Blue: Fraction over all respondents, who have at least once experienced sexualized harassment against themselves by a superior; Purple: Responses grouped by sections; Organge: Responses grouped by gender; Green: Responses grouped by nationality. Appendix Figure A.27 resolves the recurrence of this behaviour.

the higher women reach in their career the more likely they are to experience sexual discrimination and also harassment [22]. Based on these evidences we urge the MPS to enact improvements, which ensure a safe working environment for every employee irrespective of their gender.

"I am aware of all of these services and I am very confident that they will never be able to help me in any meaningful way."

(Anonymous respondent)

"Some superiors seem to overlook work place bullying and neglect it, if the person who is the bully is a 'good scientist' and would not easily be replaced (in terms of academic output)."

(Anonymous respondent)

"I think there is a lot of implicit bias towards women and minorities and I've

witnessed situations that could be interpreted as taking women less seriously, etc. However, I wouldn't list this as harassment as I don't think it's really intentional."

(Anonymous respondent)

4.4 Key Findings

- 14% of DRs have conflicts with their supervisors but only 1/3 of these conflicts are reported.
- About 1/3 of DRs (32%) do not know the Ombudssystem as a resource to help in case of a conflict. Other mechanisms such as the Equal Opportunity officer and Works Council are even less known (41% and 38% respectively).
- 11% of DRs have experienced bullying by a superior, which is substantially more than reported in the central MPS employee survey.
- 10% of female DRs have experienced sexual harassment in the work contexts within the MPS, a number that is strikingly high, compared to the prevalence of sexual harassment in the German population across all contexts.
- 54% of DRs were ambivalent or dissatisfied with the consequences of their report of a conflict. This could be a reason for the very low willingness to report conflicts.

Chapter 5

Mental Health

One of the main adjustments of this year's survey was to start putting a focus on the mental health situation of doctoral researchers (DRs) inside the Max Planck Society (MPS). In this chapter we try to investigate the overall situation and factors that play a role in shaping the mental health of DRs.

5.1 Mental Health Classifications

The mental health state of the individual participants was determined using three factors:

- State anxiety: the current level of anxiety is determined by investigating how people feel at the moment
- Trait anxiety: the overall level of anxiety is determined by investigating how people feel in general
- Depression: the level of depression is determined by investigating which problems have bothered people in the last weeks

The state and trait anxiety where obtained by using a short form of the Spielberger State–Trait Anxiety Inventory (STAI), which is a common diagnosis of anxiety in clinical or research settings [15]. Depression is diagnosed based on the Patient Health Questionnaire module PHQ-9 [13], which is a diagnostic tool for common mental disorders. More information about the calculation of the three factors can be found in Appendix B Methods (B.2).

5.2 Mental Health Overview

Applying the above described classifications shows a shocking prevalence of at least mild mental health problems among the MPS DRs (Figure 5.1). Only around one third show no indication of anxiety in general and even less than one third if the current state is considered. In addition, more than half were in a highly tense state at the time of the survey (autumn 2019). Concerning depression, the situation looks moderately better. Roughly half of the questioned doctoral researchers seem to be in a healthy state, while 163 DRs (6.5%) face severe or moderately severe depression. In the general population the prevalence of depressive symptoms (PHQ-9 $\geq$ 10 points, equivalent to moderate, moderately severe and severe depression) is 9.9% (95% confidence interval: 7.8–12.3) and 7.9% (5.7–10.8) in the age groups 18–29 and 30-39, respectively. In addition, it has been found that a higher socioeconomic status or higher education can be associated with a reduced likelihood of depression. Therefore, the stated number for the general population can be seen as an upper limit for our comparison [14]. In DRs we find a prevalence of depressive symptoms of 17.9%, about twice as much as in the age-related general population. This high prevalence of depressive symptoms is worrisome.

All traits and states show clear correlation with each other as shown in Figure 5.2. Due to this correlation for most results in this sections only one of the three mental health
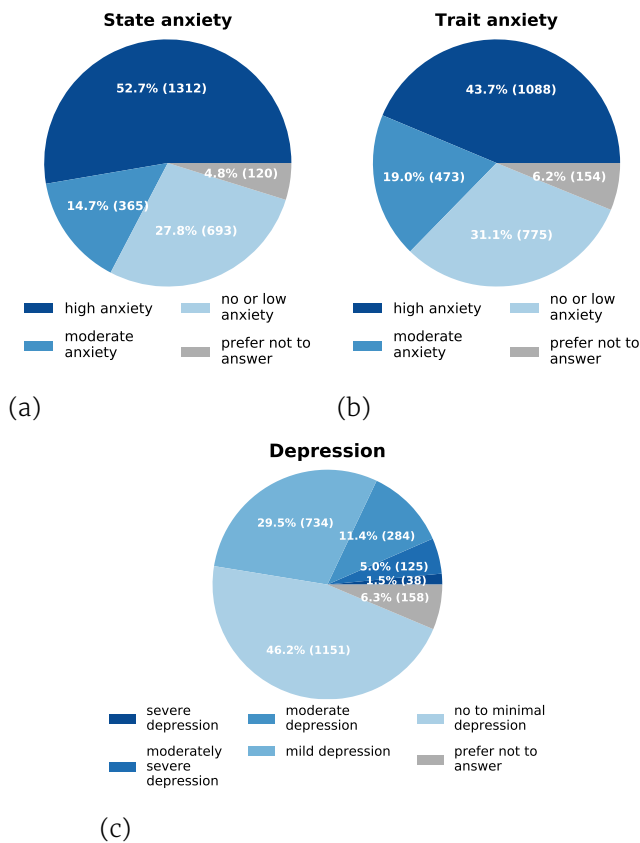
Figure 5.1: Prevalence of mental health problems among MPS DRs: Results are grouped by the three classifications obtained from the analysis, as described in the text: a) State anxiety, b) Trait anxiety and c) Depression

classifications will be shown as an example while the others can be found in the Appendix Figure A.5.

The exact classification of mental health problems based on scores from questionnaires is often debated among experts. Nevertheless, this ambiguity is drowned out by the clear trends observed in our results, e.g. the trend between thoughts of quitting one's PhD and anxiety as shown in Figure 5.3. Of those DRs thinking about quitting their PhD often or occasionally, 80% or more show symptoms of anxiety and 65% or more show some level of depression (Appendix Figure A.34). It is an essential objective for anyone in the MPS to prevent DRs from considering quitting, since abandoned PhD projects signify both a large institutional loss of efficiency and knowledge as well as a
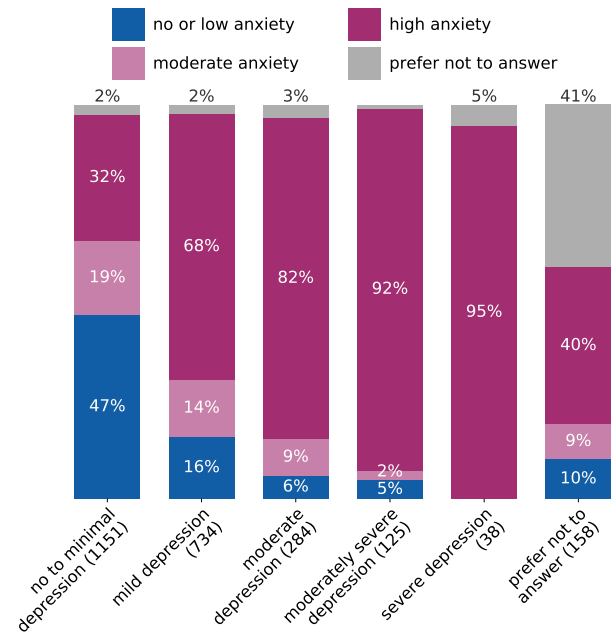
Figure 5.2: Correlation between the different mental health classifications: State Anxiety levels compared to Depression scores.
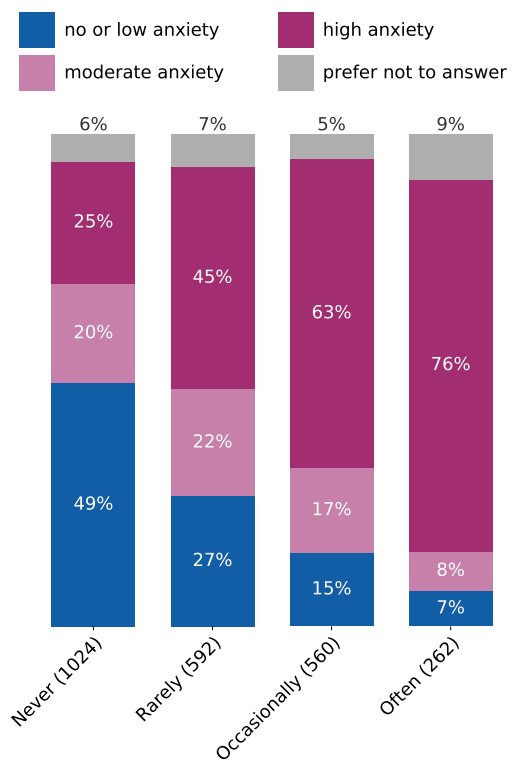
Figure 5.3: "Have you ever considered quitting your PhD?" Distribution of responses divided by trait anxiety levels.

personal catastrophe. In addition, the MPS as an employer is obliged to ensure healthy working conditions and it becomes increas-
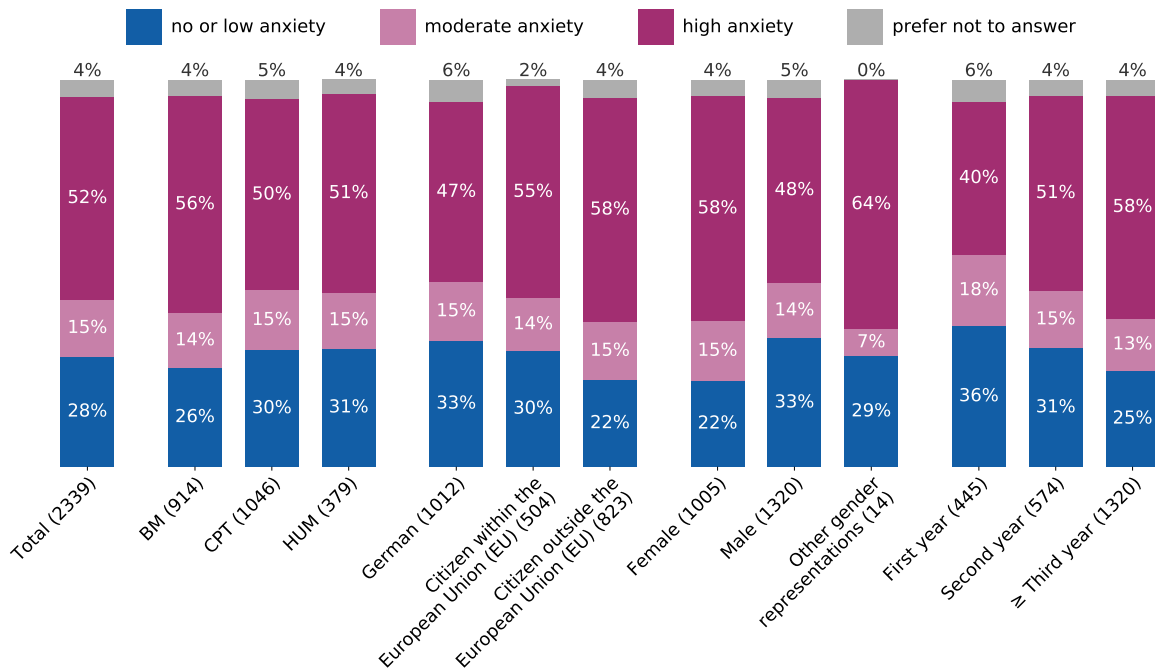
Figure 5.4: State Anxiety among different peer groups in the MPS State Anxiety levels among DRs with different demographics factors: section, nationality, gender, and time spent on the PhD so far (from left to right).

ingly clear that in this respect mental health has to be considered together with physical health. Therefore, we have to take DRs mental health problems seriously and trying to improve this situation is another important milestone.

The causes of mental health issues among the DRs can be investigated by splitting the distributions into basic demographic factors. These distributions show first trends, displayed in Figure 5.4 and Figure 5.5. When comparing sections, both anxiety and depression scores are around 5 percentage points higher for the biomedical (BM) section compared to chemistry, physics & technology (CPT) and the humanities section (HUM). Dividing the groups by nationality also presents a trend: non-German DRs and especially non-European DRs are at a higher risk for depression and anxiety. This can be seen by an increase of around 18% in DRs being affected by depression or anxiety between Non-Europeans and Germans. This difference could originate from a difference in working environment as well as many external factors, such as cultural differences,

language barrier and distance from family and friends.

In addition, in another observed trend, women and other gender representations are more likely to show symptoms than men are. The elevated levels of anxiety and depression in women and people identifying with other gender identities is a major cause of concern. This might point to an underlying hostility of the scientific environment towards non-male researchers. Inequalities between gender groups in reporting anxiety are well established. The reasons for this observed effect are complex, combining inherent gender differences with socialized expectations and environment [19].

Easier to interpret are the results depending on the duration of the PhD. A clear trend can be observed in which DRs that have been working on their project for longer have a higher risk of developing mental health issues. This might be related to higher stress levels, performance pressure, or to uncertainty about the future.

To further investigate aspects with a high impact on DRs' mental health situation, a
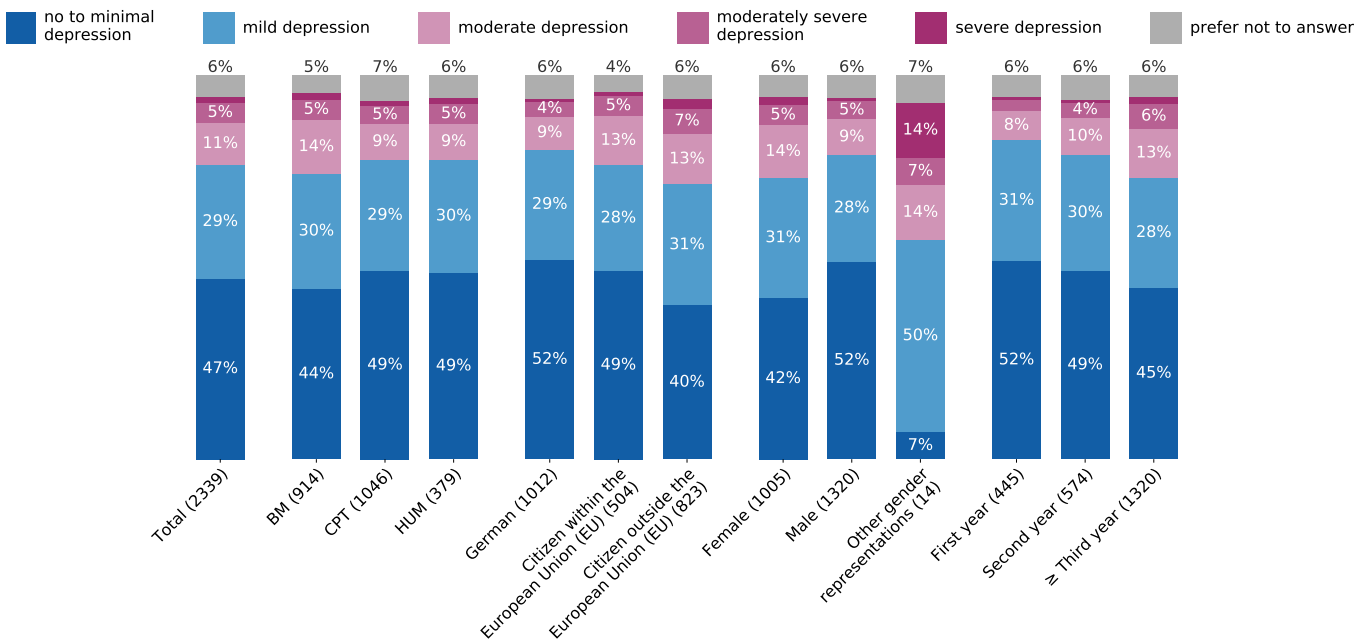
Figure 5.5: Depression among different peer groups in the MPS Distribution of the depression levels along different demographics factors: section, nationality, gender and time spent on the PhD so far (from left to right).
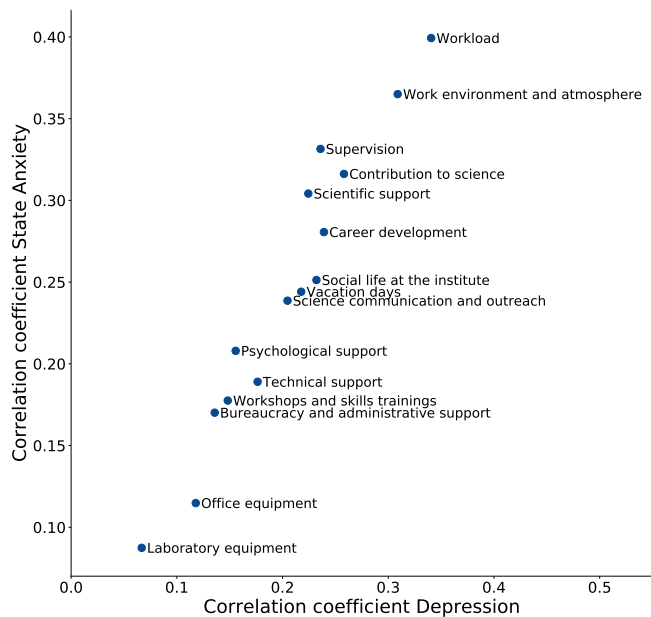
Figure 5.6: Correlation of mental health state with satisfaction factors. Significant correlation coefficients r comparing the level of dissatisfaction concerning different aspects of the PhD life with state anxiety and depression.

closer look was taken at the correlation between satisfaction with work related factors compared to the mental health results as shown in Figure 5.6. A correlation factor $r = 1$ would represent a perfect positive cor-

relation between two factors, while $r = 0$ shows no correlation and $r = -1$ shows anti-correlation.

DRs who are highly unsatisfied with their workload or work environment are more likely to report higher anxiety and depression scores. In addition, dissatisfaction with supervision can be determined as one of the key factors that predict high anxiety and depression scores. These three factors will be highlighted in the next subsections.

5.3   Workload

In order to get a grasp of what DRs state as their workload, working hours, work on weekends and behaviour of taking holidays was taken into consideration in connection to mental health problems. It is very subjective what people experience as an exceedingly high workload. But with the assumption that a never ending and unmanageable to-do list would result in people working overtime and feeling that taking holidays would slow them down too much, these factors might give a good overview.
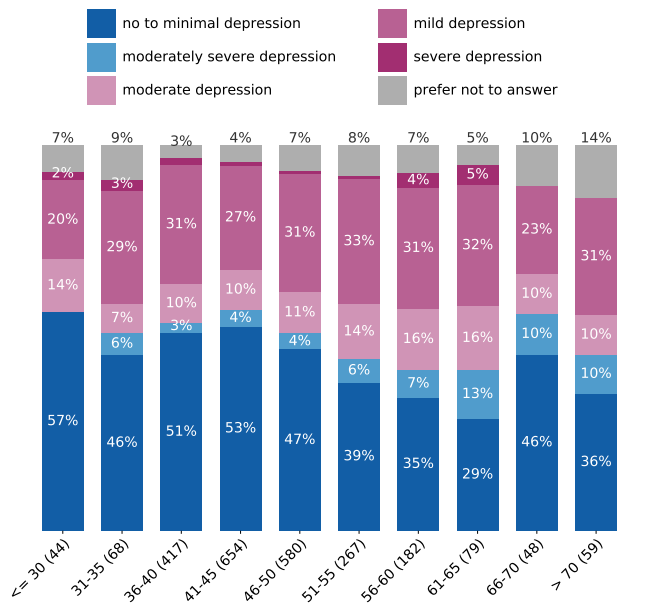
Figure 5.7: "On average, how many hours do you typically work per week in total?" Distribution of responses divided by depression levels.

Figure 5.8: "How often have you worked during weekends or public holidays in the past year?" Distribution of responses divided by state anxiety levels excluding DR's that started 2019.

Depression prevalence varies with working hours as seen in Figure 5.7: depression scores first rise with an increase in hours, reaching a peak at 61–65 working hours / week. At the very high end of the scale (above 65 working hours / week) the trend becomes less clear, as the number of respondents becomes increasingly small. In general, the prevalence of moderate to severe depressive symptoms among DRs that work between ≤ 30 and 45 hours per week is clearly less (14%) than among those who work 45 or more hours a week (19%).

Another clear trend can be observed in the correlation between working on weekends and anxiety scores as seen in Figure 5.8. A higher frequency of weekend work correlates strongly with an increased state anxiety. This emphasizes that periods of rest are important to preserve mental health and, by extension, productivity.

Similar behaviour comparing free time away from work with mental health states is found when considering holidays taken as displayed in Figure 5.9. Especially the perception of ones freedom to take holidays seems to cause better health results, e.g.

feeling free to take holidays leads to around 40% more DRs with no or only low anxiety compared to DRs not feeling free to take holidays because of pressure from their supervisors or self-pressure due to a high workload.

5.4 Supervision

As seen in Figures 5.2 and illustrated even clearer in the Appendix Figures A.44, A.45, and A.46, supervision seems to be a key point in mental health concerns. Therefore, the question comes back to what makes up good supervision. As mentioned in section 3.2 having PhD guidelines improves supervision satisfaction noticeably. A slight impact on the mental health status can also be seen in the Appendix Figures A.47, A.48, and A.49, but not enough to explain all the improvements with rising satisfaction. Some of the main problems in supervision are connected to not enough or not regular enough meetings Figure 2.8. For mental health the regularity of communicating with ones supervisor

(a)   (b)
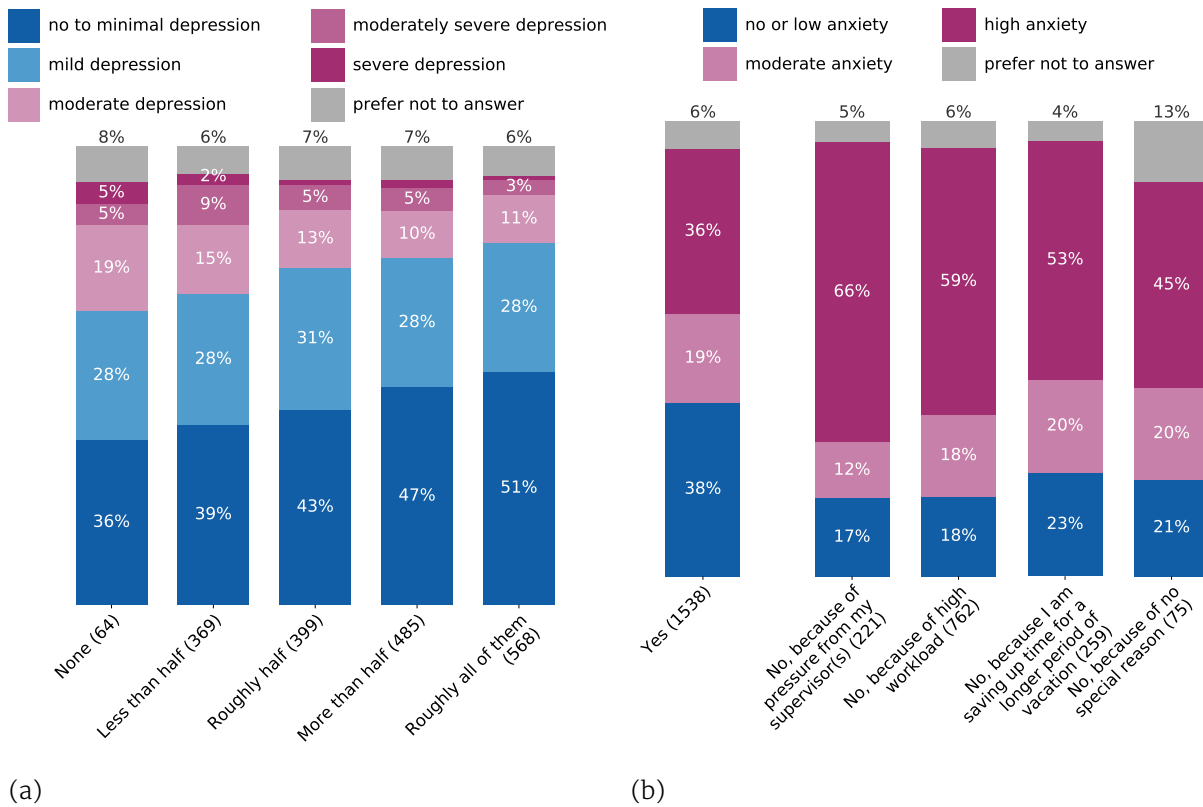
Figure 5.9: a) "How many days of your entitled holidays did you take in the past year?" Distribution of responses divided by depression levels. b) "Do you feel free to take days off?" Distribution of responses divided by trait anxiety levels.
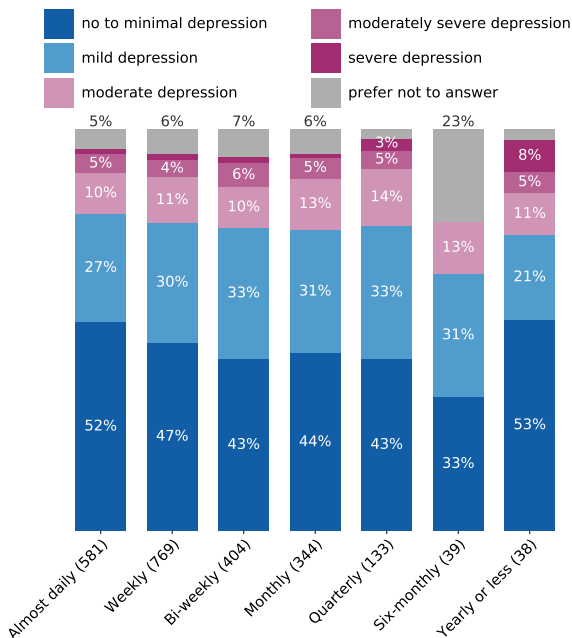
Figure 5.10: "How often do you communicate on average with your daily/direct supervisor about your PhD project?" Distribution of responses divided by depression levels.

does seem to have a correlation as displayed in Figure 5.10, but also not as clear as the regularity of meetings with the supervision satisfaction (Appendix Figure A.52). Even if we do not understand the key factor for good supervision as yet, the importance of it and the support it gives to DRs is highlighted with these results.

This is probably a good point to thank all of the supportive and motivated official or in-official supervisors often neglected when talking about where improvements could be done.

5.5   Work Environment

One of the main topics concerning work environment is the financial situation and security provided to DR. What should be mentioned is that these results might be correlated with the results depending on nation-

alities since foreigners are more likely to be on less stable working agreements.
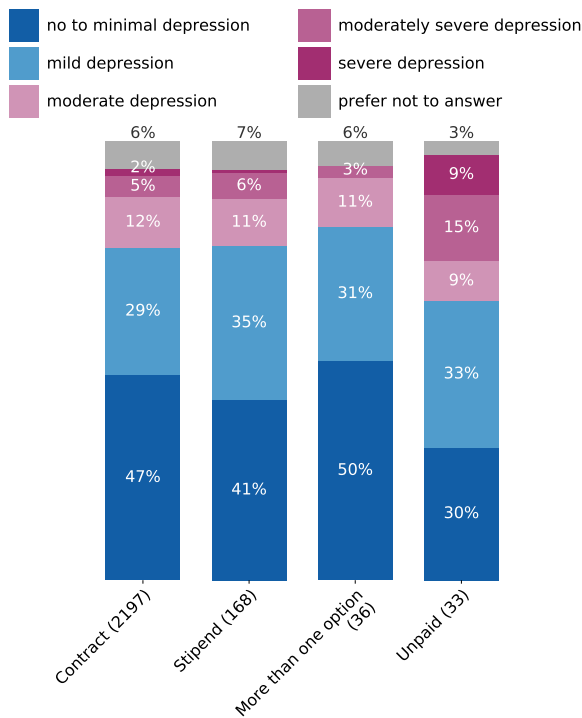
Figure 5.11: "How is your doctoral research currently financed (multiple answers possible)?" Distribution of responses divided by depression levels.

As displayed in Figure 5.11, less stable situations – like being on a stipend – compared to a contract increases the population of DRs affected by depression by ≈ 5 percentage points while being unpaid leads to increases of ≈ 20 percentage points.

In addition, especially DRs with short term financial agreements of only 6–12 months are in more vulnerable mental health situations as shown by the $\approx$ percentage points difference in people affected by depression in Figure 5.12 compared to contracts with a longer duration.

5.6 Experiences with Bullying and Harassment

Another important topic that should not be neglected when talking about work atmosphere are harassment and bullying issues.
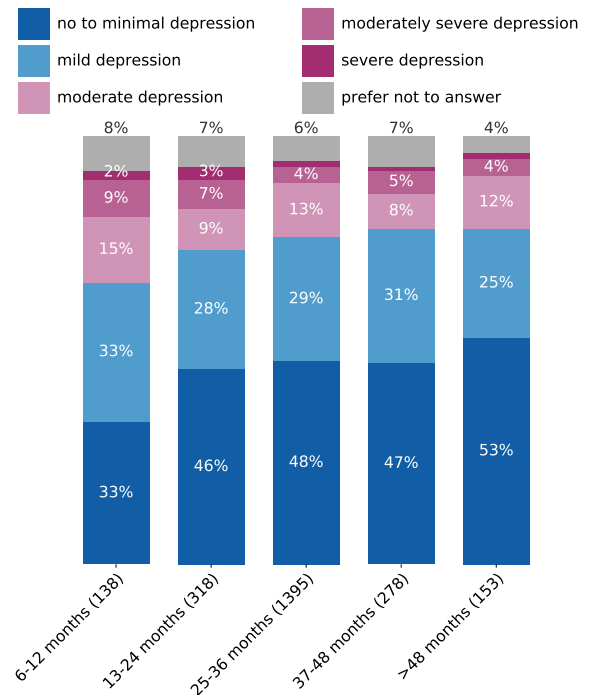
Figure 5.12: "What was or is the longest duration of your contract or stipend related to your PhD project?" Distribution of responses divided by depression levels.

As shown in Figure 5.13, people who experience bullying or harassment show increased mental health issues increasing with regularity of the occasions in which they have become victims of bullying or sexualized harassment. Both mental health issues and experiences with bullying and sexualized harassment are more prevalent among nonmale DRs. Therefore such experiences could explain a portion of the variance in mental health issues between the genders.

This is just one more argument why power abuse problems should be taken seriously and not be ignored. Especially since the prevalence of power abuse is probably higher than reported. Additionally, we could also take the dissatisfaction with ones supervision as a first sign of power abuse, which also showed a clear relation to deteriorating mental health. Such an example are DRs who indicated that they are not treated professionally by their supervisor: Figure 5.14 shows, that the response to this question has a pronounced effect on the likelihood to develop depression. Similar trends can be found also

(a)   (b)
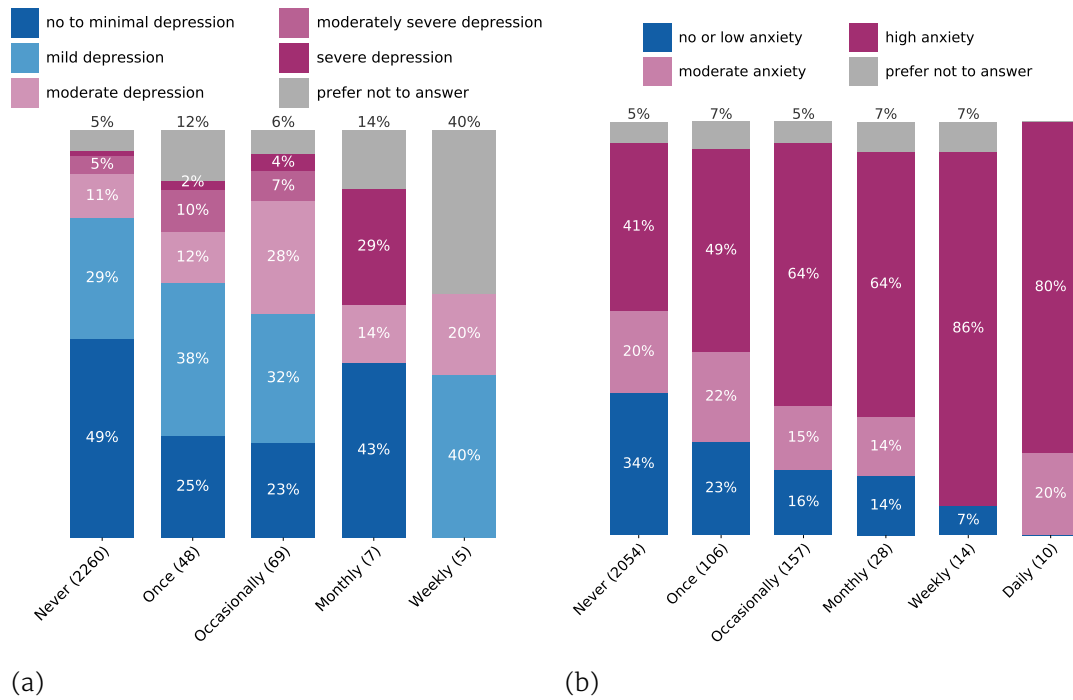
Figure 5.13: a) "While working at your institute/center, have you at any point experienced unwanted behavior that you would call 'sexualized harassment' from a superior?" Distribution of responses divided by depression levels. b) "While working at your institute/center, have you at any point been subjected to bullying by a superior?" Distribution of responses divided by trait anxiety levels.
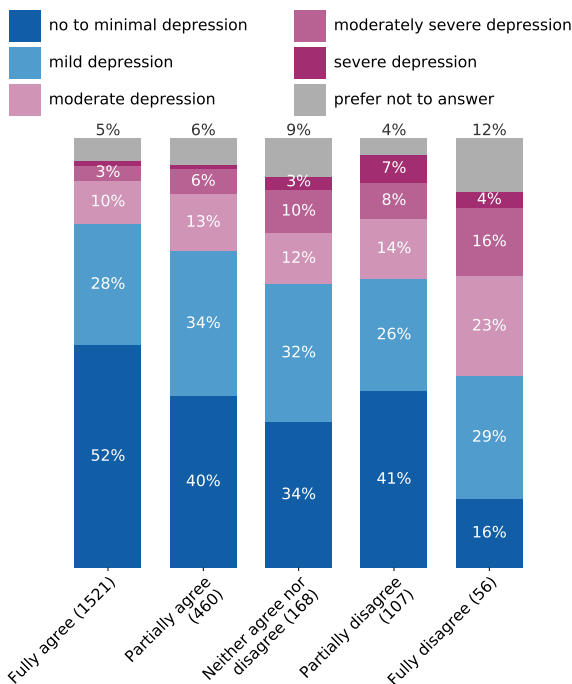
Figure 5.14: "Please rate the supervision provided by your formal/primary supervisor: My supervisor treats me professionally." Distribution of responses divided by depression levels.

for the question of polite treatment in the appendix (Figure A.61–A.65).

5.7 Conclusion

In conclusion, mental health issues among DRs are alarmingly abundant and severely elevated when compared to the general population. Figure 5.15 shows that mental health issues severely influence DRs ability to work and should be a major concern for an organization such as the MPS that thrives on the mental capacity of its employees.

Stressful environments, unstable working conditions or missing support contribute to mental health issues. However, a balanced of taking time off work or supportive supervision and work environment are nurturing the mental health of the individual DRs, which should be further fostered during all stages of the PhD.
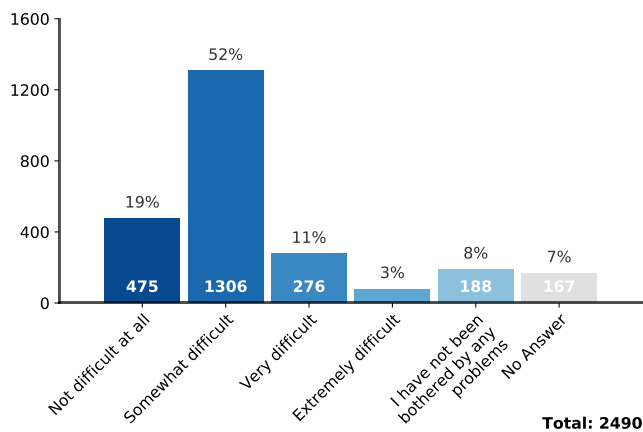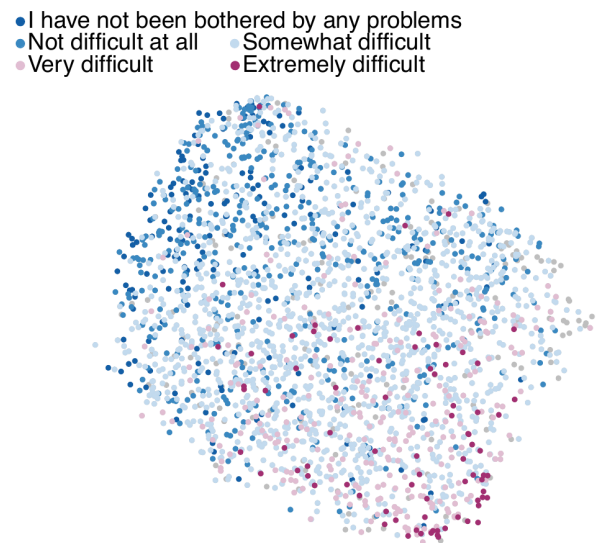
Figure 5.15: "If you have been bothered by any problems, how difficult have these problems made it for you to do your work?"

"After realizing I am not able to work, having nightmares, sleep deprivation, panic attacks and persistent suicidal thoughts I had a massive break down and I was finally able to get help. I am currently on sick leave. The institute has not been very helpful nor competent in dealing with the situation. I don't know how/ if I would be able to proceed with my PhD after/if I recover."

(Anonymous respondent)

"In general, I am happy and satisfied with my project and especially with my team and supervisor. Just the workload and (often self-made) pressure makes it impossible to have a healthy "work-life-balance.""

(Anonymous respondent)

5.8 Key Findings

- Prevalence of mental health issues is very high among doctoral researchers as 17.9% report moderate to severe depressive symptoms and 62.7% show moderate to high state anxiety.
- Prevalence of mental health issues is correlated to long working hours, work on weekends and not taking vacation.

- None-male DRs are more likely to experience mental health issues, which might point to an underlying hostility in the scientific environment towards non-male researchers.
- Satisfaction with supervision alleviates mental health issues while unstable working conditions in the form of short contracts and insecure financing are detrimental.

Chapter 6

Unbiased Cluster Analysis

For this year's report, an unbiased cluster analysis methods was implemented in addition to the exploratory approach used for generating most results. Two different unsupervised machine learning approaches (k-medoids clustering and a dimensionality reduction approach) were used which are explained in detail in the method section B.1.3. For simplicity, the results of k-medoids clustering will be the focus of this result section, while the dimensionality reduction approach will only be commented on. More detailed results can be found in the appendix A.6.

Doctoral researchers (DRs) were grouped based on the similarity of their answers and the most abundant or selective question-answer-pairs of each cluster were derived. This produced a Top 100 list of important answers from the clustering, the most discriminative ones were selected and are shown for selected clusters in Table A.1, A.2, A.3 and A.4 in the appendix.

Both methods inferred distinct clusters of DRs. Interestingly, these clusters were characterised by satisfaction as demonstrated by comparing Figure 6.1 and 6.2 (Appendix Figure A.73 for the dimensionality reduction method). Figure 6.1 indicates a 2-dimensional representation of DRs grouped into clusters based on the similarities of their answers. We detected a clear gradient of satisfaction levels from top to bottom as demonstrated in Figure 6.2. We assumed that satisfaction with supervision has a high impact on the overall satisfaction, thus it was chosen as a representative for this interpretation. We further attempted to investigate underlying reasons and tried to detect answers reflecting why DRs are satisfied or dissatisfied by screening the most extreme clusters. The most discriminative patterns were selected and shown in 2-dimensional representation either in this section or in Appendix section A.6.1 and they can be evaluated via comparison with Figure 6.1.

- cluster 1
- cluster 2
- cluster 3
- cluster 4
- cluster 5
- cluster 6
- cluster 7
- cluster 8
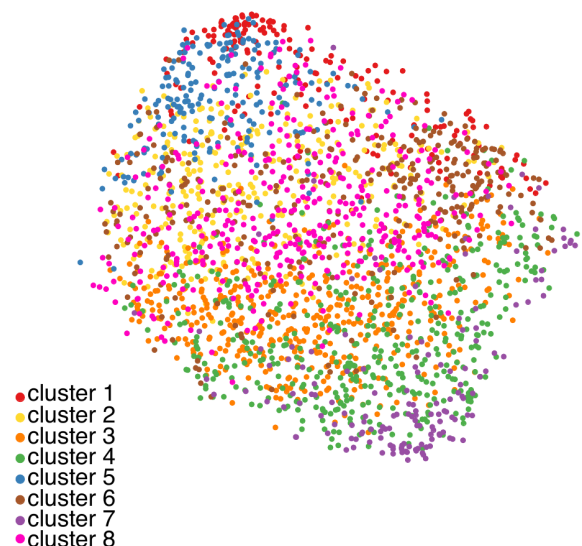
Figure 6.1: Representation of clustering analysis of DRs based on their answers to the survey questions. Proximity reflects similarity of DRs answers. The different colors highlight the distinct clusters.
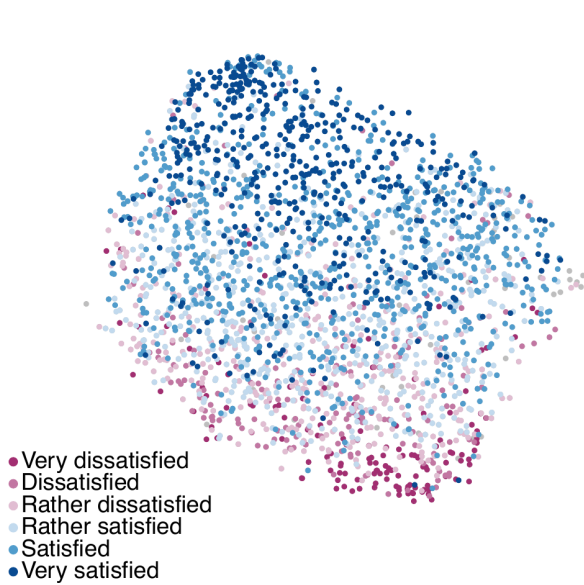
Figure 6.2: "How satisfied are you with your PhD supervision in general?" 2-dimensional representation of DRs answers from 6.1. Color code indicates DRs answers to the indicated question.
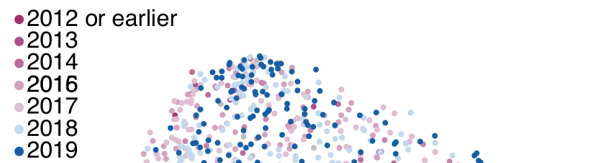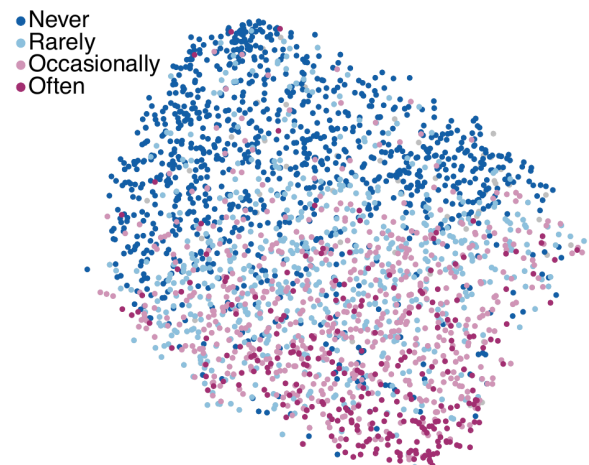

Figure 6.3: "Which year did you start your PhD?" 2-dimensional representation of DRs answers from 6.1. Color code indicates DRs answers to the indicated question.

6.1   Extreme cluster groups

In this section we describe four groups (clusters) of DRs, whose characteristics are based on the above described cluster analysis. These groups account for about 40% of respondents. We intend to illustrate, which response patterns tend to co-occur, without analyzing cause-effect relationships, which has been done largely in the sections before.

6.2   Cluster 1

Cluster one (red cluster, Figure 6.1) is made of 175 DRs, which have often answered "Very Satisfied" when rating the aspects of their PhD and "Not at all" when asked for improvements. This together with the gradient seen in Figure 6.2 allowed us to assume that this is one of the most satisfied group of DRs. In general, they are young, have recently started their PhD and originate predominantly from outside the European Union as shown in Figure 6.4 and 6.3.

Despite earning significantly less than most

of the other satisfied clusters [1], they consider salaries in academia as very attractive. Their average income is 1571.69 EUR, which ranks second for the lowest income clusters as displayed in Appendix Figure A.71.

Most of them do not speak German, but receive good support from their institutes which is reflected by language not being stated as an obstacle as can be seen in Appendix Figures A.67 and A.68. Also the support from their supervisor is rated highly positive and there are no problems involving supervision.

As shown in Appendix Figure A.70 they exhibit the third highest working hours among the clusters with an average of 47.9 hours, but work significantly less than the dissatisfied clusters 4 and 7 [2]

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[1] p-value < 0.05 for pairwise comparisons with clusters 5,2,8,3

[2] p-value < 0.05 for both comparisons

• German
• Citizen within the European Union (EU)
• Citizen outside the European Union (EU)
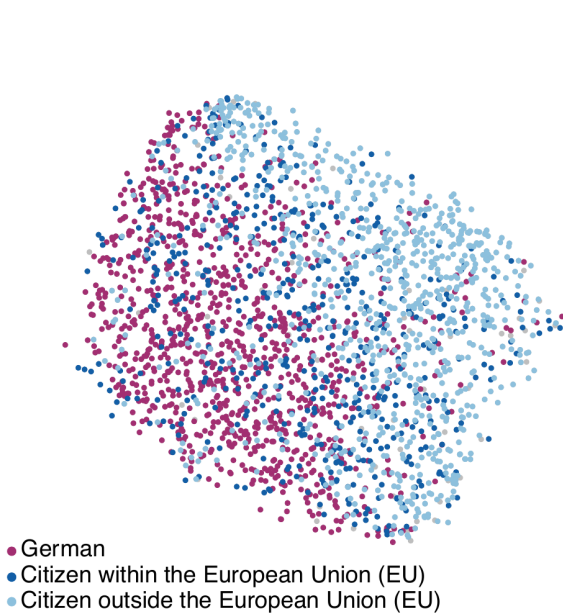
Figure 6.4: "What is your citizenship?" 2-dimensional representation of DRs answers from 6.1. Color code indicates DRs answers to the indicated question.

6.3 Cluster 5

Cluster 5 (blue cluster, Figure 6.1) also belongs to the very satisfied clusters of DRs. It consists of 208 DRs and most aspects of their PhD are rated with "Very Satisfied" by them as well as most improvements are rated with "Not at all" or "Rather not". They seem to have no mental health issues and do not want to quit their PhD as displayed in Figure 6.5. They have average weekly working hours of 44.7 hours, which is significantly less than all other clusters except for cluster 2 [3]. In addition they tend to take their holidays and feel free to do so.

Communication with their supervisor is almost daily and there are no problems related to supervision as shown in Appendix Figure A.69. In addition they meet with their TAC frequently and they are in time with their project plan. Moreover, they identify themselves very much with their institute.

Their salary, with an average of 1736.00 EUR, is on average highest among all clusters and

---

[3]p-value < 0.05 for pairwise comparisons with all other clusters except cluster 2

• I have not been bothered by any problems
• Not difficult at all   • Somewhat difficult
• Very difficult   • Extremely difficult

Figure 6.5: "If you have been bothered by any problems, how difficult have these problems made it for you to do your work? 2-dimensional representation of DRs answers from 6.1. Color code indicates DRs answers to the indicated question.

significantly more than cluster 4,1 and 7 [4]

6.4 Cluster 7

Cluster 7 (purple cluster, Figure 6.1) is the most dissatisfied cluster containing 152 DRs. Most aspects of the PhD situation were rated with "Very dissatisfied" inside the high z-ranks and improvements were asked for.

Their supervision can be considered as very poor: They are not treated politely or professionally by their supervisors and are subject to bullying and harassment on a regular basis as shown in Figure 6.6. Their mental health problems make it extremely difficult for them to work and they consider quitting their PhD very often and for multiple reasons. Answers reflecting conflicts with superiors are very abundant in this cluster and they do not feel free to take days off because of external pressure.

Additionally, they do not identify themselves, with their research institute or the MPS and

---

[4]p-value< 0.05 for indicated pairwise comparisons

do not like to attend social activities in their group or institute. After submitting their thesis, they definitely do not want to stay in academia and would like to take an extended break as indicated in Appendix Figure A.66.

With an average of 51.1 hours per week they are rank 1 among the highest average working hours and they work significantly more than all other clusters [5].

In addition, they also rank first among the lowest average salaries with 1544.18 EUR, which is significantly less than most of the more satisfied clusters[6]. They are due to submit their thesis soon and are on short term contracts between 1-2 years.

which includes rather dissatisfied DRs. Most aspects of their PhD are connected to "Dissatisfied" or "Neither/Nor" answers.

Their supervision situation is not as bad as cluster 7, but nonetheless dissatisfying, stating unprofessional treatment by their supervisor. There were no social activities at their institutes and research stays abroad or raising a child is not supported sufficiently. In addition, they do not identify themselves strongly with their institute or the MPS.

They express the desire to work in non-scientific jobs after completing their PhD and also think about quitting, partly due to other more interesting jobs (Figure 6.7). Mental
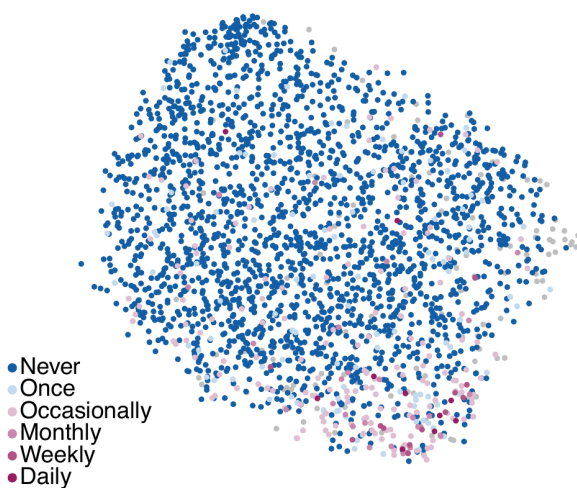
Figure 6.6: "While working at your institute/center, have you at any point been subjected to bullying by a superior?" 2-dimensional representation of DRs answers from 6.1. Color code indicates DRs answers to the indicated question.

Figure 6.7: "Have you ever considered quitting your PhD? 2-dimensional representation of DRs answers from 6.1. Color code indicates DRs answers to the indicated question.

6.5   Cluster 4

The largest of the distinct clusters with 437 DRs is cluster 4 (green cluster, Figure 6.1),

health issues make it very difficult for them to work and they are mostly on short term contracts with relative low salaries.

With an average income of 1619.52 EUR they are in a comparable situation to cluster 7 and earn significantly less than most of the satisfied clusters[7].

They work on average 48.6 hours, which is significantly more than all other clusters ex-

---

[5]p-value < 0.05 for pairwise comparisons with all other clusters

[6]p-value< 0.05 for pairwise comparisons with clusters 5,2,8,3

[7]p-value < 0.05 for comparisons with clusters 5,2,8,3

cept for cluster 7[8]. In addition, they do not feel free to take days off because of the high workload, which results in less than half of their holidays being used.

6.6 Key Findings

- Successful first attempt of exploring the survey data in an unbiased way using cluster analysis that supports some of the claims made before in the earlier chapters

- The inferred clusters were grouped by satisfaction, which was directly connected to mental health and thinking about quitting

- Power abuse and supervision problems are common features of the dissatisfied clusters

- Good support from the institute and supportive supervision are key features in the satisfied clusters

- Except for cluster 1, which we considered as a special case, the satisfied clusters (cluster 2 can be considered as satisfied cluster as well) earn significantly more than the dissatisfied clusters and work significantly less hours.

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[8]p-value < 0.05 for pairwise comparisons with all clusters except for cluster 7

Chapter 7

Conclusion

In this survey report, we have outlined a detailed picture of the situation of doctoral researchers (DRs) in the Max Planck Society (MPS). More aspects can be retrieved from the Appendix attached at the end, where graphics illustrate responses to all questions that were asked in the questionnaire for this survey. In this paragraph, we summarize the key findings of the above chapters:

Overall, we find that DRs generally feel content with their situation in the MPS. Especially with the laboratory equipment as well as the scientific and technical support they are very satisfied. One positive trend over the recent years is that now most DRs are members of a graduate school, which has a positive impact on their satisfaction. Furthermore, last year's increase in vacation days from 20 to 30 is acknowledged and highly appreciated by DRs (83% are satisfied now as opposed to 39% before the change). Lastly, a positive long-term trend is that stipends, as the cheap form of financing doctoral projects without contractual social benefits, are becoming less and less (by now only 3% are on an internal stipend directly by the MPS).

With regard to **Mental Health** we find, that 17.9% of DRs show moderate to severe depression symptoms and a striking majority of 62.7% show moderate to high state anxiety. Therein, non-male DRs are significantly more likely to experience mental health issues. This points towards discrimination of the scientific environment against women and people identifying with other gender representations. We find the underlying reasons for this large abundance of mental health problems to be connected to long working hours, including weekend work, and not taking vacation. Furthermore, unstable working conditions induced by short term contracts and financial problems are other factors, that fuel deterioration of mental health. On the contrary, good supervision seems to reduce the likelihood to experience problems with mental health.

The second key objective of this study was the quantification of **Power Abuse** against DRs. We find that 5.1% have reported conflicts with their superiors; 14% have experienced conflicts, but did not report them. This difference may partly be explained by the fact that apart from PhD representatives and Ombudspersons, existing conflict reporting mechanisms are barely known among DRs. Furthermore, 11% experience bullying by a superior in the working environment. Lastly, we find that a stunning 10% of female DRs have experienced sexual harassment by a superior in the Max Planck Society (MPS). These numbers are substantially higher than the numbers in the report published by an internal MPS task force this year [22]. Reasons for this difference and detailed analysis of the manifestations of Power Abuse are discussed in the respective section.

Furthermore in our investigations of the **Support Structures**, we took a closer look on the role of international researchers, career development, and starting a family. Therein, strikingly 2 out of 3 **international DRs** report,

that they would have needed more support to establish themselves within a new country and the MPS. The existing measures in this direction do not seem to full-fill the demand especially for key challenges like finding accommodation and getting the right Visa. Regarding **career development**, our data indicate that preparation for a non-academic career is much less promoted than skills important for academia, even though a vast majority of doctoral researchers will pursue a career outside of the academic bubble. With regard to **starting a family**, our analysis reveal, that at least over the last 10 years the fraction of parents remained constantly low at around 8%. This may be an indication that the attempts to support parents, have failed to encourage them to start a family. This may eventually be due to a deficient flow of information, as there is little awareness even about the simple fact, that a child is a sufficient reason for a contract extension. More details on all of these aspects can be found in the respective paragraph or in our previous reports, which cover these support structures in more detail [3], [21].

Additionally, we looked in detail how established and new **Scientific Support** instruments influence the projects of DRs. Briefly, we find that structured PhD programs are widely established in the MPS in the form of graduate schools (74% are a member). Their impact is generally perceived to be very positive by members and non-members of graduate schools. Furthermore, instruments like thesis advisory committees (TAC) and supervision agreements, which are strongly encouraged by the MPS guidelines on the education of doctoral researchers [10], are wide spread (e.g. 67% have a TAC) and correlate with satisfaction. However, more in depth analysis reveals, that their full positive impacts depend on other factors of supervision: e.g. frequency of meetings with the supervisor and the TAC.

The basic **Working conditions** of a DR have a big influence on many aspects we dis-

cuss herein, like mental health and power abuse. On this account, we find significant differences in salary between DRs working in the humanities section (HUM) and their colleagues from the biomedical (BM), and chemistry physics & technology (CPT) section. Even when we correct for the different gender distributions in the sections, women earn significantly less than their male colleagues do. Another group with smaller salaries are non-EU nationals, which are in addition also more likely to be on stipends (11%), even though the MPS has committed to a policy of granting all DRs equal contracts with social benefits instead of stipends. Furthermore, 19% of DRs are working with short term contracts/stipends (624 months), even though this practice is violating internal MPS guidelines, which intend 36 months as the default initial contract duration. Such short contracts do not reflect a realistic duration of a doctoral project, as periods longer than 4 years are a common phenomenon.

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Appendices

Appendix A

Additional Information

A.1   Introduction
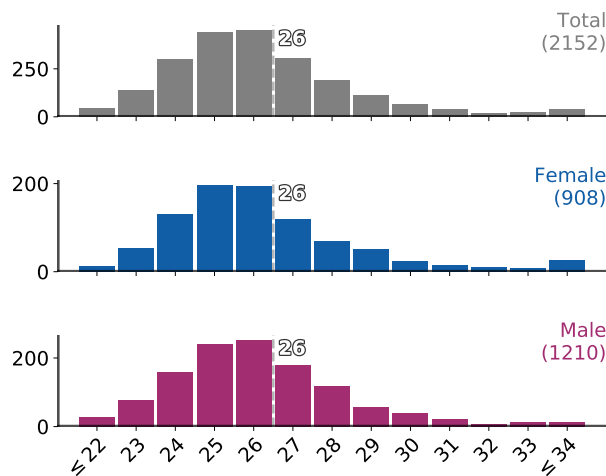
Figure A.1: "Estimated age when starting the PhD" Y–axis shows the number of responses relative to each gender group. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines.
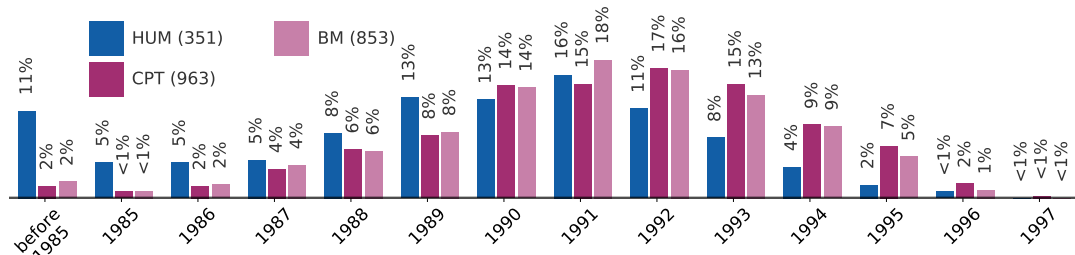
Figure A.2: "What is you year of birth?" Responses grouped by sections. The total number of responses is shown in brackets.
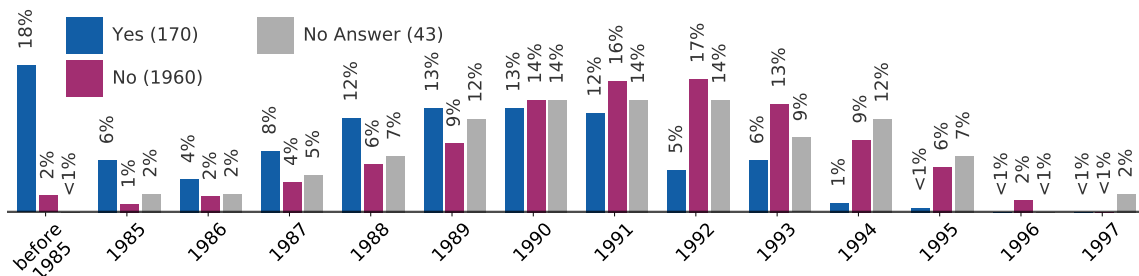
Figure A.3: "What is you year of birth?" Relative response rates grouped by Question: Do you have children?. The total number of responses is shown in brackets.

A.2 Working Conditions
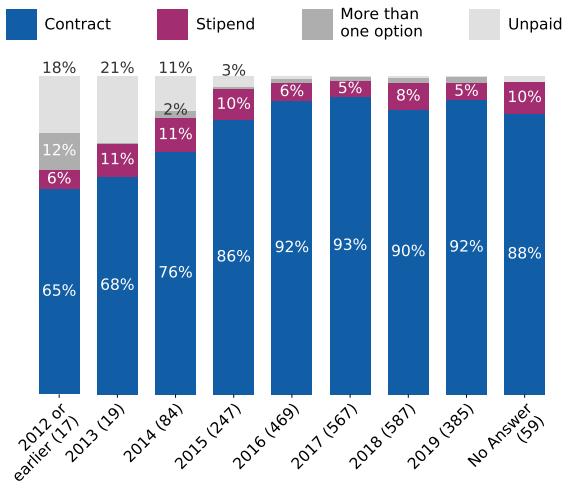
Figure A.4: "Type of employment by starting year of the PhD." The total number of responses is shown in brackets.
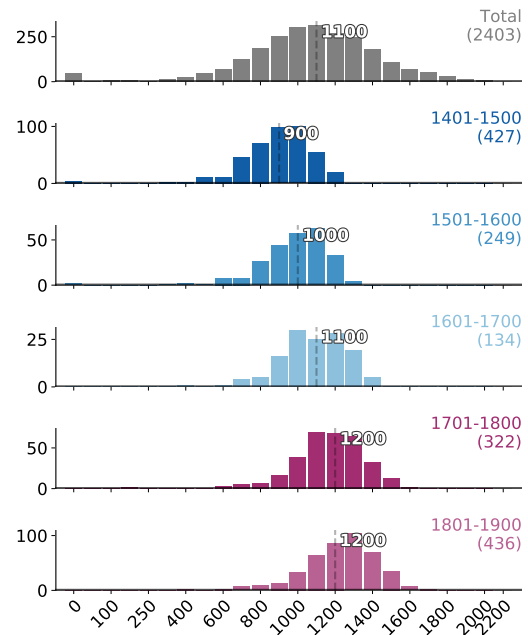
Figure A.6: "Spending power when adjusted for living costs (rent including utilities)" Y-axis shows the number of responses relative to each income group. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines.
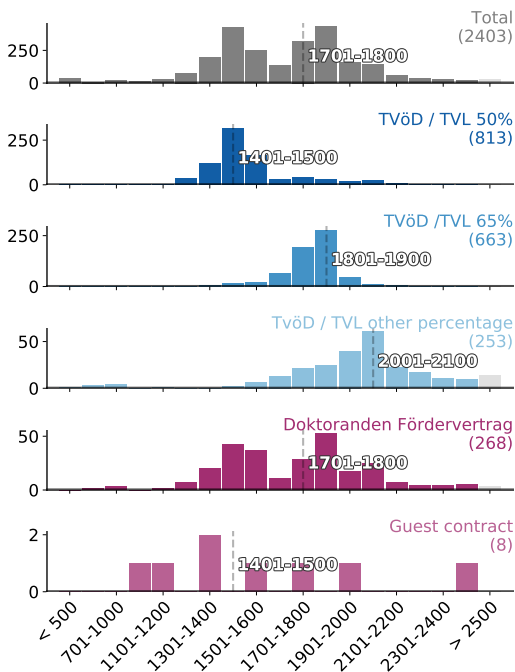
Figure A.5: "How much money (net amount in euros) do you receive for your doctoral research work per month?" Y-axis shows the number of responses relative to each contract type. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines.
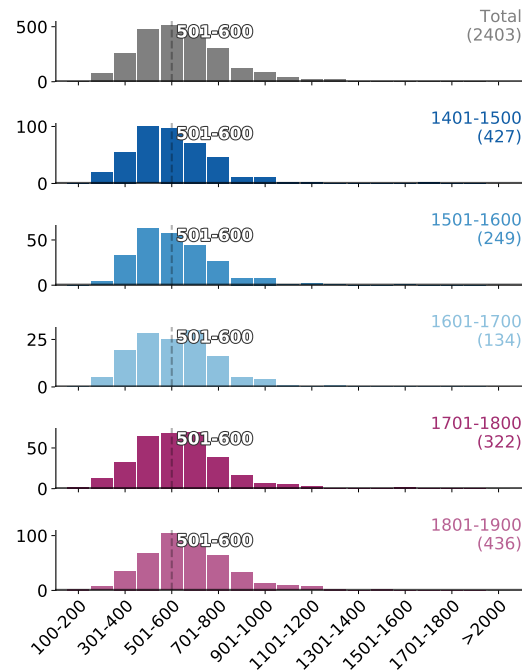
Figure A.7: "Amount of money spent on living costs (rent including utilities)" Y-axis shows the number of responses relative to each income group. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines.
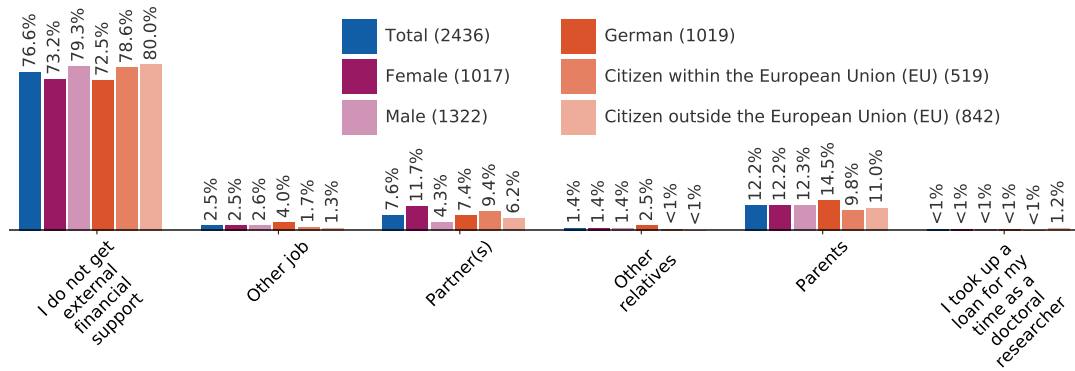
Figure A.8: "Do you get external financial support to cover your living expenses besides your salary? If yes, who is assisting you financially (multiple answers possible)?" Relative response rates to gender and nationality.
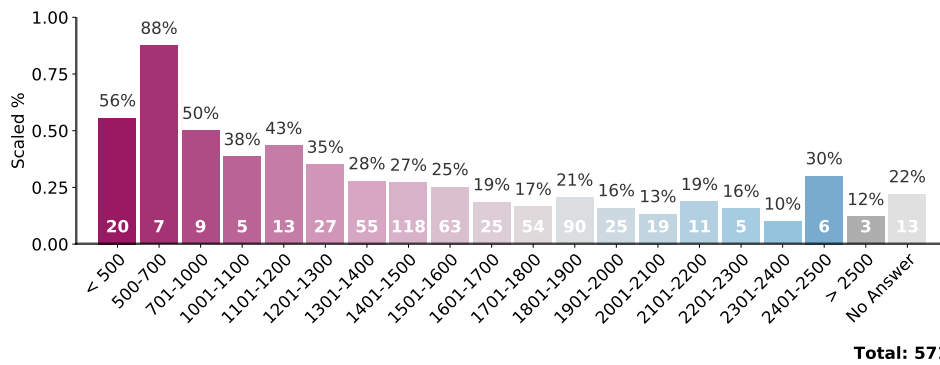
Figure A.9: "Fraction of people receiving financial support per net income" Y–axis show relative response rate.
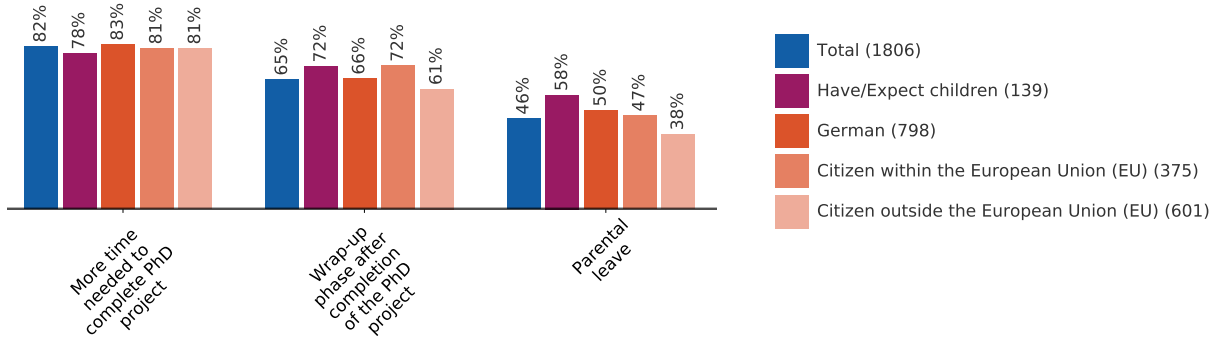
Figure A.10: "Would it be possible for you to extend your current contract/stipend for the following reasons?" Relative response rates for each reasons by gender, nationality and parenthood.
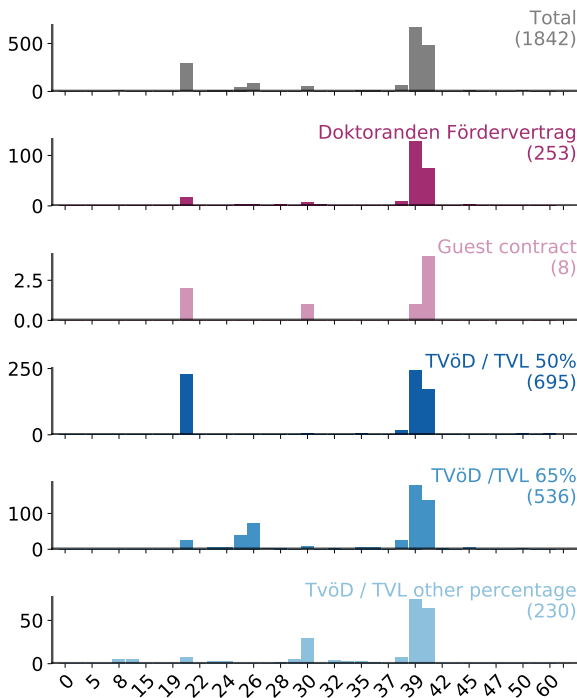
Figure A.11: "Number of working hours in the contract compared to contract type" Y–axis shows the number of responses relative to each contract type. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines.
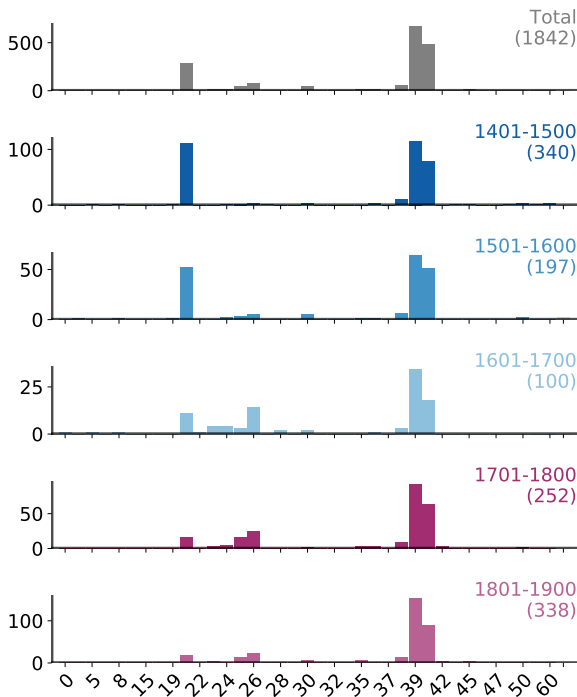
Figure A.12: "Number of working hours in the contract compared to net income." Y–axis shows the number of responses relative to each income group. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines.
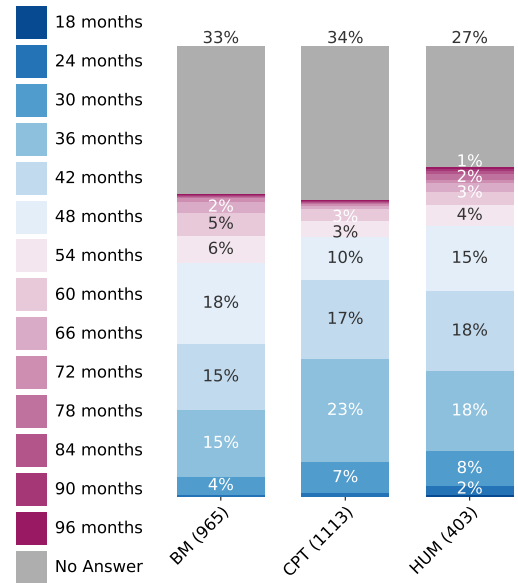
Figure A.13: "Expected duration until submission of thesis based on self–reported finish time per section"
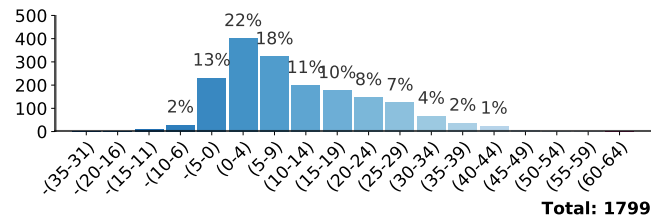
Figure A.14: "Overtime hours worked per week." Over–time hours were calculated by subtracting working hours in the contract from actual working hours. Y–axis show number of answers.
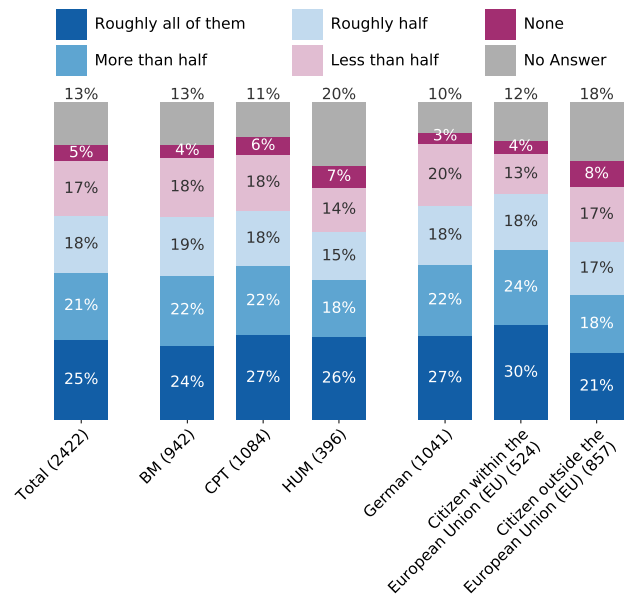
Figure A.15: "Holidays taken" Relative response rates are grouped by section and nationality. The total number of responses is shown in brackets.

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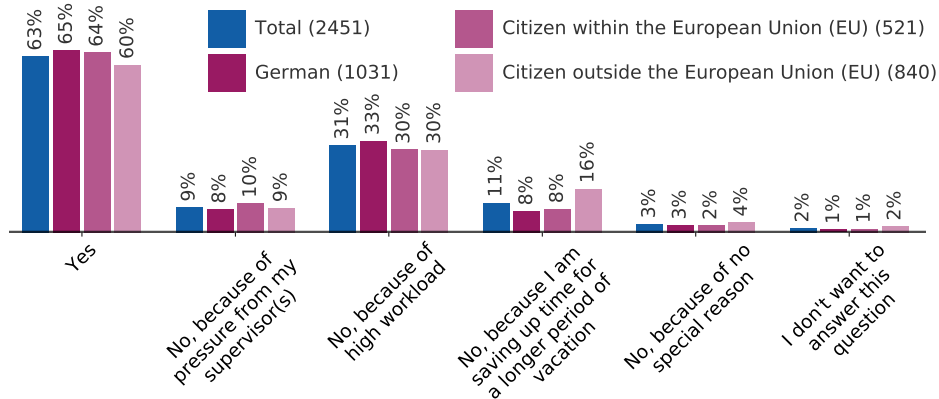
Figure A.16: "Do you feel free to take days off" Relative response rates grouped by nationality.
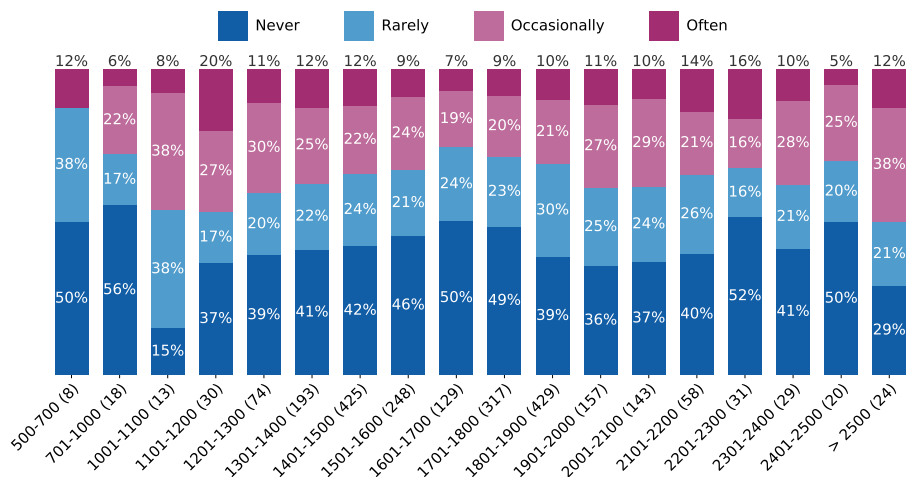
Figure A.17: "Quitting by income" Relative response rates. The total number of responses is shown in brackets.
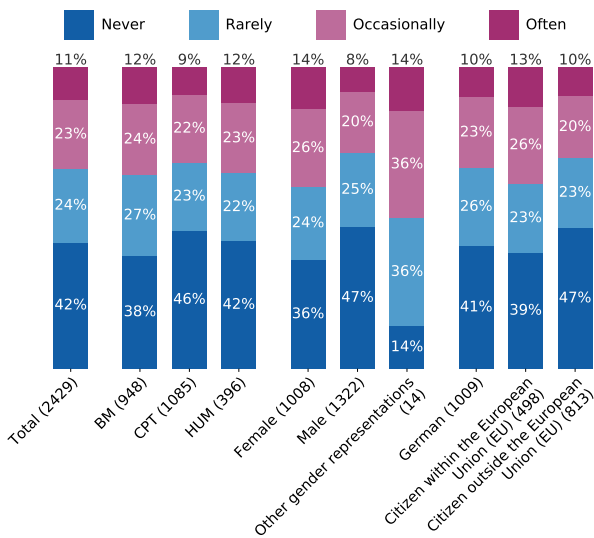
Figure A.18: "Quitting overall, by section, by gender, and by nationality" Relative response rates. The total number of responses is shown in brackets.
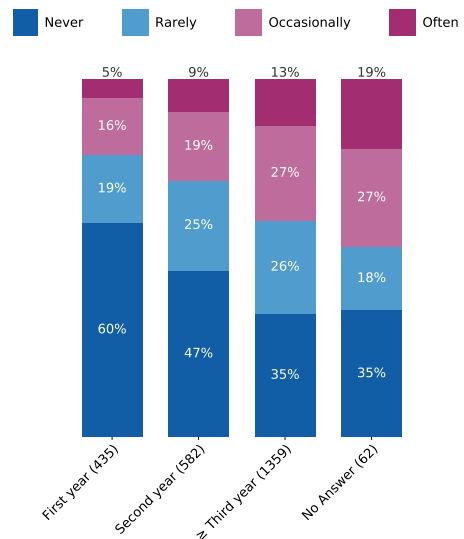
Figure A.19: "Quitting by year" Relative response rates. The total number of responses is shown in brackets.

A.3 Scientific Environment Support Structures
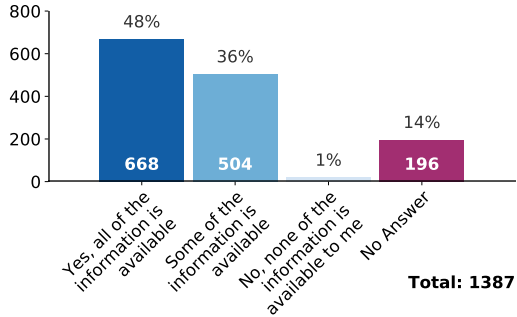
Figure A.21: "Is all the important information (group internal, administrative, your contract/stipend) available in a language you understand?" Responses from non–Germans only.

Figure A.23: "Please specify the number and kind of publications (whether published, accepted for publication, or submitted) your institute/university requires you to obtain your PhD"
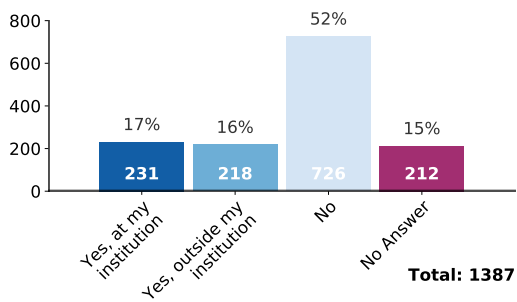
Figure A.22: "Are you currently taking German language classes?" Responses from non–Germans only.
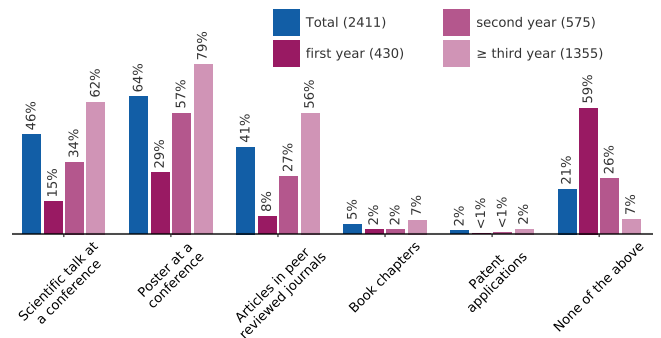
Figure A.24: Which of the following types of scientific output have you published so far during your doctoral research?

Figure A.20: "Do you think that you are well trained for a job outside science?" Answers are grouped by question: Which field would you like to work in after completing your PhD? As multiple answers were possible, the percentages add up to more than 100%

A.4 Power Abuse
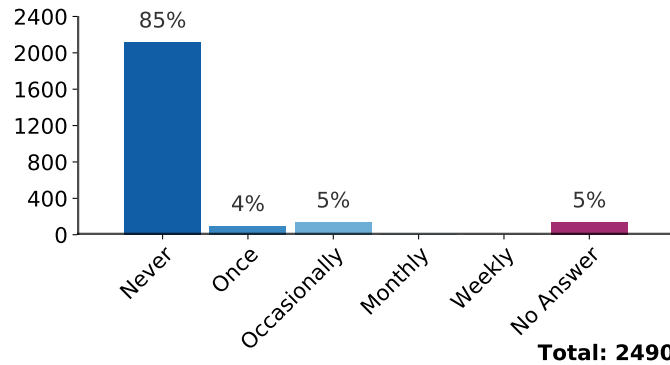
Figure A.25: "While working at your institute/center, have you at any point witnessed any unwanted behavior towards a colleague that you would call "sexualized harassment" from a superior?"

(a)   (b)
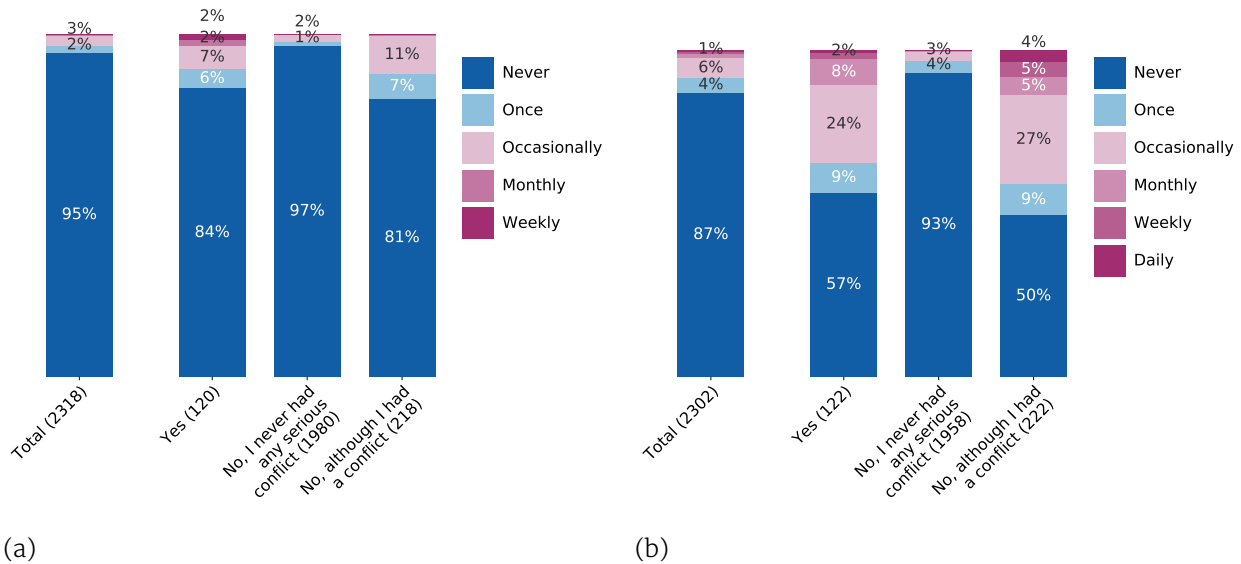
Figure A.26: a) "While working at your institute/center, have you at any point experienced unwanted behavior that you would call 'sexualized harassment' from a superior?" b) "While working at your institute/center, have you at any point been subjected to bullying by a superior?" Responses are grouped by: Did you ever report a conflict with a superior to one of the institutions above?
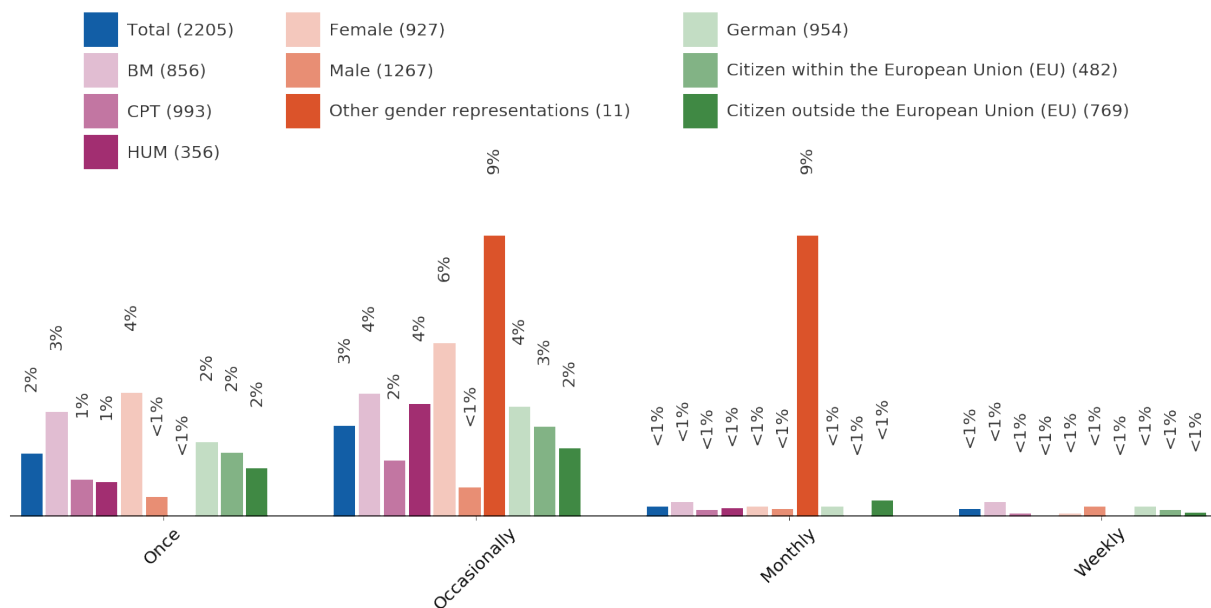
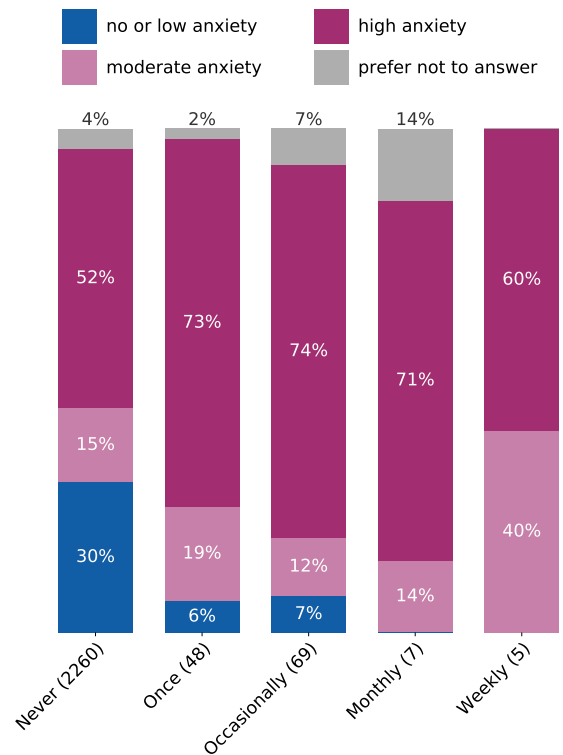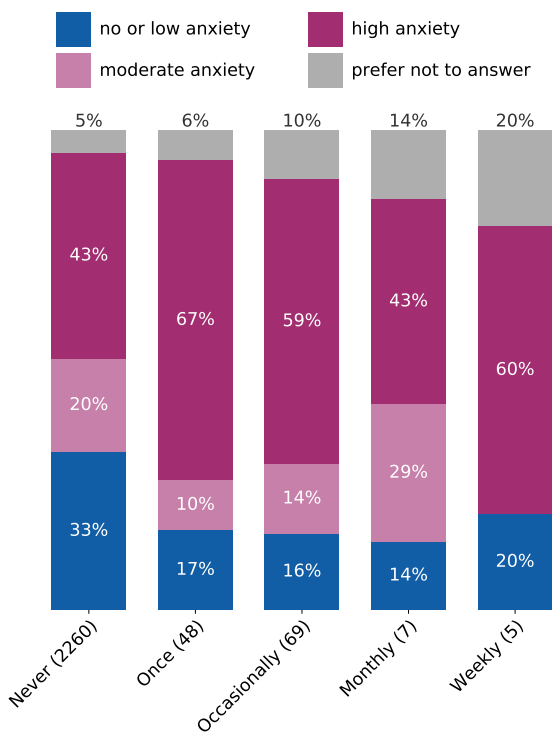**Figure A.27:** "While working at your institute/center, have you at any point experienced unwanted behavior that you would call 'sexualized harassment' from a superior"
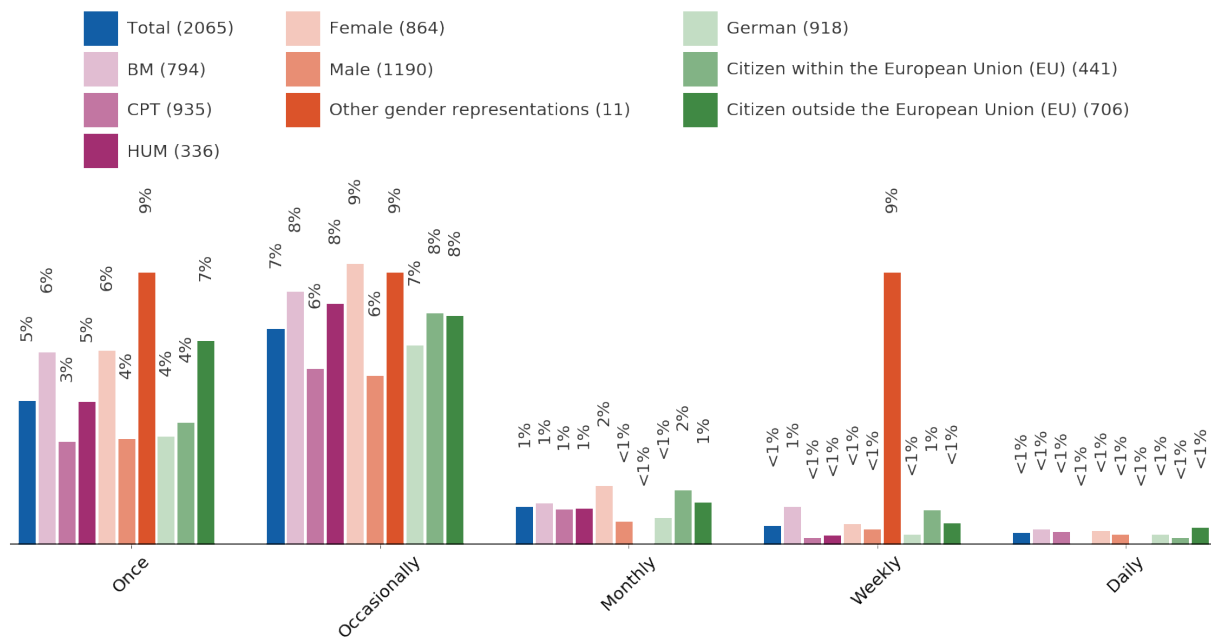
Figure A.28: "While working at your institute/center, have you at any point been subjected to bullying by a superior"
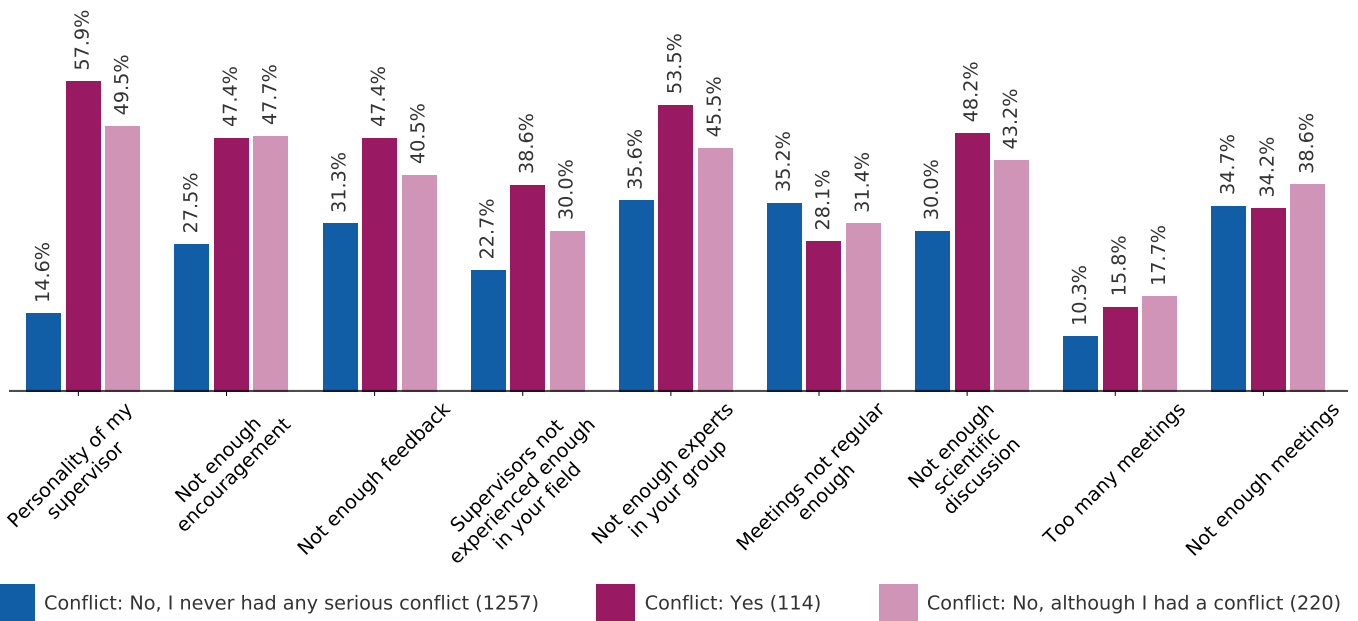
Figure A.29: "Did you ever encounter problems regarding your supervision?" Responses are grouped by: Did you ever report a conflict with a superior to one of the institutions above?.
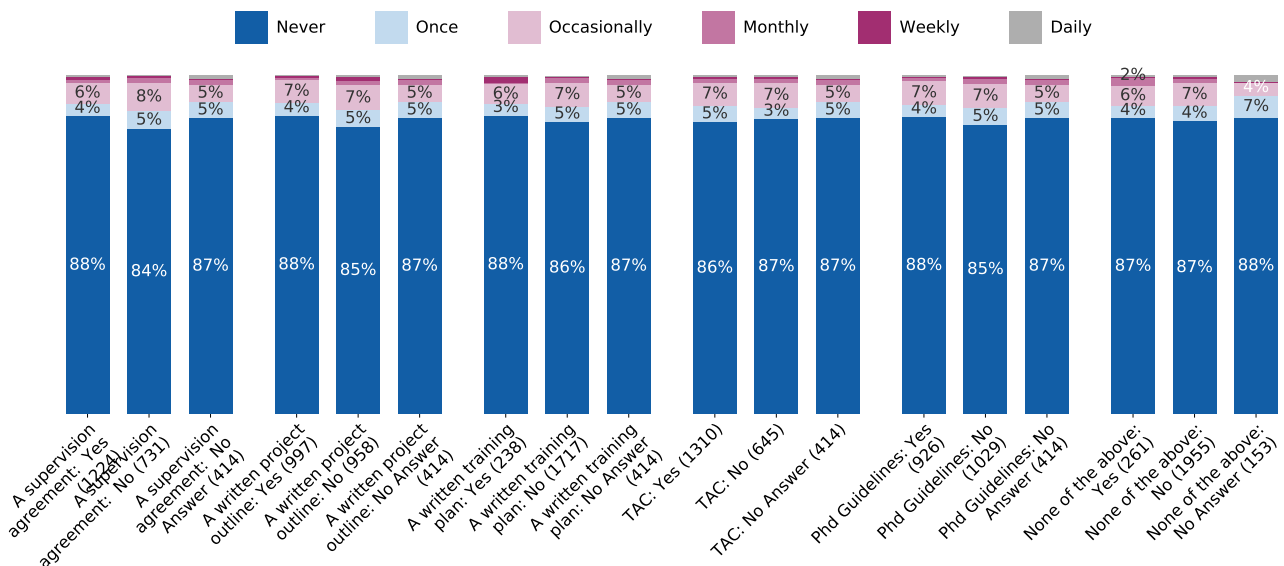
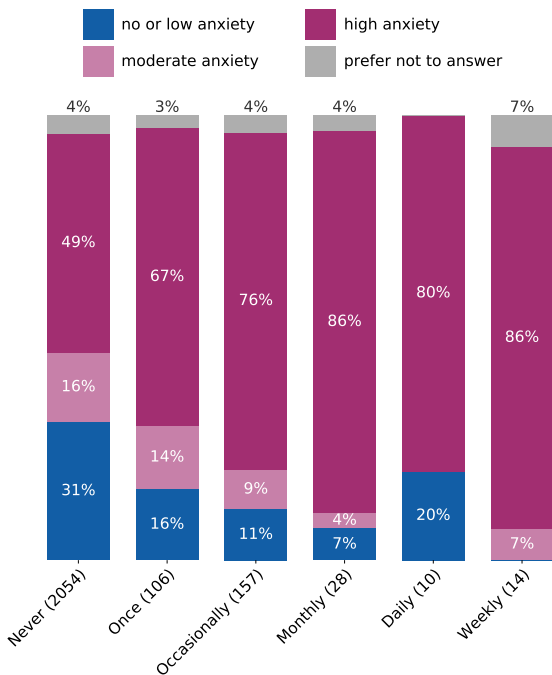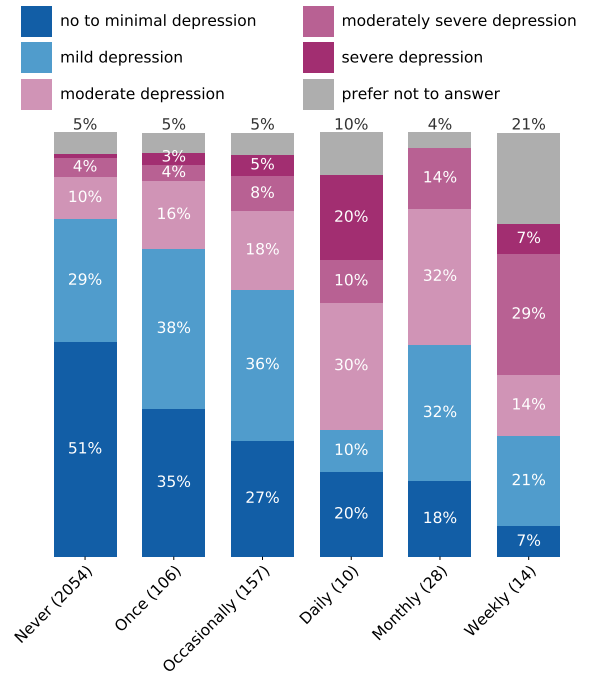**Figure A.30:** "While working at your institute/center, have you at any point been subjected to bullying by a superior?" Responses are grouped by having or not having the indicated support instrument in place.

A.5 Mental Health
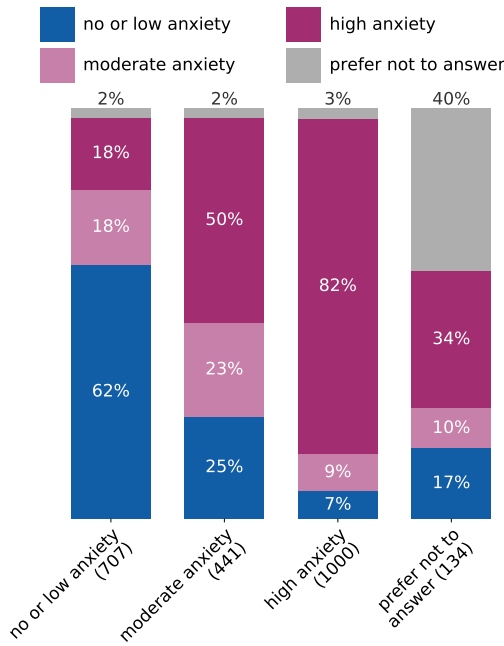
Figure A.31: Correlation between the different mental health classifications: a) State Anxiety levels compared to Trait Anxiety.

Figure A.32: Correlation between the different mental health classifications: a) State Anxiety levels compared to Depression.
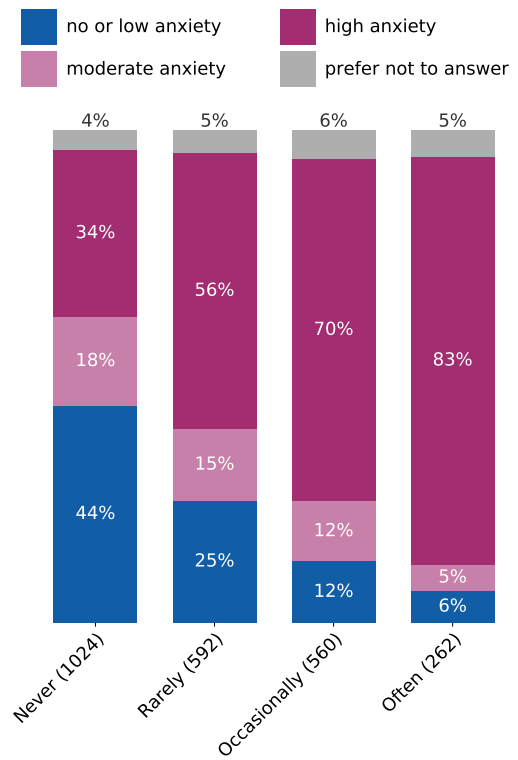
Figure A.33: "Have you ever considered quitting your PhD?" Distribution of responses divided by state anxiety levels.
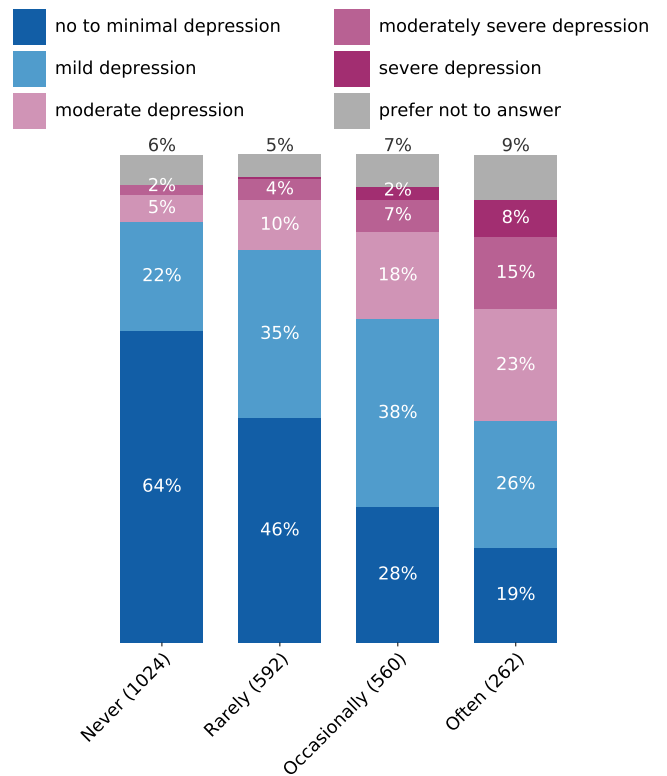
Figure A.34: "Have you ever considered quitting your PhD?" Distribution of responses divided by depression levels.
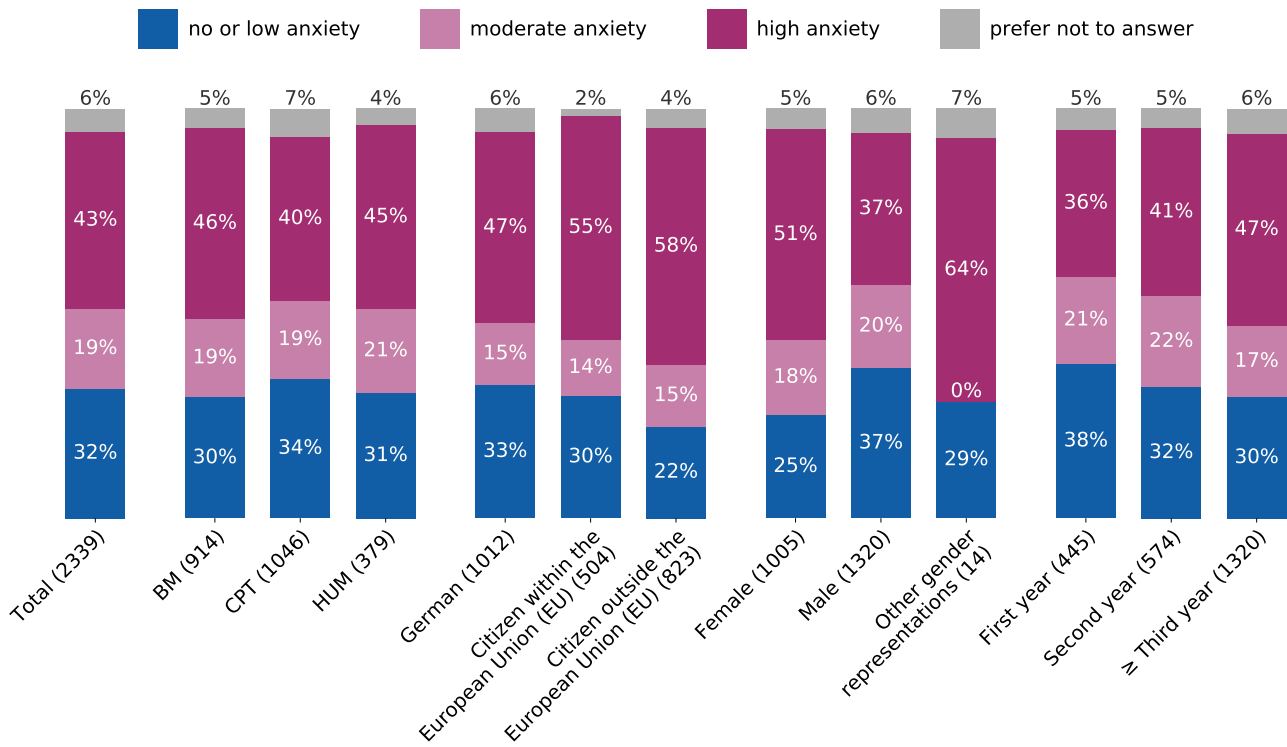
Figure A.35: Distribution of the Trait Anxiety levels among DRs with different demo–graphics factors: section inside the MPS, nationality, gender and time spent on the PhD so far (from left to right).
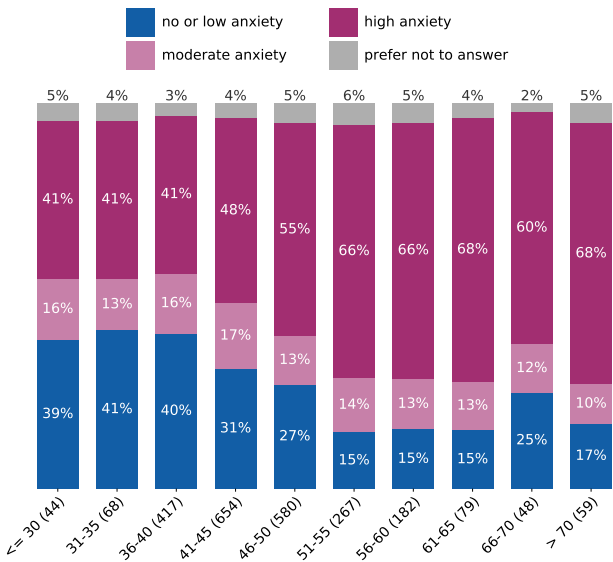
Figure A.36: "On average, how many hours do you typically work per week in total?" Distribution of re–sponses divided by state anxiety levels.
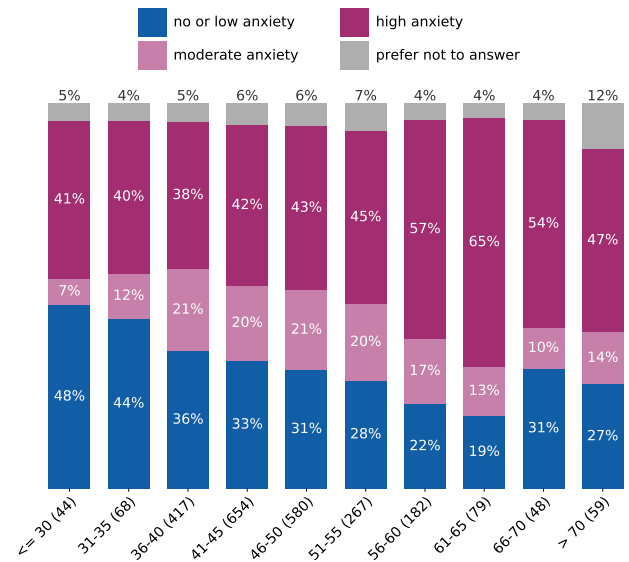
Figure A.37: "On average, how many hours do you typically work per week in total?" Distribution of re–sponses divided by trait anxiety levels.
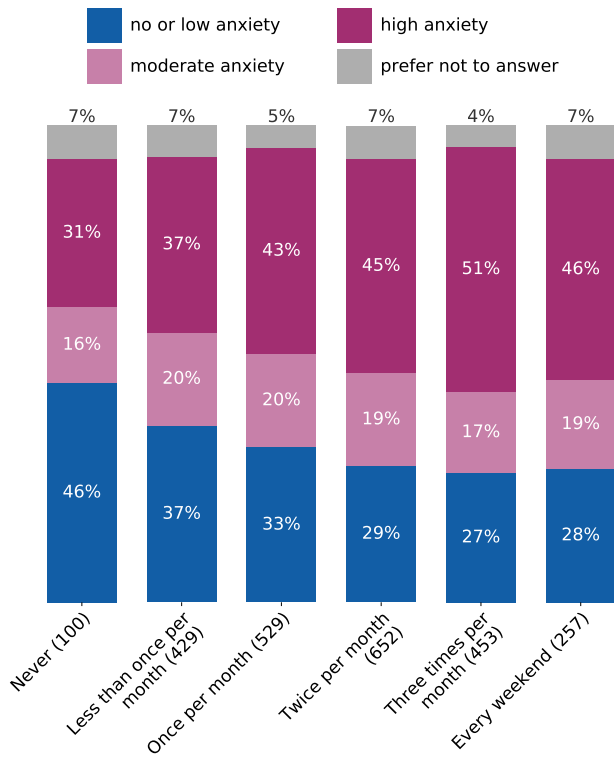
Figure A.38: "How often have you worked during weekends or public holidays in the past year?" Distribution of responses divided by trait anxiety levels.
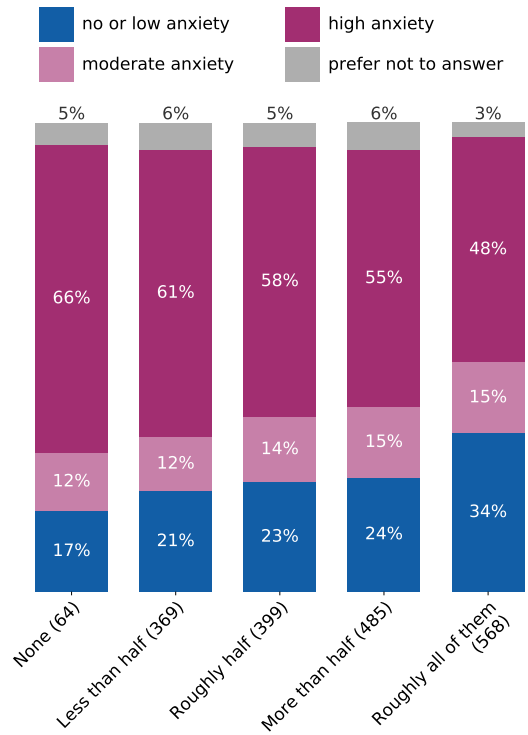
Figure A.40: "How many days of your entitled holidays did you take in the past year?" Distribution of responses divided by state anxiety levels excluding DR's that started 2019.
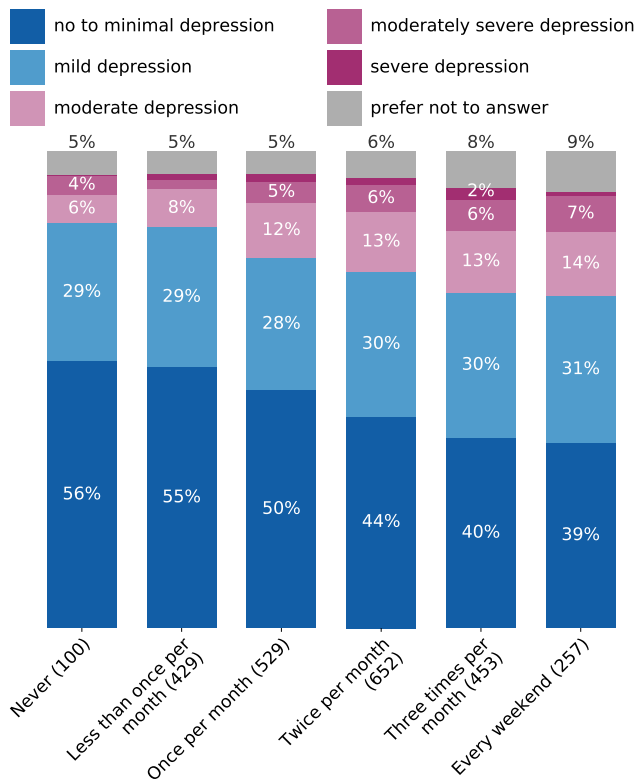
Figure A.39: "How often have you worked during weekends or public holidays in the past year?" Distribution of responses divided by depression levels.
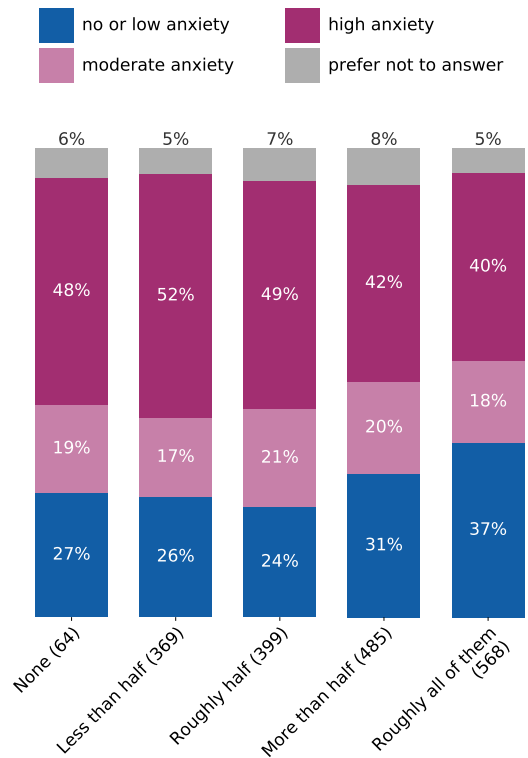
Figure A.41: "How many days of your entitled holidays did you take in the past year?" Distribution of responses divided by trait anxiety levels excluding DR's that started 2019.
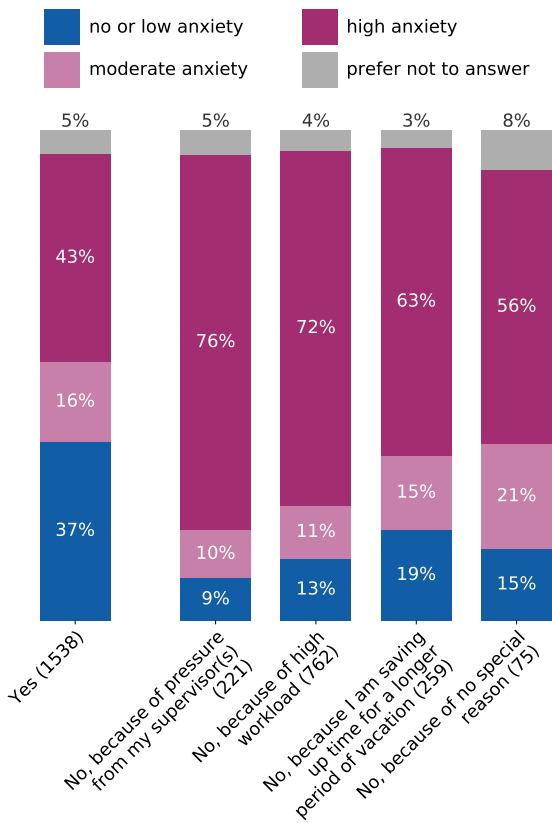
Figure A.42: "Do you feel free to take days off?" Distribution of responses divided by state anxiety levels.
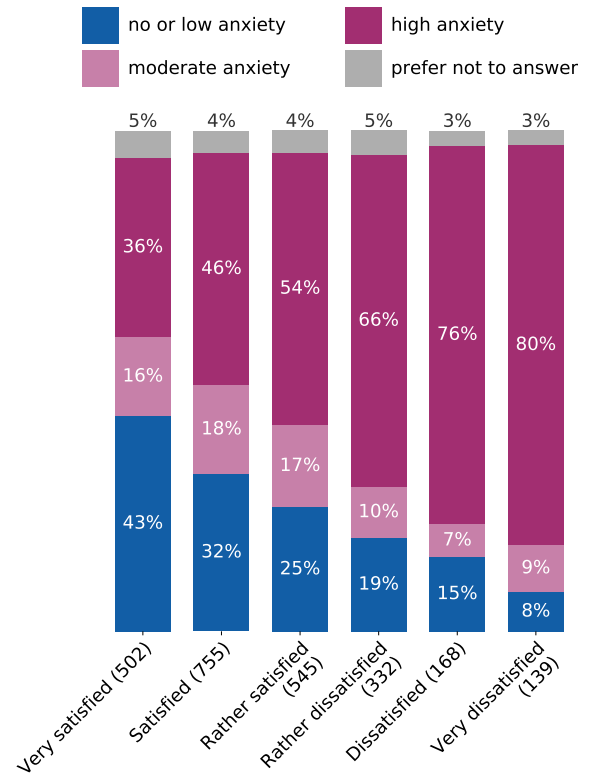
Figure A.44: "How satisfied are you with your PhD supervision in general?" Distribution of responses divided by state anxiety levels.
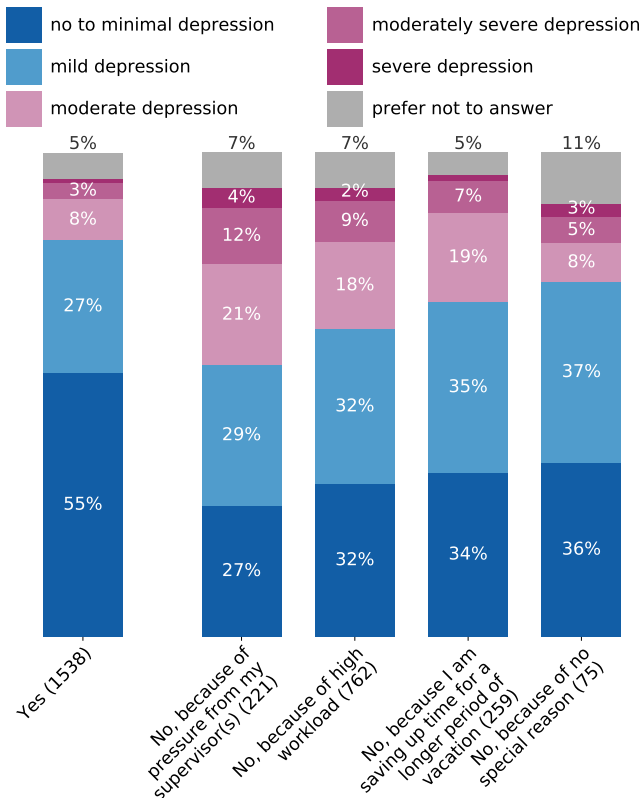
Figure A.43: "Do you feel free to take days off?" Distribution of responses divided by depression levels.
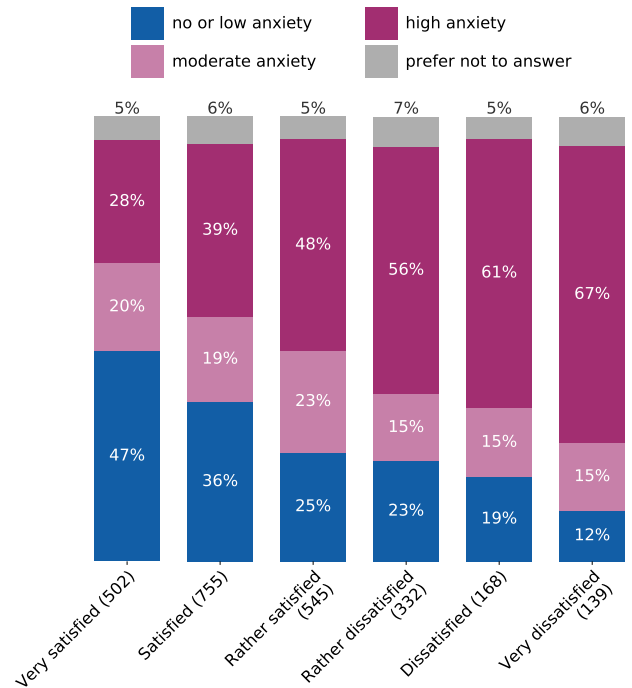
Figure A.45: "How satisfied are you with your PhD supervision in general?" Distribution of responses divided by trait anxiety levels.
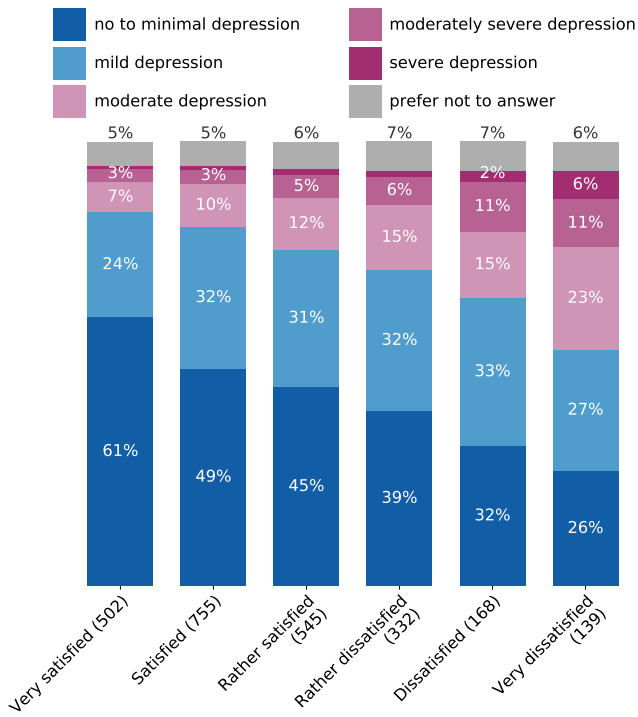
Figure A.46: "How satisfied are you with your PhD supervision in general?" Distribution of responses divided by depression levels.
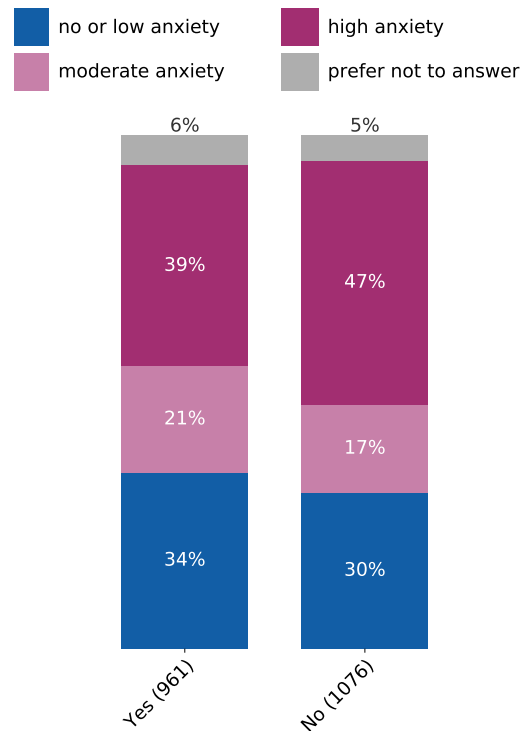
Figure A.48: "Do you have one of the following (multiple answers possible)?: PhD guidelines" Distribution of responses divided by trait anxiety levels.
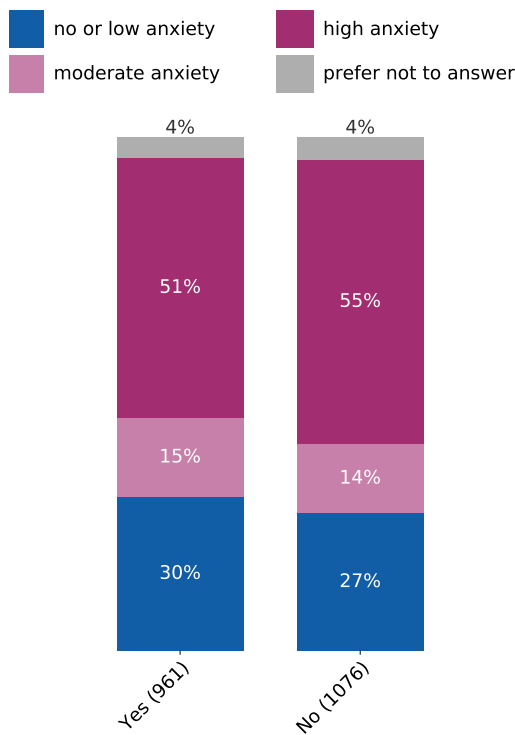
Figure A.47: "Do you have one of the following (multiple answers possible)?: PhD guidelines" Distribution of responses divided by state anxiety levels.
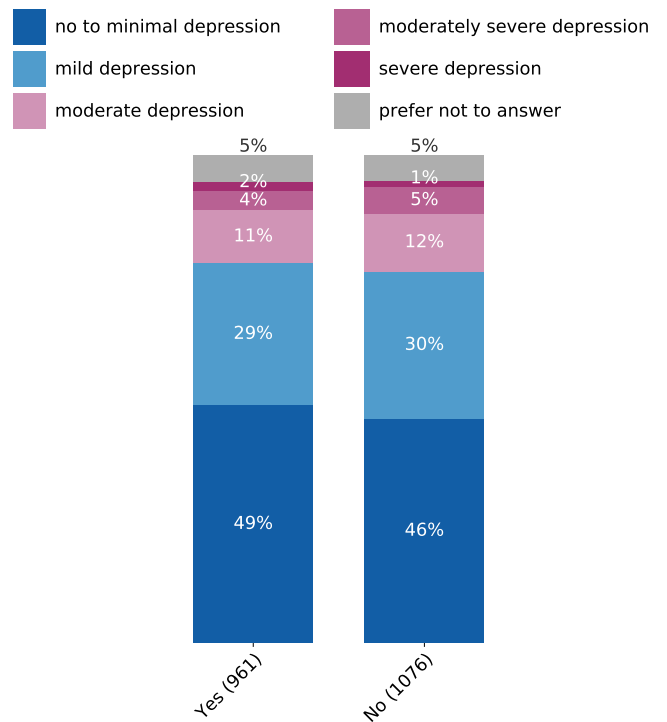
Figure A.49: "Do you have one of the following (multiple answers possible)?: PhD guidelines" Distribution of responses divided by depression levels.
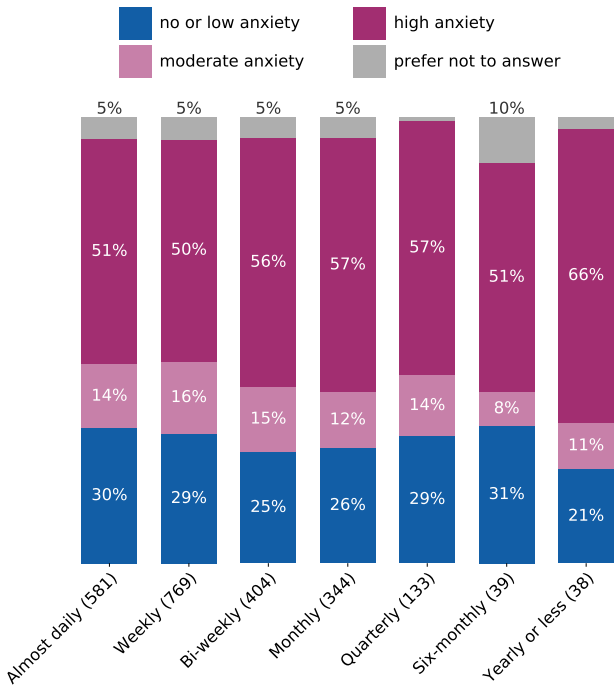
Figure A.50: "How often do you communicate on average with your daily/direct supervisor about your PhD project?" Distribution of responses divided by state anxiety levels.
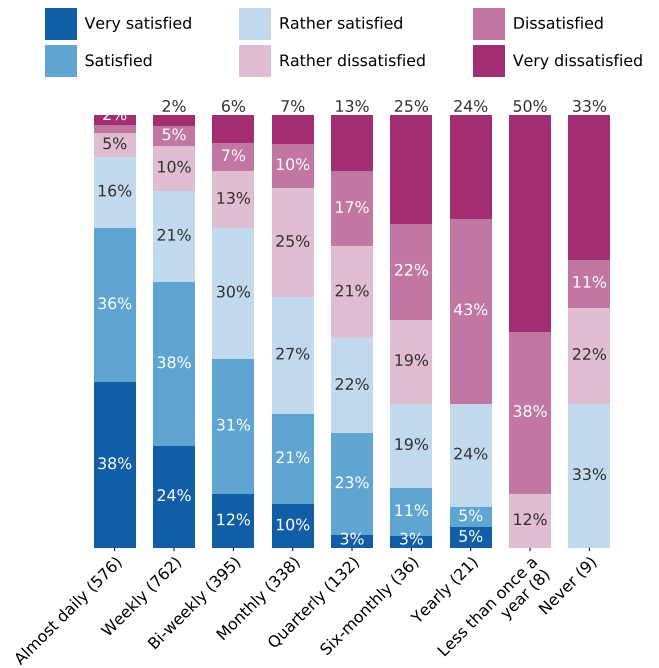
Figure A.52: "How often do you communicate on average with your daily/direct supervisor about your PhD project?" Distribution of responses divided satisfaction with supervision.
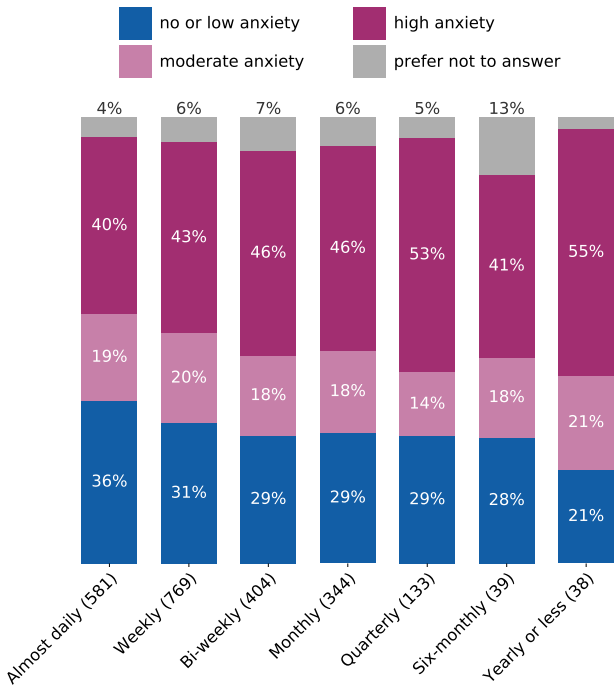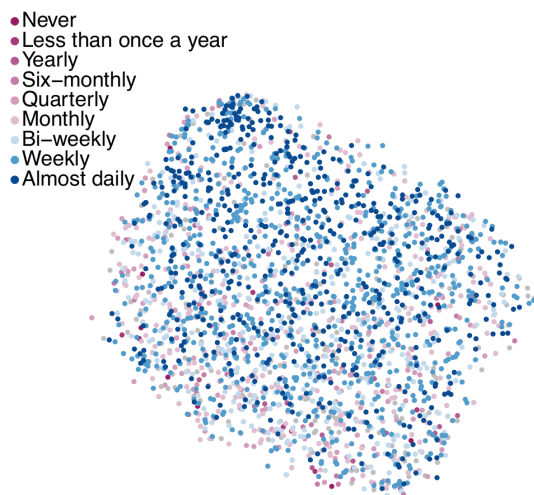

Figure A.51: "How often do you communicate on average with your daily/direct supervisor about your PhD project?" Distribution of responses divided by trait anxiety levels.
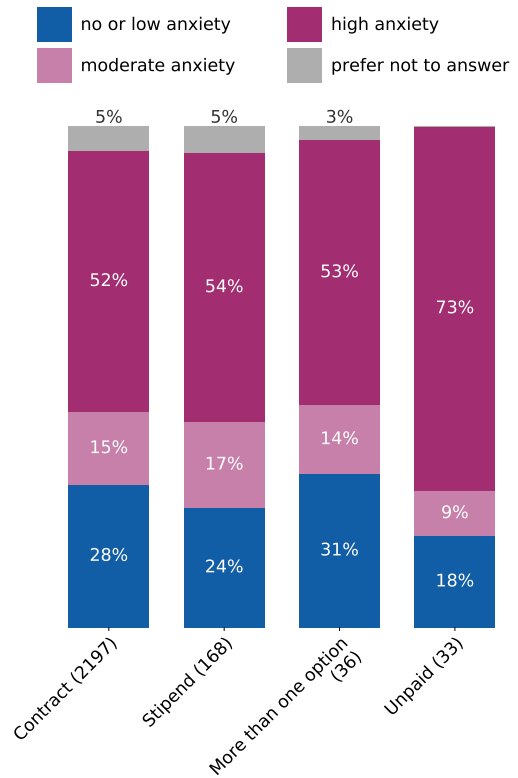
Figure A.53: "How is your doctoral research currently financed (multiple answers possible)?" Distribution of responses divided by state anxiety levels.
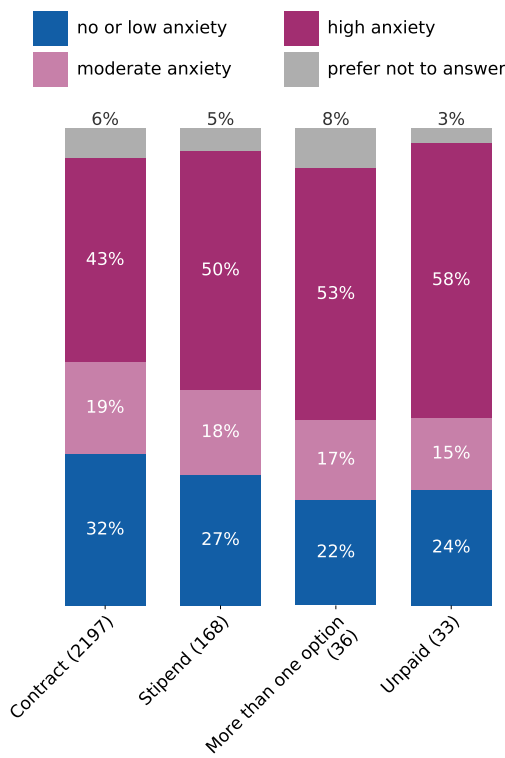
Figure A.54: "How is your doctoral research currently financed (multiple answers possible)?" Distribution of responses divided by trait anxiety levels.
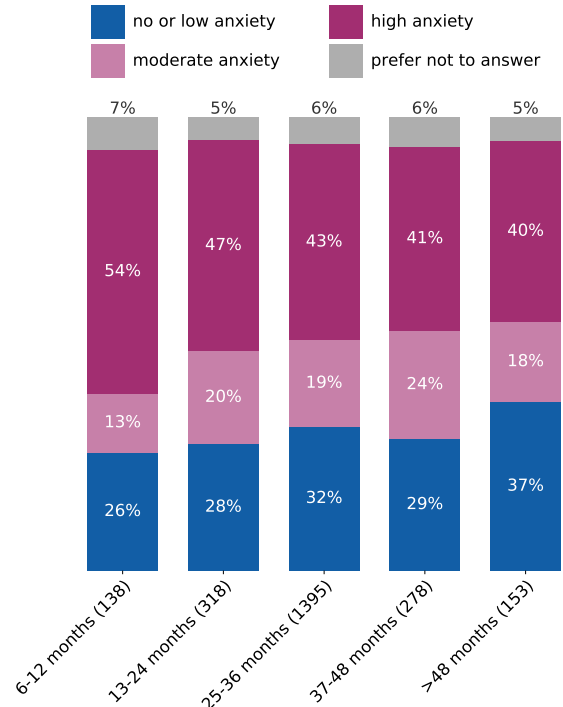
Figure A.56: "What was or is the longest duration of your contract or stipend related to your PhD project?" Distribution of responses divided by trait anxiety levels.
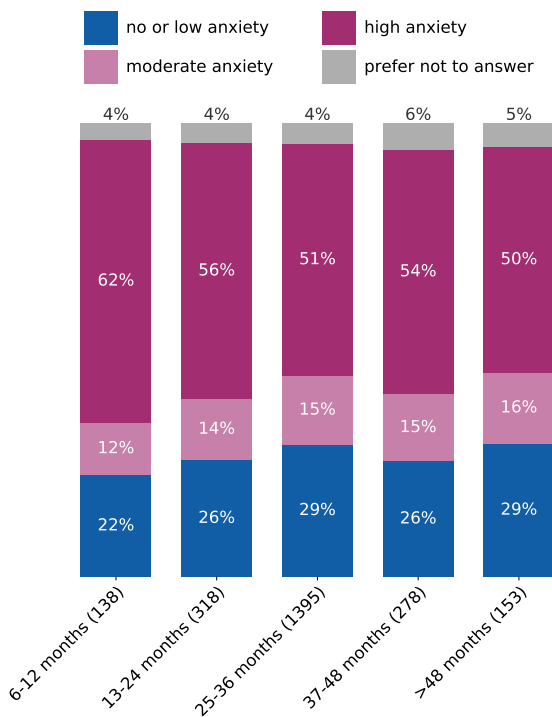
Figure A.55: "What was or is the longest duration of your contract or stipend related to your PhD project?" Distribution of responses divided by state anxiety levels.

Figure A.57: "While working at your institute/center, have you at any point experienced unwanted behavior that you would call 'sexualized harassment' from a superior?" Distribution of responses divided by state anxiety levels.

Figure A.58: "While working at your institute/center, have you at any point experienced unwanted behavior that you would call 'sexualized harassment' from a superior?" Distribution of responses divided by trait anxiety levels.

Figure A.59: "While working at your institute/center, have you at any point been subjected to bullying by a superior?" Distribution of responses divided by state anxiety levels.

Figure A.60: "While working at your institute/center, have you at any point been subjected to bullying by a superior?" Distribution of responses divided by depression levels.
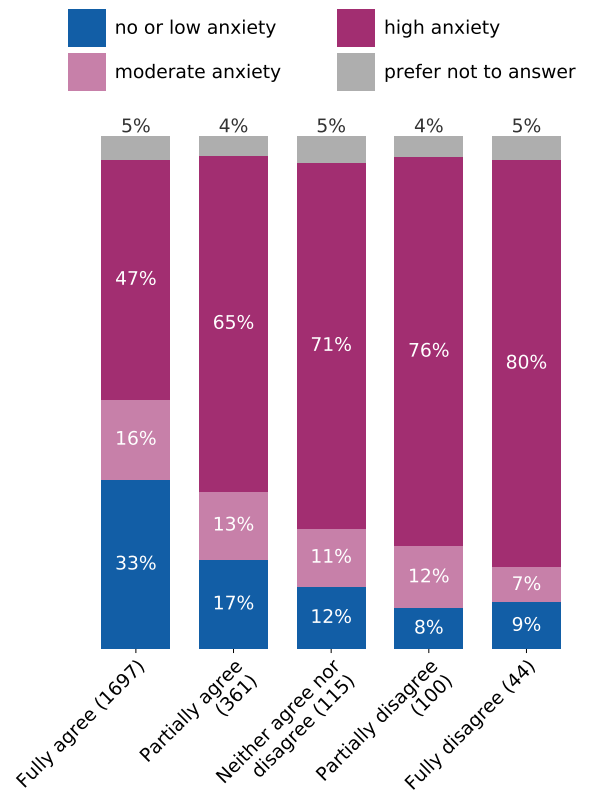
Figure A.61: "Please rate the supervision provided by your formal/primary supervisor: My supervisor treats me politely." Distribution of responses divided by state anxiety levels.
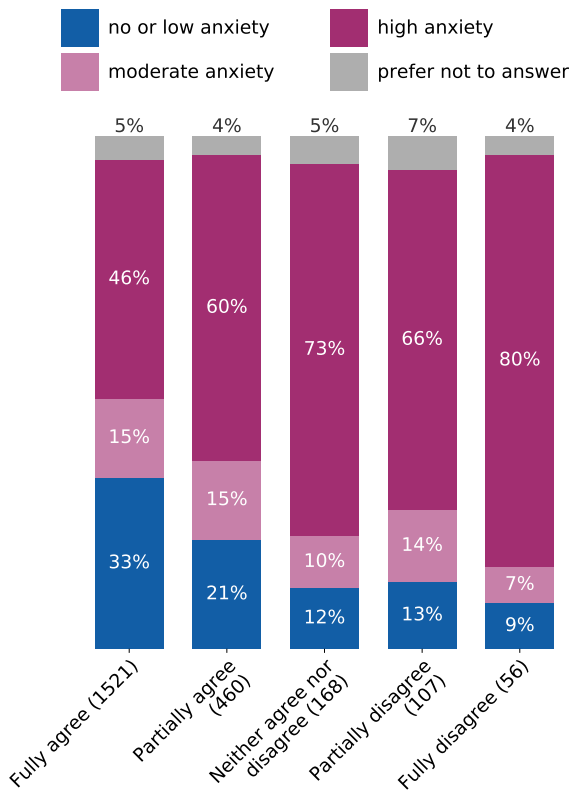
Figure A.62: "Please rate the supervision provided by your formal/primary supervisor: My supervisor treats me professionally." Distribution of responses divided by state anxiety levels.
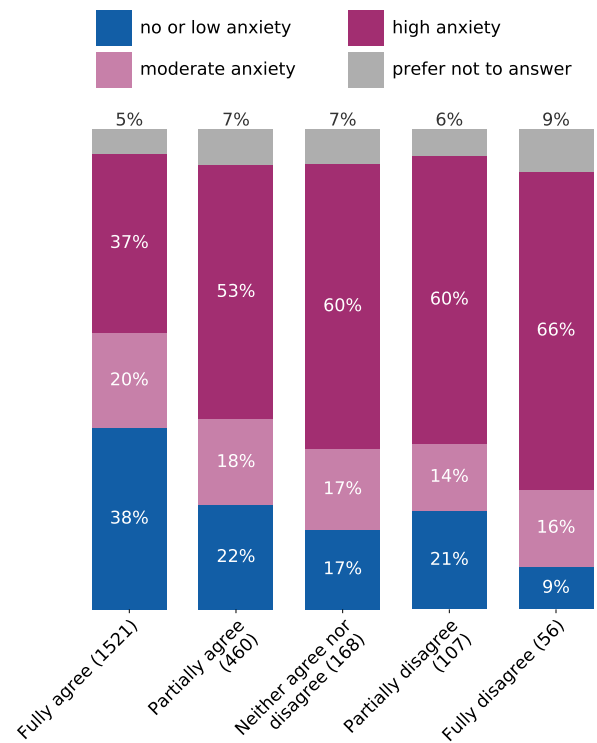
Figure A.64: "Please rate the supervision provided by your formal/primary supervisor: My supervisor treats me professionally." Distribution of responses divided by trait anxiety levels.
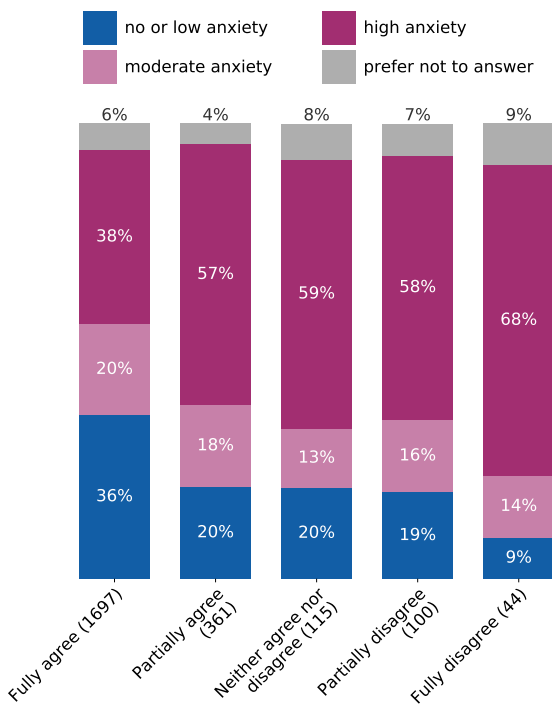
Figure A.63: "Please rate the supervision provided by your formal/primary supervisor: My supervisor treats me politely." Distribution of responses divided by trait anxiety levels.
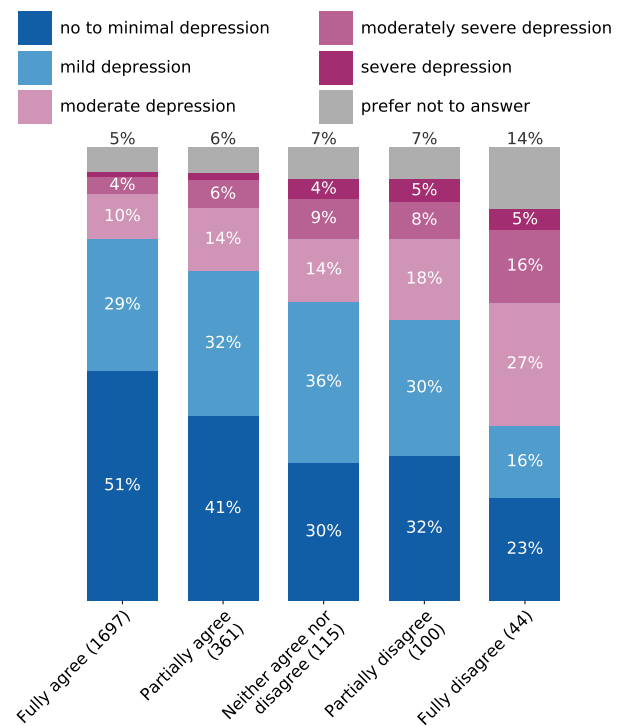
Figure A.65: "Please rate the supervision provided by your formal/primary supervisor: My supervisor treats me politely." Distribution of responses divided by depression levels.

A.6 Cluster Analysis

A.6.1 K-medoids Clustering
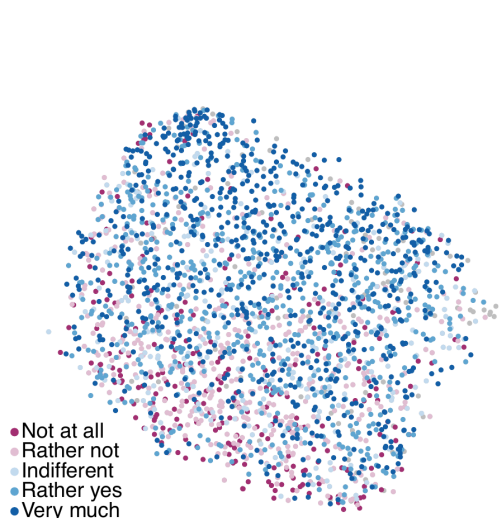
Figure A.66: "Which field would you like to work in after completing your PhD? Academia" 2-dimensional representation of DRs answers from 6.1. Color code indicates DRs answers to the indicated question.

Figure A.67: "Is language an obstacle for communication with people at your center/institute?" 2-dimensional representation of DRs answers from 6.1. Color code indicates DRs answers to the indicated question.

Figure A.68: "For which of the following aspects would you have needed more support from your institute? None of the above" 2-dimensional representation of DRs answers from 6.1. Color code indicates DRs answers to the indicated question.

Figure A.69: "How often do you communicate on average with your daily/direct supervisor about your PhD project? 2-dimensional representation of DRs answers from 6.1. Color code indicates DRs answers to the indicated question.
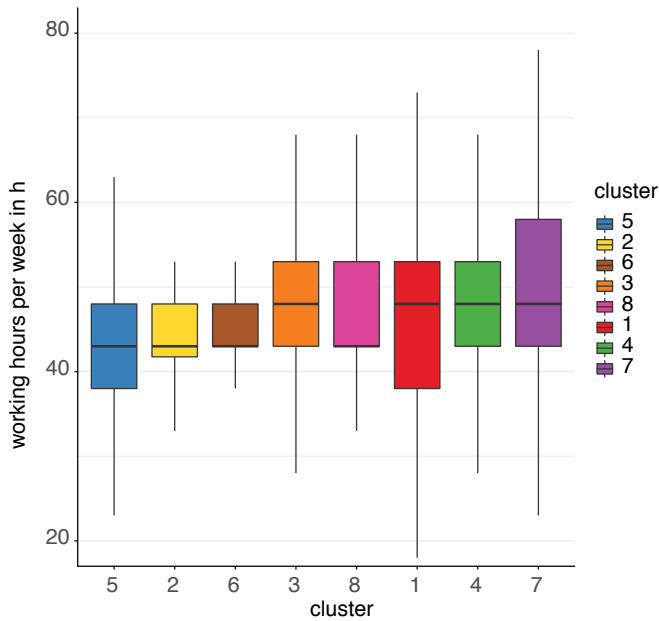
Figure A.70: DRs working hours distributions per cluster. DRs working hour distribution per cluster shown in Figure 6.1, ordered by the average working hours per cluster, in increasing order from left to right. The lower and upper end of the boxes for each cluster, correspond to first and third quartiles, respectively. The horizontal black lines mark the medians in each cluster. For each cluster, the upper whisker extends from the upper hinge to the largest value no further than 1.5 * the inter quartile range(IQR) and the lower whisker extends from the lower hinge to the smallest value not further than 1.5 * IQR.

Figure A.71: DRs income distribution per cluster. DRs income distribution per cluster shown in Figure 6.1, ordered by the salary per cluster, in decreasing order from left to right. The lower and upper hinges of the boxes for each cluster, correspond to first and third quartiles, respectively. The horizontal black lines mark the medians in each cluster. For each cluster, the upper whisker extends from the upper hinge to the largest value no further than 1.5 * IQR and the lower whisker extends from the lower hinge to the smallest value not further than 1.5 * IQR.

Table A.1: Cluster 1 statistics for the most relevant question answer pairs including z–rank and p values.

z	Question	Answer	p
4	In general, how do you judge the following aspects of an academic research career?: Salaries in academia	Very attractive	3.05e–08
5	Do you speak German?	None	1.01e–13
7	Do you have one of the following?: I don't know	Yes	3.15e–10
12	Which year do you expect to submit your PhD thesis?	2023	6.65e–08
18	Is all the important information (group internal, administrative, your contract/stipend) available in a language you understand?	Yes, all of the information is available	3.12e–07
19	Is language an obstacle for communication with people at your center/institute?	Not at all	1.12e–06
21	Which year did you start your PhD?	2019	2.52e–16
22	Do you know PhDnet?	No	3.91e–13
24	Which of the following measures for your career development are supported by your center/institute?: Language classes	Yes, to a great extent	7.03e–06
28	Right now, what is your monthly net income for your work at your research organization?	1301–1400	0.0288
35	Which of the following aspects of your work as a doctoral researcher would you like to be improved?: Salary and benefits	Not at all	3.70e–07
37	If you think about your own situation as a doctoral researcher, how satisfied are you with the following aspects?: Support for international doctoral researchers	Very satisfied	8.94e–21
43	What is your year of birth?	1995	0.00190
44	Do you identify with your research organization the Max–Planck Society?	Yes, very much	1.60e–10
53	Do you know your current PhD representatives at your institution?	No	5.55e–09
56	How is your doctoral research currently financed?: Stipend	Yes	1.72e–05
62	Which of the following aspects of your work as a doctoral researcher would you like to be improved?: Support for foreign employees	Not at all	3.70e–11
65	What is your citizenship?	Citizen outside the European Union (EU)	1.29e–07
66	How many days of your entitled holidays did you take in the past year?	None	2.40e–06
77	Which field would you like to work in after completing your PhD?: Academia	Yes, very much	6.61e–06
83	Which year do you expect to submit your PhD thesis?	2022	4.70e–05

85	If you think about your own situation as a doctoral researcher, how satisfied are you with the following aspects?: Supervision	Very satisfied	8.14e-18
90	Did you ever encounter problems regarding your supervision? I did not encounter problems regarding my supervision	Yes	2.86e-17
99	How satisfied are you with your PhD supervision in general?	Very satisfied	4.42e-14

Table A.2: Cluster 5 statistics for the most relevant question answer pairs including z-rank and p values.

z	Question	Answer	p
6	If you have been bothered by any problems, how difficult have these problems made it for you to do your work?	I have not been bothered by any problems	7.28e–12
8	If you think about your own situation as a doctoral researcher, how satisfied are you with the following aspects?: Psychological support	Does not apply	2.85e–07
20	How often do you meet your thesis advisory committee (TAC) ?	I meet my TAC twice a year or more frequentl	0.0013
43	Is your project progress according to your (reviewed) project plan?	Yes	1.94e–06
44	For which of the following aspects would you have needed more support from your institute? None of the above	Yes	0.000147
45	How satisfied are you with your PhD supervision in general?	Very satisfied	2.47e–21
61	Did you ever encounter problems regarding your supervision? (multiple answers possible)I did not encounter problems regarding my supervision	Yes	3.06e–21
63	Do you identify with your research center/institute?	Yes, very much	3.23e–10
74	On average, how many hours do you typically work per week in total?)	36–40	0.00550
82	Which field would you like to work in after completing your PhD (multiple answers possible)?: Private sector science–related job	Rather not	0.0263
85	How often do you communicate on average with your daily/direct supervisor about your PhD project?	Almost daily	0.000116
92	Do you feel free to take days off? (multiple answers possible)	Yes	3.50e–05
95	What is your year of birth?	1994	0.0278
99	Have you ever considered quitting your PhD?	Never	5.27e–18
100	How many days of your entitled holidays did you take in the past year?	Roughly all of them	0.0250

Table A.3: Cluster 7 statistics for the most relevant question answer pairs including z-rank and p values.

z	Question	Answer	p
1	Please rate the supervision provided by your formal/primary supervisor: My supervisor treats me politely.	Fully disagree	1.09e-18
2	While working at your institute/center, have you at any point been subjected to bullying by a superior?	Monthly	1.16e-12
3	Please rate the supervision provided by your formal/primary supervisor:My supervisor treats me professionally.	Fully disagree	1.09e-18
7	Which field would you like to work in after completing your PhD?: Non-scientific job	Very much	0.0268
9	While working at your institute/center, have you at any point witnessed bullying by a superior?	Monthly	2.36e-08
14	How satisfied are you with your PhD supervision in general?	Very dissatisfied	1.00e-25
15	While working at your institute/center, have you at any point witnessed any unwanted behavior towards a colleague that you would call 'sexualized harassment' from a superior?	Occasionally	2.042e-09
16	If you have been bothered by any problems, how difficult have these problems made it for you to do your work?	Extremely difficult	3.68e-14
22	What was/were the reason(s) for considering to quit your PhD? I have personal difficulties with my supervisor.	Yes	1.11e-25
23	While working at your institute/center, have you at any point experienced unwanted behavior that you would call 'sexualized harassment' from a superior?	Occasionally	1.30e-09
24	While working at your institute/center, have you at any point been subjected to bullying by a superior?	Occasionally	1.23e-17
32	Do you identify with your research organization the Max-Planck Society?	Not at all	1.13e-08
36	Do you identify with your research center/institute?	Not at all	5.97e-13
41	Did you ever report a conflict with a superior to one of the institutions above?	Yes	1.22e-10
50	Do you feel free to take days off? (multiple answers possible)No, because of pressure from my supervisor(s)	Yes	1.26e-17
53	Did you ever report a conflict with a superior to one of the institutions above?	No, although I had a conflict	2.89e-18

56	Are there regular social activities in your group or at your institution (e.g., sports events, going out for dinner/drinks, discussion forums, movie nights, etc.)?	Yes, but I do not attend them	0.000470
57	Which field would you like to work in after completing your PhD?: Take an extended break	Very much	4.72e-06
58	On average, how many hours do you typically work per week in total?	56-60	0.000260
64	What was/were the reason(s) for considering to quit your PhD? I have work related difficulties with my supervisor.	Yes	1.155e-21
66	Have you ever considered quitting your PhD?	Often	1.28e-23
67	Which field would you like to work in after completing your PhD?: Academia	Not at all	0.000175
71	What was/were the reason(s) for considering to quit your PhD? I do not like my working conditions.	Yes	1.39e-19
73	What was/were the reason(s) for considering to quit your PhD? I don't like the social environment at my workplace.	Yes	5.11e-18
80	Do you have one of the following? I don't have any of the above	Yes	7.63e-05
81	Which year do you expect to submit your PhD thesis?	2019	0.00168
88	What was or is the longest duration of your contract or stipend related to your PhD project?	13-24 months	0.0043
94	What was/were the reason(s) for considering to quit your PhD? I have problems getting by financially.	Yes	1.70e-06
96	For which of the following aspects would you have needed more support from your institute?Visa for my residency	Yes	7.79e-05

Table A.4: Cluster 4 statistics for the most relevant question answer pairs including z-rank and p values.

z	Question	Answer	p
7	Which field would you like to work in after completing your PhD?: Non-scientific job	Very much	2.85e-06
17	How satisfied are you with your PhD supervision in general?	Dissatisfied	5.92e-15
24	Are there regular social activities in your group or at your institution (e.g., sports events, going out for dinner/drinks, discussion forums, movie nights, etc.)?	No, there are no social activities	4.60e-06
27	How much do you pay for your rent and associated living costs per month in euros?	701-800	0.0436
28	Do you identify with your research organization the Max-Planck Society?	Not quite	1.73e-06
32	Please rate the supervision provided by your formal/primary supervisor: My supervisor treats me politely.	Partially agree	2.11e-08
34	What was/were the reason(s) for considering to quit your PhD? I find other jobs more interesting	Yes	4.43e-06
37	Have you ever been on a research stay abroad?	No, and my institute does not support it	4.48e-12
45	Do you feel that there is sufficient support (financial and organizational) from your institute for raising a child?	No	4.06e-08
47	If you have been bothered by any problems, how difficult have these problems made it for you to do your work?	Very difficult	5.66e-19
48	What was/were the reason(s) for considering to quit your PhD? I do not like my topic.	Yes	1.25e-08
50	Do you identify with your research center/institute?	Not quite	1.33e-
51	What was or is the longest duration of your contract or stipend related to your PhD project?	6-12 months	5.44e-05
57	Have you ever considered quitting your PhD?	Occasionally	1.77e-11
64	What was/were the reason(s) for considering to quit your PhD? I can't cope with the high workload.	Yes	3.52e-09
67	Which field would you like to work in after completing your PhD?: Academia	Not at all	9.64e-07
77	Please rate the supervision provided by your formal/primary supervisor: My supervisor treats me professionally.	Partially disagree	7.31e-09
83	Why did you start your work on your doctoral thesis at your research center/institute? I did not find or look for better work opportunities	Yes	1.82e-05

| 86 | How many days of your entitled holidays did you take in the past year? | Less than half | 0.0295 |
| 94 | Do you feel free to take days off? No, because of high workload | Yes | 2.24e-12 |

A.6.2 Dimensionality reduction

The second clustering analysis used the dimensionality reduction and UMAP embedding described in B.1.3. It finds three main clusters shown in Figure A.72 (cluster 1: 1420 participants, cluster 2: 547 participants, cluster 3: 523 participants), which in comparison to the k-medoids clusters described in chapter 6 does not only focus on the extremes (very satisfied/dissatisfied). A fourth cluster might be hidden inside Cluster 1 (top right part of cluster 1), but is not distinct enough to be distinguished.

Figure A.73: "How satisfied are you with your PhD supervision in general?"

Figure A.72: Distribution of clusters among DRs based on all their answers to the survey questions found by the dimensionality reduction method.

It seems like two main features are driving the clustering: First satisfaction with supervision, which was also found in section 6. As seen in Figure A.73 cluster 3 and the top right part of cluster 1 show far higher satisfaction levels than cluster 2 or the rest of cluster 1.

In addition the division between the top clusters 2, 3 and bottom cluster 1 can be explained by looking at the tendencies to quit the PhD as displayed in Figure A.74.

Other indicators such as income (cluster 1: 1664±356, cluster2: 1665±330, cluster 3: 1664± 316) and working hours (cluster 1: 47.5 ± 9.2, cluster 2: 46.7 ± 9.4, cluster 3: 45.9 ± 9.1) show

Figure A.74: "Have you ever considered quitting your PhD?"

no or only small differences. [12].

More similarities to the k-medoids clustering are found when looking at the nationalities of DRs as shown in Figure A.75 or the duration of the PhD displayed in Figure A.76. The nationality has a clear influence on the clustering inside each cluster but does not show a distinct division between the clusters. At the same time, DRs with a closer due date are more abundant in the dissatisfied parts

[1]income: $p_{12} = 0.96$, $p_{13} = 0.99$, $p_{23} = 0.95$
[2]working hours: $p_{12} = 0.132$, $p_{13} = 0.002$, $p_{23} = 0.133$
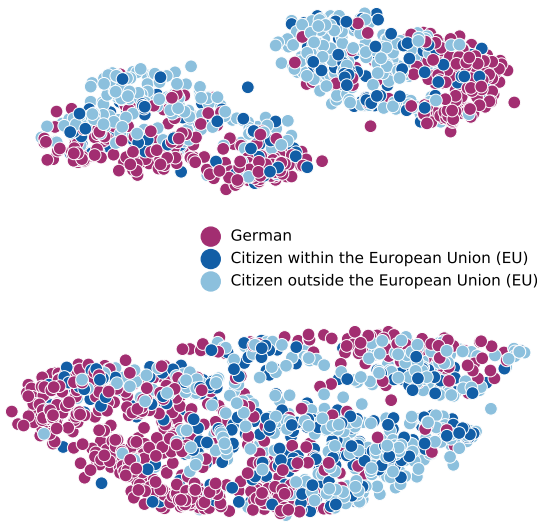
Figure A.75: "What is your citizenship?"
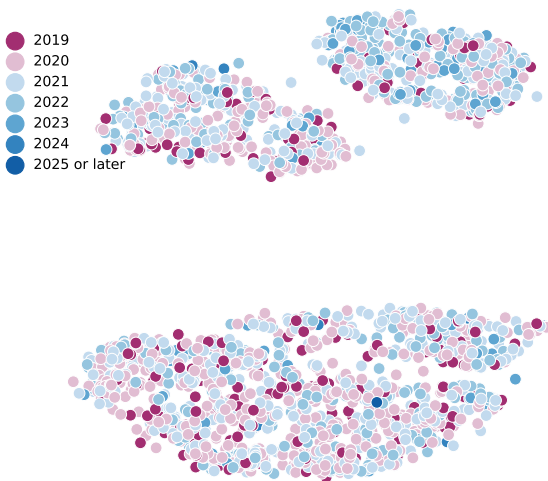
Figure A.76: "Which year do you expect to submit your PhD thesis?"

Figure A.77: "While working at your institute/center, have you at any point been subjected to bullying by a superior?"
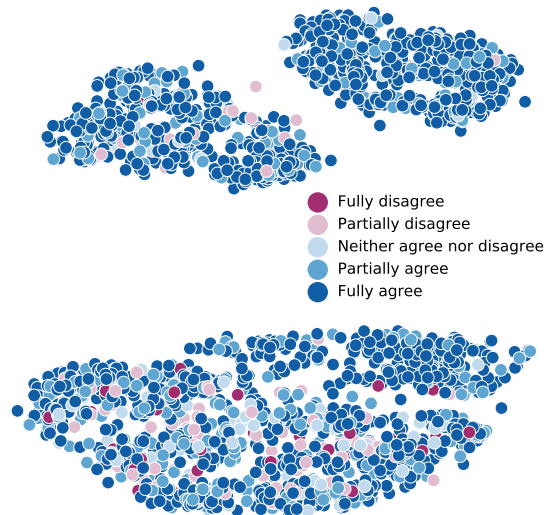
Figure A.78: "Please rate the supervision provided by your formal/primary supervisor: My supervisor treats me politely."

of the clusters than DRs that only recently started their PhD. Other demographic factors like section or gender are distributed equally among the clusters.

To investigate the influences of power abuse on the clustering and therefore the satisfaction and motivation to continue the PhD Figure A.77, Figure A.79 and Figure A.78 show some of the relevant factors.

Bullying occurs far more regular in the dissatisfied clusters 1 and 2 and is an even more severe problem in the dissatisfied part of cluster 1, where DRs tend to think about quitting more often.

The same conclusions can be reached when taking occurring conflicts or being treated politely by ones supervisor into consideration. DRs located in cluster 3 seem to have hardly any conflicts with their supervisors. Being treated impolitely by superiors is one of the first indications of power abuse and is not reported by DRs in cluster 3. DRs in cluster 2 (and also the more satisfied sub-cluster of cluster 1) seem to have had conflicts more

often but still the majority seems to have a harmonic interaction inside their groups and with their supervisors. DRs in the other sub-cluster of cluster 1, however, have had conflicts much more often, supporting a correlation between quitting the PhD and having had a serious conflict with the supervisor.
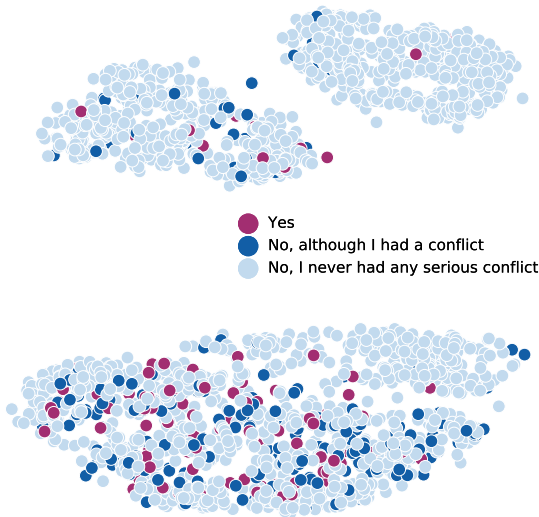
Figure A.79: "Did you ever report a conflict with a superior to one of the institutions above?"

Since mental health issues are one of the main topics of this year's survey the distributions of all three factors described in chapter 5 among the clusters are shown in Figure A.80, Figure A.81 and Figure A.82.
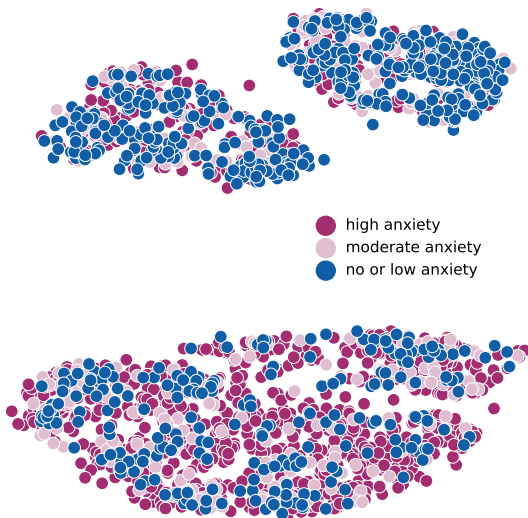
Figure A.80: Distribution of state anxiety levels
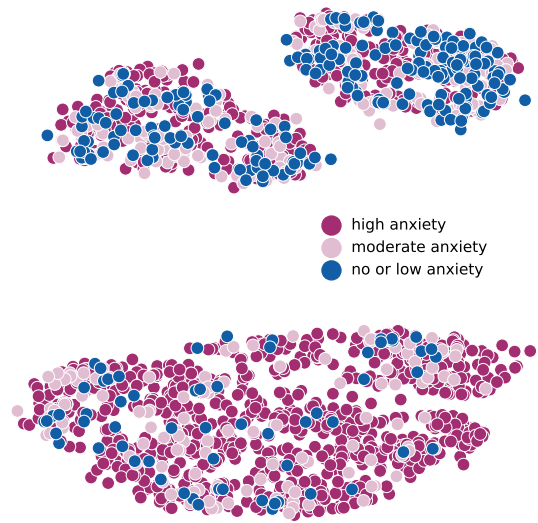
Figure A.81: Distribution of trait anxiety levels

Both state and trait anxiety show more mental health issues inside cluster 1: anxiety scores of state anxiety (52.8 ± 14.1) and trait anxiety (64.1 ± 16.4) are both significantly[3][4] elevated over the anxiety scores in cluster 2 (43.1 ± 13.4 and 52.6 ± 14.9) and cluster 3 (39.1 ± 12.0 and 47.5 ± 13.7 respectively).
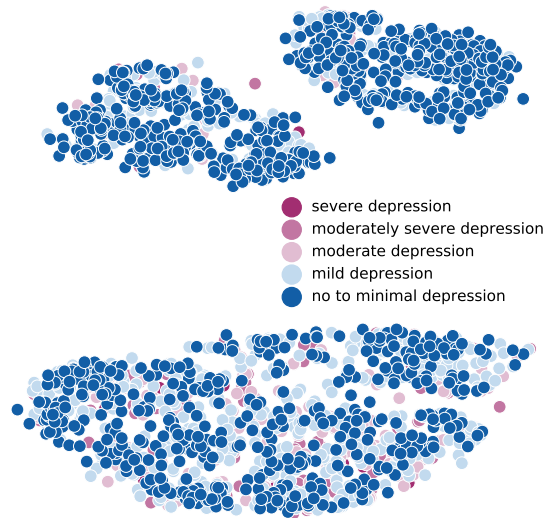
Figure A.82: Distribution of depression levels

A similar trend is seen in the depression levels, where cluster 3 hardly shows any symptoms (depression score of 3.5 ± 3.6), cluster 2 some mild ones (4.2 ± 3.9) and clus-

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[3]state anxiety: $p_{12} = 2 \cdot 10^{-40}$, $p_{13} = 8 \cdot 10^{-76}$, $p_{23} = 6 \cdot 10^{-7}$
[4]trait anxiety: $p_{12} = 4 \cdot 10^{-42}$, $p_{13} = 4 \cdot 10^{-81}$, $p_{23} = 3 \cdot 10^{-8}$

ter 1 a far more dense distribution of mild or
moderate symptoms (7.1 ± 5.2)[5].

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[5]depression: $p_{12} = 9 \cdot 10^{-32}$, $p_{13} = 6 \cdot 10^{-44}$, $p_{23} = 7 \cdot 10^{-3}$

Appendix B

Methods

For the PhDnet Survey 2019, we collected email addresses of all doctoral researchers affiliated to a Max Planck Institute (MPI). Although we requested email addresses, the survey was anonymous; email addresses were needed to generate one-time tokens such that no link between the response and the survey participant could be established. The survey was conducted using LimeSurvey (https://www.limesurvey.org/), hosted by the Gesellschaft für wissenschaftliche Datenverarbeitung mbH Göttingen (GWDG), the computing and IT competence centre for the Max Planck Society (MPS). It was available online from 27th of September to 15th of November, 2019. We neither tracked IP addresses nor did the MPS administration have access to the raw survey data.

Doctoral researchers eligible for participation in the survey were: those who started a doctoral research project or who have stayed at an MPI for at least six months, who are/were affiliated with an MPI (through MPS or graduate school programs, scholarships, etc.), who are/were mainly working at an MPI at the time the survey was conducted.

B.1 Statistical analysis

For some questions, participants could choose to select multiple answers or to skip the question by providing no information. This resulted in varying response rates per question. Unless otherwise specified, each figure and percentage linked to a survey question was generated exclusively from the sample of respondents that consented to answering that question. All percentage points were rounded to the nearest integer, whenever increased precision was not required. For mathematical operations performed on question involving number intervals the medians of each intervals were used.

Statistical analysis was performed with Python (NumPy, Pandas, SciPy). The focus of our analysis was merely of a descriptive nature, resulting in histograms and grouped charts to illustrate correlations. For some results, statistical tests were employed to explore associations in the data. Methods we used are:

- Independent two-sample t-test:

  With the aim of quantifying differences between groups the independent two-sample t-test was used to check for significant differences. For data given in intervals (e.g. income, working hours,...), the median value of each interval was used for the computation. Categorical data with 'Yes' and 'No' answers was transformed into a binary (1 and 0) scheme to calculate the significance.

- Spearman's rank–order correlation coefficient:

  The Spearman rank–order correlation coefficient was chosen to calculate the correlation factor r and find linear and monotonic relationships between groups of numerical data. For all significant correlation results with a p–value < 0.05 the correlation values are taken into account.

B.1.1 Time classifications

The classification of DRs in first, second and $\geq$ third year was done by taking the 1st of November 2019 as a due date and comparing it with the stated starting year and month.

The estimated PhD length was computed by taking the difference between stated starting year+month and the expected submission year+month. For both categories DRs not stating a year or month are put in the category "No Answer".

The age for each DR was computed by assuming that all DRs already had their birthday at the time of the survey since only a birth year was stated.

B.1.2 Satisfaction

The overall satisfaction was computed by converting the results for each aspect in question C1 to a scale from 1 to 5 ("Very satisfied" = 5, "Very dissatisfied" = 1). No answers or "Does not apply" were set to zero and not taken for the normalisation count. The sum of all satisfaction factor was normalised by the non–zero counts and rounded to the nearest integer values. Afterwards the integer values were converted back to the original satisfaction scale. In case the average satisfaction was stated, the satisfaction score computed above was transformed in a percentage scale were 100% represent the most satisfied part of the scale ("Very satisfied" or 5) and 0% the dissatisfied extreme.

In order to check for linear correlation using the Spearman's rank–order correlation coefficient the satisfaction answer possibilities were converted to numerical values and afterwards the correlation with the mental health scores computed.

B.1.3 Clustering

K–medoids Clustering

In order to investigate DRS survey data in an unbiased fashion, we performed clustering analysis using an adapted version of RaceID2 [8]. All answers were interpreted as factors and answers comprising of integers were interpreted as ordered factors. Distance matrix was computed using the daisy–function from the R cluster package with gower distance as distance metric. The distance metric was then used for k–medoids clustering. Cluster number was chosen as 8, based on the within cluster dispersion as a function of cluster number, i.e. after 8 clusters, average within cluster dispersion decreases linear. Distance matrix was used to generate UMAP representation using the R umap–function with default parameters.

z–score calculation: For every question–answer–pair, the frequency was calculated within each cluster. These frequencies of question–answer–pairs across cluster were then used to calculate z–scores for each question–answer–pair across clusters. For every clusters z–scores where than ranked in decreasing order of z–scores. Ranked z–score were filtered for minimum frequency of question–answer–pairs within the clusters as indicated.

Statistical test: p-values were obtained by testing whether a question-answer pair was significantly enriched within a cluster using a one-sided fisher-test implemented in the R fisher.test function.

Dimensionality Reduction

Each survey participant is characterized by a high-dimensional vector of answers to the questions. To visualize that complex structure, UMAP (Uniform Manifold Approximation and Projection) [18] was employed. That technique projects the high-dimensional data points (survey participants) to a lower-dimensional space (two-dimensional here) while preserving distances between points. Categorical and numerical answers were projected independently and joined at a later stage, as suggested by the authors [1]. For the numerical answers, eucledian distance was used while the dice metric was used for the categorical answers. In the two-dimensional space, each point corresponds to a survey participant. The points were colored according to how the DR that is represented by the point has answered a particular question.

hdbscan Clustering: The dimensionality reduction approach using UMAP [18] described above can also be used to detect clusters in the respondents. To that end, dimensionality reduction was performed first to find a two-dimensional embedding of the data. On this embedding the clustering algorithm hdbscan [17] was performed to find both the optimal number of clusters and the cluster label for each survey participant. Clustering with different seeds for the stochastic clustering algorithm consistently yielded an optimal cluster number of three. To quantify differences in variables such as income or working hours, independent two-sample t-tests were performed between the variable distributions in each of the three clusters.

B.2 Background Mental health analysis

Anxiety

Different questions on the current or general state of feeling were answered and afterwards were converted to scores according to a short form of the Spielberger State-Trait Anxiety Inventory (STAI) [15]. By these scores people are grouped in three different levels of anxiety [11]

- high anxiety (45-80 points)
- moderate anxiety (38-44 points)
- no or low anxiety (0-37 points)

Depression

Depression is diagnosed based on the Patient Health Questionnaire module PHQ-9 [13], which is a diagnostic tool for common mental disorders. The PHQ-9 is the depression module measuring the presence and severity of depression symptoms by asking questions concerning emerging symptoms. Again the questions can be converted to scores and different levels of depression severeness are specified.

- severe depression (20-24 points)
- moderately severe depression (15-19 points)

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[1]https://github.com/lmcinnes/umap/issues/58

- moderate depression (10–14 points)
- mild depression (5–9 points)
- no to minimal depression (0–4 points)

The specific questions used to determine the different classifications can be found in the Appendix E.4.

As all psychological surveys and social studies are subject to many different influences and biases, which are hard to rule out completely, the results presented in Chapter 6 Mental health will only be presented in a qualitative way. They should be treated as impressions of the real situation, but nonetheless provide a clear foundation for improving the mental health situation among the MPS DRs.

Appendix C

Acknowledgments

This report is the cumulative work of many months of preparation. It was a collaborative effort, definitely not only realized by the PhDnet Survey Group alone.

We would like to thank many people who contributed to making the survey possible. Firstly, the N² Board, who combined the knowledge, opinions and strengths of the Helmholz Juniors, Leibniz PhD network, and Max Planck PhDnet for the development of the questions we use in the questionnaire.

Secondly, the PhDnet Steering Group 2018/19, led by Alexander Filippi , and 2019/20, led by Lindsey Bultema, who were involved in all stages of decision making, in setting up the main topics of the survey, and continuous support in any way we needed.

Thirdly, the PhDnet Secretary Group, especially Liane Klein, who helped us with the most up-to-date information about institute representatives. We would like to thank Pierre Ekelmans for his help in contacting the representatives.

A big thank you goes out to May Ho, Ting Sun, Lou Haux, Nono Saha Cyrille Merleau and all the other members of our analysis team who sifted through the huge amount of data at hand, finding interesting connections and processing the data in general. Our special gratitude goes out to Christian Roth, who invested a lot of work in data preparation and cleaning making it workable for all other member. Additionally he invested in the python framework which will benefit many future generations of the survey team.

Finally, we would like to thank all PhD representatives at the institutes who maintained the contact lists and informed all doctoral researchers about the survey – without them the survey could not have reached such a high participation rate. We would like to thank all survey participants for taking the time to answer our questions and the Max Planck Society for financial support of the PhDnet.

Appendix D

About the authors of this survey

As Max Planck PhDnet survey group 2019/2020, we have been lucky to be able to build on experiences of our predecessors. Having this, we managed to pull together this survey over the course of a year with peers from the Helmholtz and Leibniz association. Due to the hard work and motivation from many colleagues, who cannot all be acknowledged in this section, we are proud to have pulled together this report. We hope the results can together with the partner reports become a landmark for the status of doctoral education in Germany. Thanks to everyone involved and all participants.

Linda H.M. Olsthoorn

Hello! I moved to Germany after my Bachelor for my Master/Phd Program in Neuroscience in Goettingen. Currently I am in my third year working on the development of a microfluidic platform to image the dynamics of synaptic vesicle filling. Besides from my PhD I fill my time with a lot of (beach)volleyball, my 'Kleingarten', reading and way too many other hobbies that I do not really have time for anymore. After starting my PhD, I quickly became actively involved in the PhDnet community and realized that without a comprehensive overview of our problems, it is hard to make improvements, so I hope that this report can help with that.

Lea A. Heckmann

Hej! I moved to Munich last year to follow my passion for astroparticle physics and I'm pursuing a PhD here at the Max Planck Institute for Physics. Studying Engineering Physics in Vienna and Stockholm lead me on this path and I continue trying to solve the riddles of the most energetic sources in our universe, which unfortunately involves visiting our telescope in La Palma regularly :) With my work on this report I aim to shed light on topics overlooked too often and help other DRs to ensure the quality work and life should have for everyone. Besides all of this I enjoy reading, exploring the world, being an active person and I'm trying to again become decent at playing the piano.
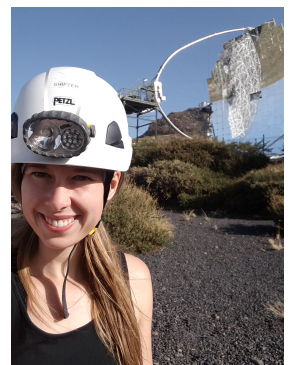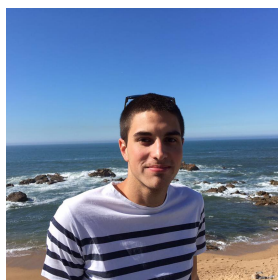
Alexander Filippi

After my studies in Biomedical Chemistry at the Johannes-Gutenberg University, I started my PhD at the Max Planck Institute for Chemistry in Mainz. Therein, I am working on the health effects of ambient air pollution. For most of my time with the MPS, I was involved with Max Planck PhDnet and was the elected Spokesperson 2019. I hope with this publication and in exchange with our fellow DRs networks we can raise our issues to stakeholders and therewith improve the life of many collegues.

Renee M. Vieira

Hi there! After taking many paths in life; outdoor educator, climbing instructor, photographer...I ended up in Munich where I completed my Master's degree in Biology at the LMU. Now I'm a doctoral researcher studying receptors in the visual system of the pesky fruit fly at the Max Planck Institute for Neurobiology. When I am not in the lab you can find me in the mountains or reading about intersectionality and systems of oppression. I'm particularly passionate about making STEM more accessible for fellow underrepresented people.

Rama Srinivas Varanasi

Hi, I am Rama; please don't confuse my name with Unilever's brand of margarines! I am currently doing my doctoral studies at the Max-Planck-Institut für Eisenforschung. Earlier, I did my dual degree (B.Tech & M.Tech) in materials science and engineering at IIT Madras, which included two stints as an exchange student at RWTH Aachen university. My research interest lies in alloy design and engineering the microstructure at the atomic scale to tailor the properties. I was fortunate enough to work with exciting class of materials, some of which include steels, Ni-based super alloys, Li-ion batteries, Cr based nano coatings, self healing MAX phases and so on. The pioneering nature of the survey in its attempt to shed light on issues such as mental health and power abuse motivated me to join the team. My escape from reality include anime, badminton, board games and comics.

Jana Lasser

Hey there, I am Jana. I completed my PhD in physics at the Max Planck Institute for Dynamics and Self-Organization in 2019. Now I am a Post-Doc at the Complexity Science Hub Vienna and apply my statistics and programming skills to do computational social science. During almost all of my time at the Max Planck Society I was engaged in student representation and served as spokesperson of the PhDnet in 2018. Back then, together with our partners from N² we also kicked off the effort to unify the respective surveys of our three organizations and conduct them together. I am very happy to see this effort come to fruition. The focus on mental health and power abuse in academia is timely and helps to shed a light on these important and very prevalent issues.

Felix Bäuerle

Hello there! My name is Felix Bäuerle and I did my PhD in Physics at the MPI for Dynamics and Self-Organisation in Göttingen. Besides science I got engaged as a representative locally and with PhDnet in general. Over time I learned to love the community and applied myself for the Survey Group last and this year. If you want to know more or feel like I could be of help to you, please don't hesitate to contact me. I truly hope this survey can help you where ever you might stand right now.

Patrice Zeis

Hey you, out there. My name is Patrice. I am in the process of finishing my PhD in Systems Biology at the Max Planck Institute of Immunobiology and Epigenetics. Over the past 4 years, I used machine learning approaches to study cellular differentiation and uncover novel immune cell types and cell states. Knowing that PhD life can sometimes be frustrating, I wanted to apply my knowledge, while thinking outside the box and helping fellow and future DR to have their best possible PhD experience. We discovered known and unknown correlations important for satisfaction and by doing so, I believe we will contribute to improve the situation of DR. Besides working, I enjoy good music and researching blockchain applications.

Roman Schulte-Sasse

Hi there, I am Roman. I am currently in the last stages of my PhD in computer science at the Max Planck Institute for molecular genetics in Berlin. Two years ago, I was the PhDNet representative of our institute where we tried to raise the salary levels for all doctoral researchers. We found the survey data extremely helpful to communicate problems and solutions during the negotiation. Since then, I appreciate this huge effort and wanted to contribute to it. When not working on my PhD thesis, I like politics and enjoy sports and outdoor activities. I believe that the data this year not only shows a lot of progress but also reveals issues where we can still improve, especially in areas harder to quantify such as mental health and power abuse.

Appendix E

All Results

E.1 Section A
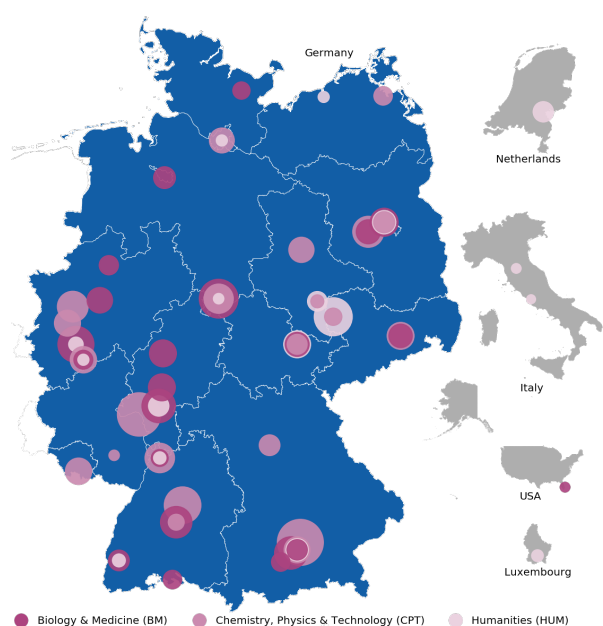
Figure E.1: Which institute / section / center are you associated with? Distribution of responses from Max Planck doctoral researchers in Germany, Netherlands, Luxembourg, USA, and Italy color coded by section. Larger circles indicate more responses

Total: 2342
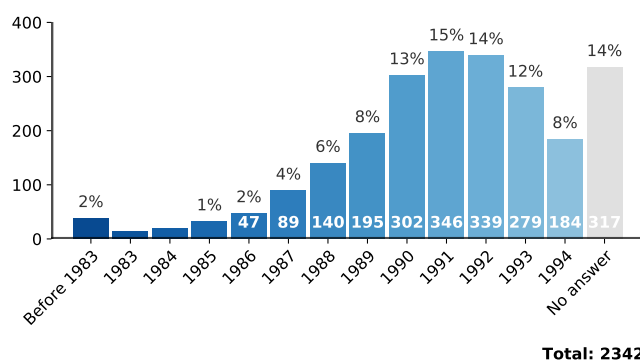
Figure E.2: What is your year of birth?. Y–axis show number of answers.
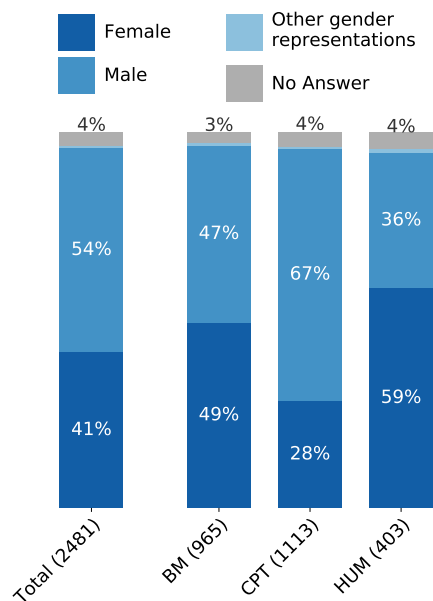
Figure E.3: To which gender do you identify most?. Relative response rates are grouped by section. The to-tal number of responses is shown in brackets.
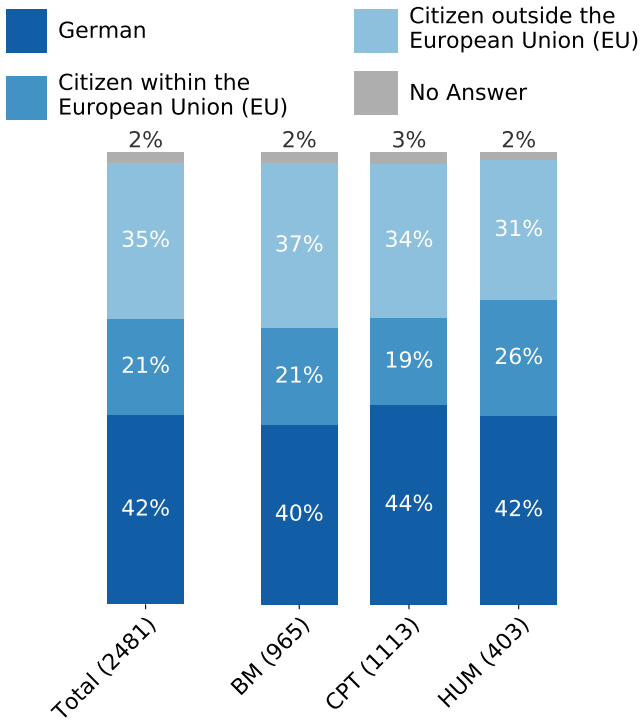
Figure E.4: What is your citizenship? Should you have multiple citizenships, please select the one you feel best represented by. Relative response rates are grouped by section. The total number of responses is shown in brackets.

Figure E.5: Which year did you start your PhD? Y–axis show number of answers.
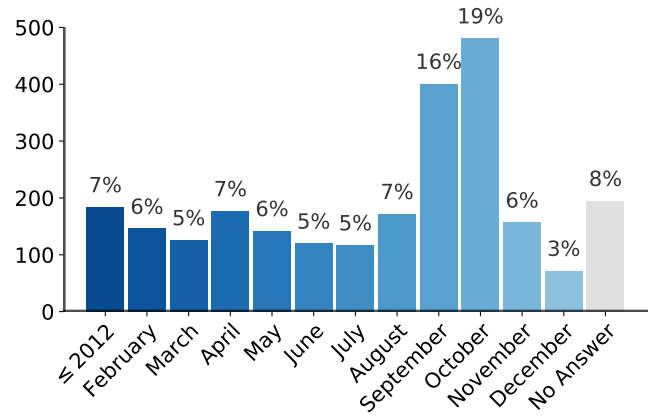
Figure E.6: Which month did you start your PhD? Y–axis show number of answers.
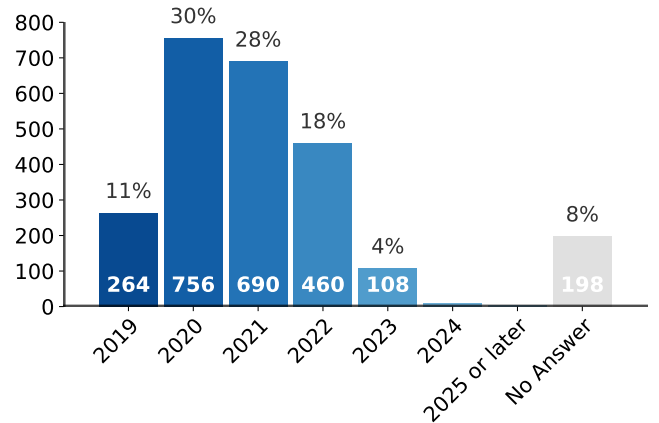
Figure E.7: Which year do you expect to submit your PhD thesis? Y–axis show number of answers
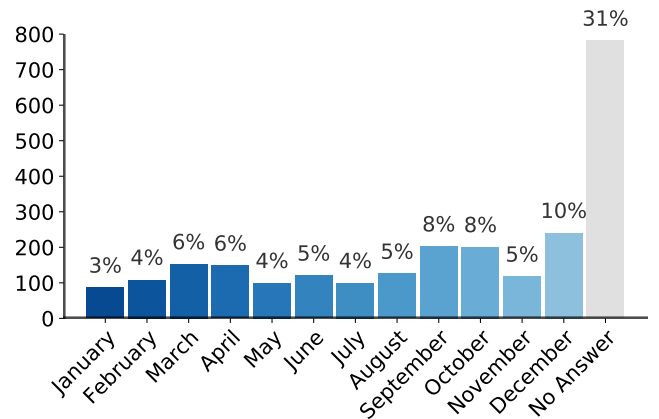
Figure E.8: Which month do your expect to submit your PhD? Y–axis show number of answers

E.2　Section B
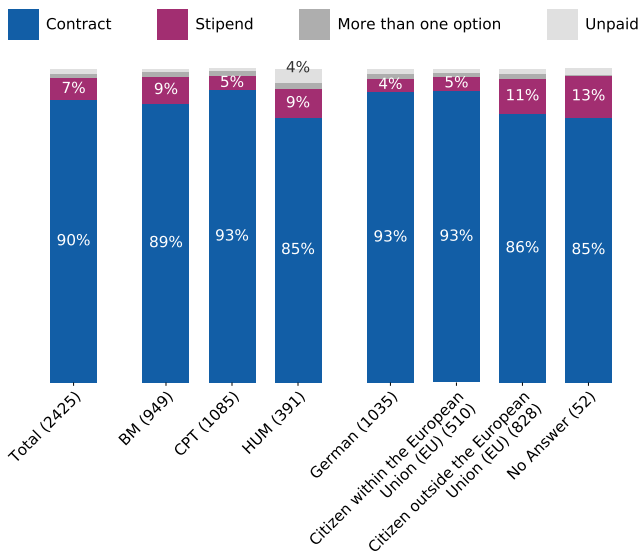
Figure E.9: "How is your doctoral research currently financed (multiple answers possible)? Explanation: A contract is usually paid according to the TVöD system (e.g. 50% or 65%) and also includes the Fördervertrag. With a stipend you are not legally bound to your workplace, but do not pay into the social security system." Relative response rates are grouped by section. The total number of responses is shown in brackets.
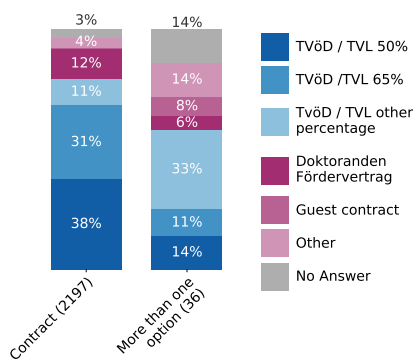
Figure E.10: "What kind of contract do you have?"
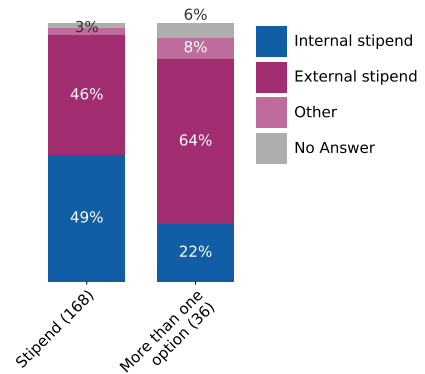
Figure E.11: "What kind of stipend do you have? An internal stipend is granted through your graduate school, institute/center or the [association]. External stipends are granted through a third party e.g. DFG, DAAD, CSC, foreign associations etc."
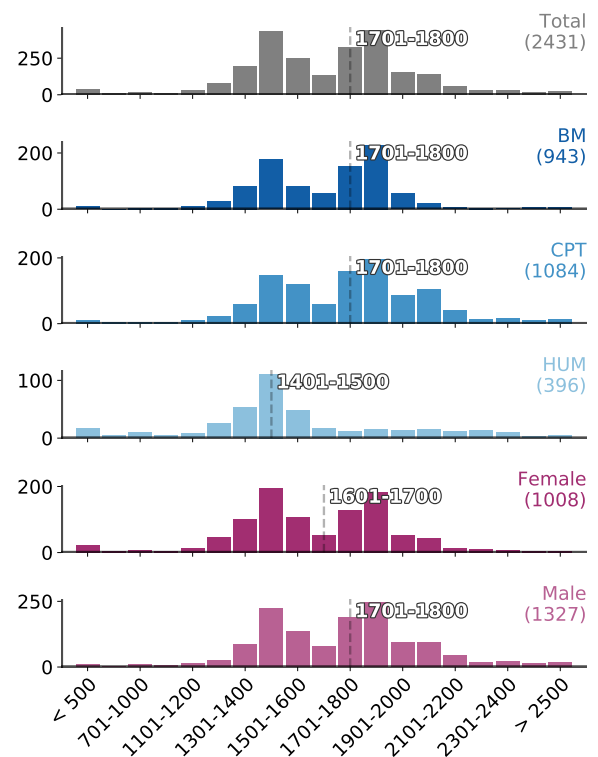
Figure E.12: "Right now, what is your monthly net income for your work at your research organization? Net income is the amount of money transferred to your bank account every month. Do not count any bonuses such as a Christmas bonus etc. Scholarship holders and freelancers: deduct tax and health insurance. Income not related to work in the institute/doctoral research should not be included." Y-axis shows the number of responses relative to each section or gender. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines.
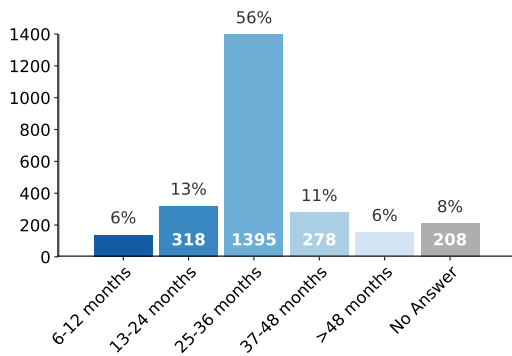
Figure E.13: "What was or is the longest duration of your contract or stipend related to your PhD project?" Y–axis show number of answers.

Figure E.14: "If any, how many extensions or additional contracts/stipends did you get during your PhD?" Y–axis show number of answers.

Figure E.15: "Would it be possible for you to extend your current contract/stipend for the following reasons (multiple answers possible)?"
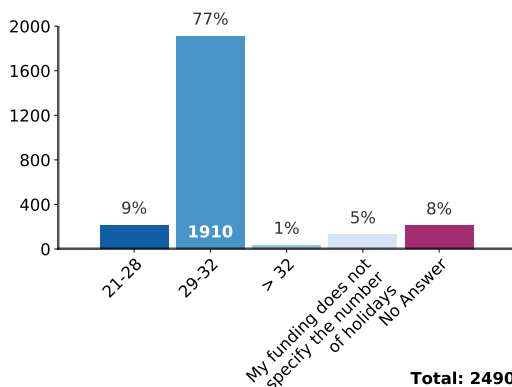
Figure E.16: "How many holidays per year can you take according to your contract or stipend?" Y–axis show number of answers.

Figure E.17: "How many days of your entitled holidays did you take in the past year?" Y–axis show number of answers.

Figure E.18: "How many days did you take off in the past year?" Y–axis show number of answers.
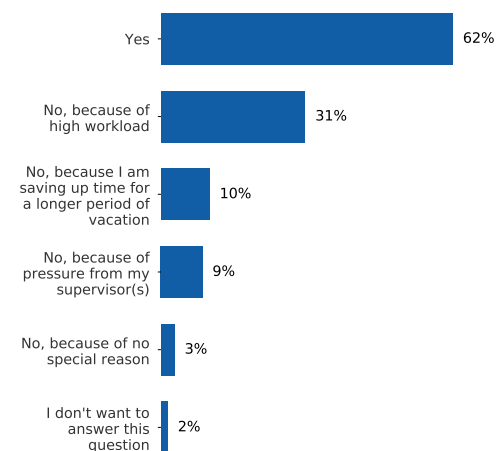
Figure E.19: "Do you feel free to take days off? (multiple answers possible)" Relative response rates.
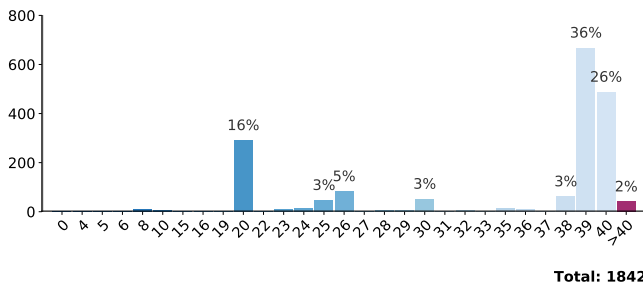
Figure E.20: "How many hours per week are you expected to work according to your contract? Please specify the number of hours in the field 'Hours per week'.Example: A 50% contract according to TVöD demands you to work 20h or 19.5h depending on the state you work in."
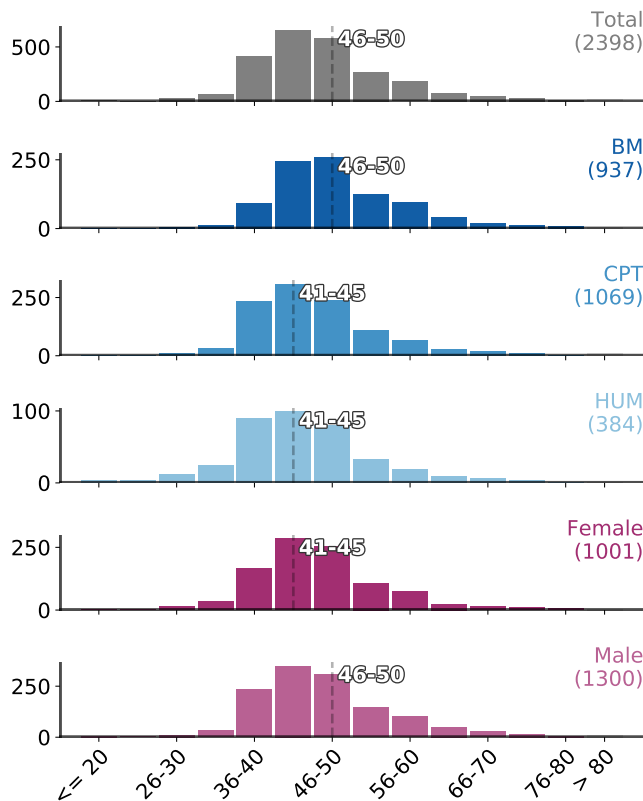
Figure E.21: "On average, how many hours do you typically work per week in total? Working time – that is both for your dissertation and all other tasks you have to perform at your institute or university, for instance project work or meetings (in your office as well as at other places) and teaching." Y-axis shows the number of responses relative to each section and gender. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines.
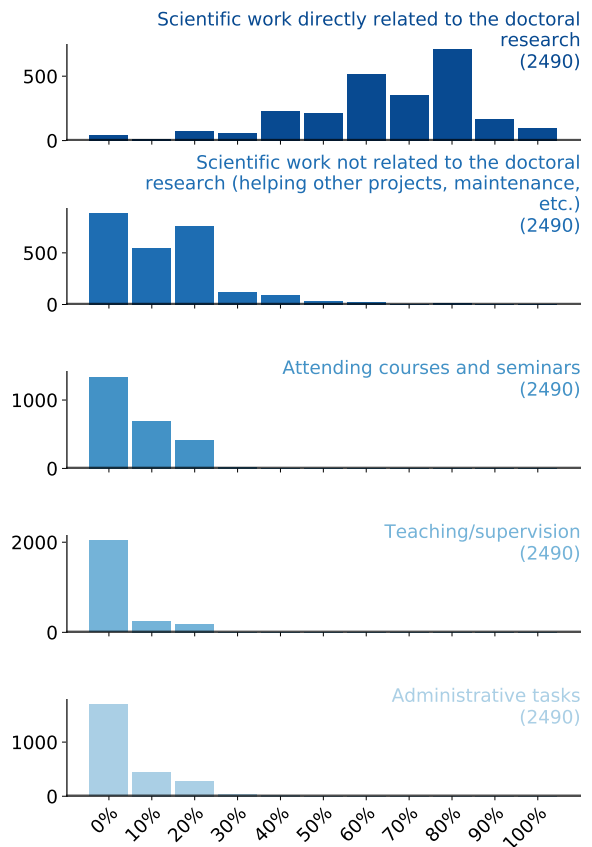
Figure E.22: "What percentage of your working time do you currently spend on average on the following tasks?" Y-axis shows the number of responses relative to each task. The total number of responses is shown in brackets. The median of each distribution is marked by the vertical dashed lines. Responses rounded to decades.

E.3   Section C
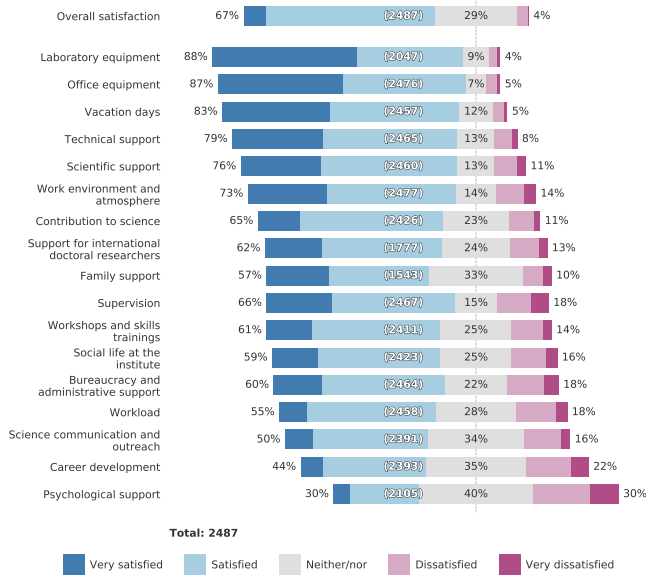
Figure E.23: "If you think about your own situation as a doctoral researcher, how satisfied are you with the following aspects?"
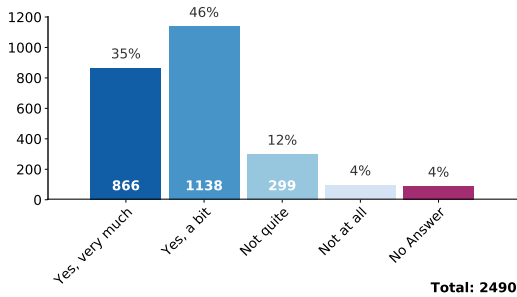
Figure E.24: Do you identify with your research center/institute?"
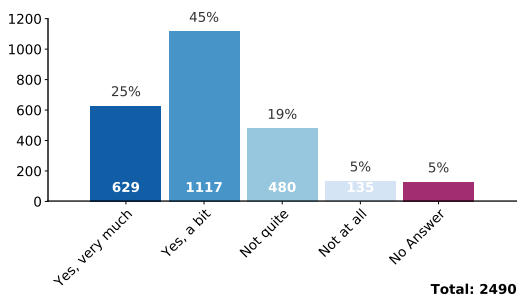
Figure E.25: "Do you identify with your research organization the Max–Planck Society?"
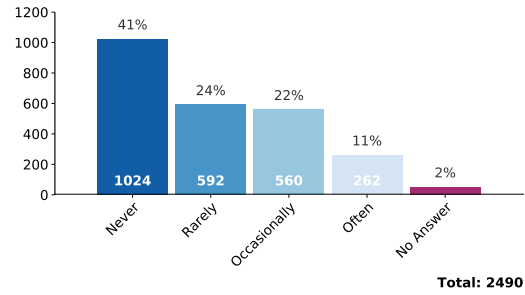
Figure E.26: "Have you ever considered quitting your PhD?"
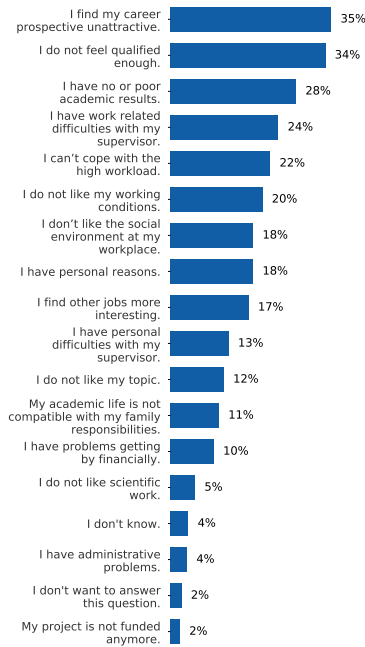
Figure E.27: "What was/were the reason(s) for considering to quit your PhD (multiple answers possible)"
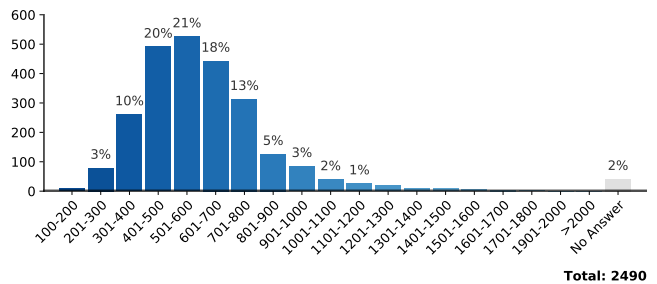
Figure E.28: "How much do you pay for your rent and associated living costs per month in euros (e.g. heating, gas, water, and electricity)?"
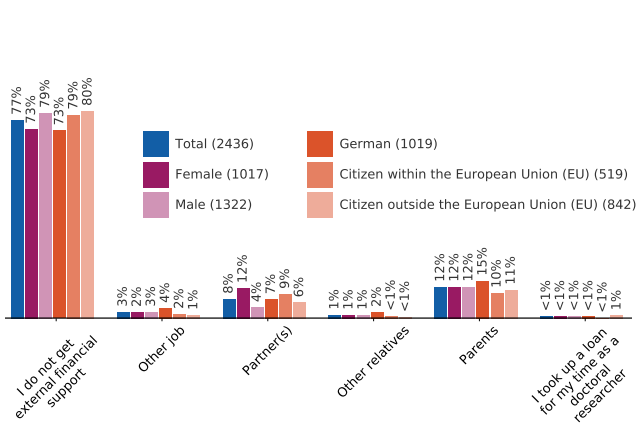
Figure E.29: "Do you get external financial support to cover your living expenses besides your salary? If yes, who is assisting you financially (multiple answers possible)"
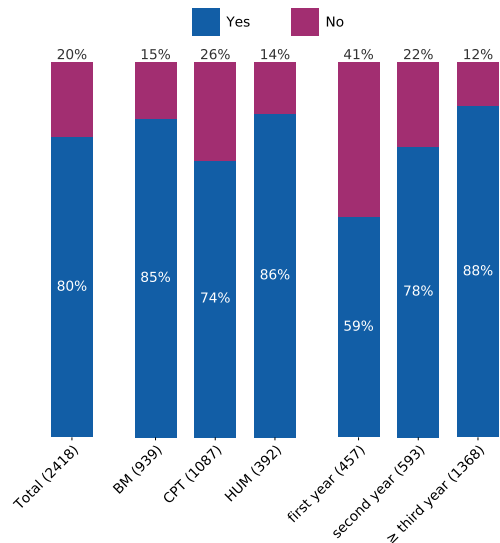
Figure E.32: "Do you know the PhDNet?"
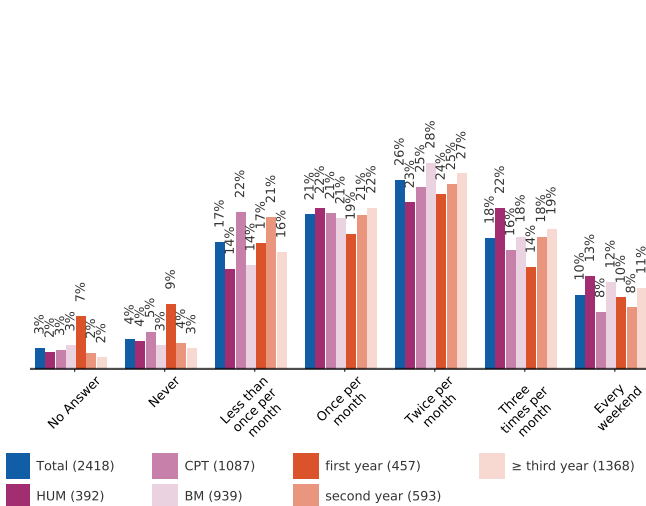
Figure E.30: "How often have you worked during weekends or public holidays in the past year?"
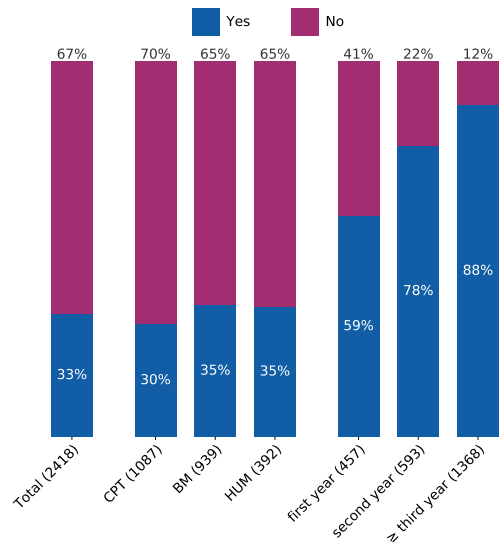
Figure E.33: "Do you know the N²?"
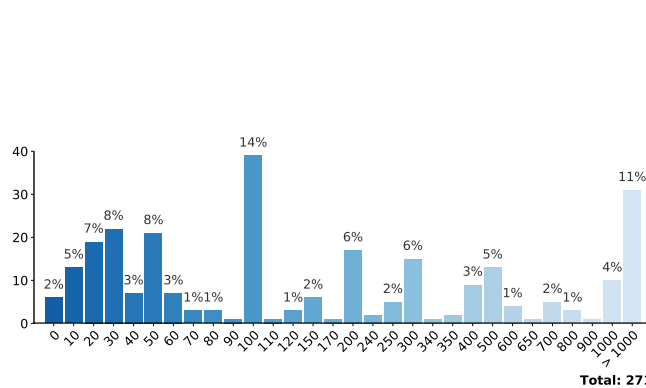
Figure E.31: "Did you spend parts of your salary on items you exclusively used for work in the past year? If yes, how much money in euros did you spend?" Rounded to steps of 10€
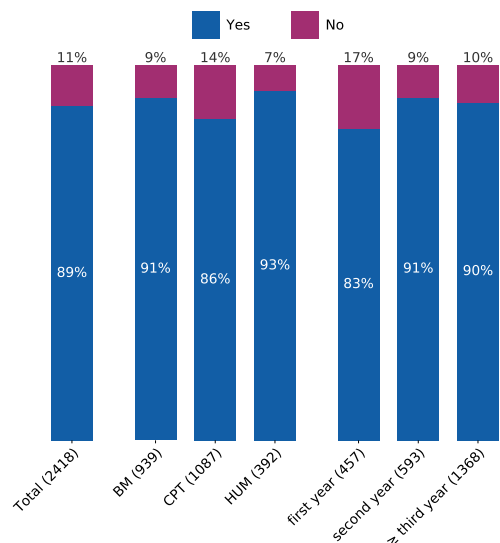
Figure E.34: "Do you know your PhD representative?"
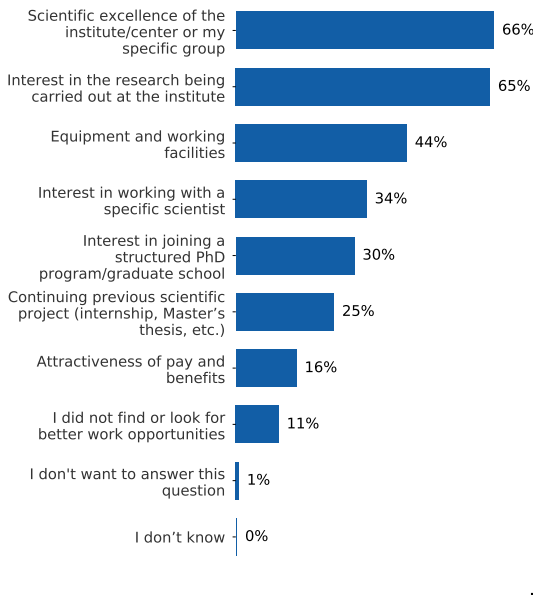
Figure E.35: "Why did you start your work on your doctoral thesis at your research center/institute (multiple answers possible)?"

Figure E.36: "In general, how do you judge the following aspects of an academic research career?"

Figure E.37: "Which of the following aspects of your work as a doctoral researcher would you like to be improved?"

E.4   Section D
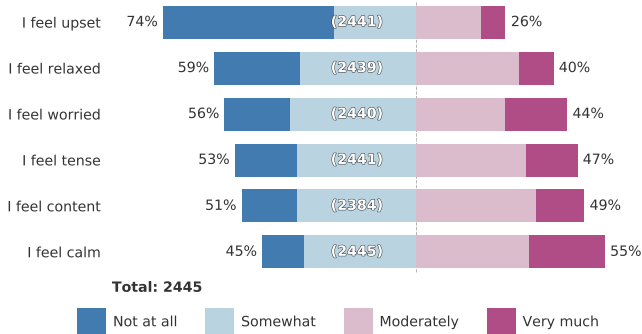
Figure E.38: "Please read each statement below and then indicate how you feel right now, at this moment"
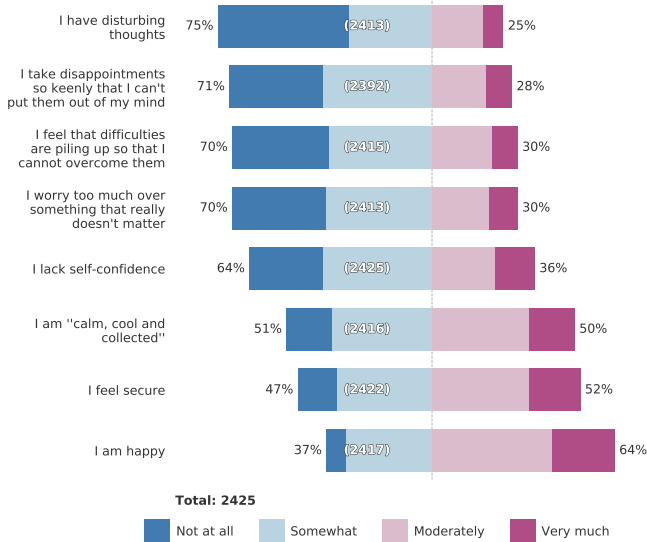
Figure E.39: "Please read each statement below and then indicate how you generally feel"
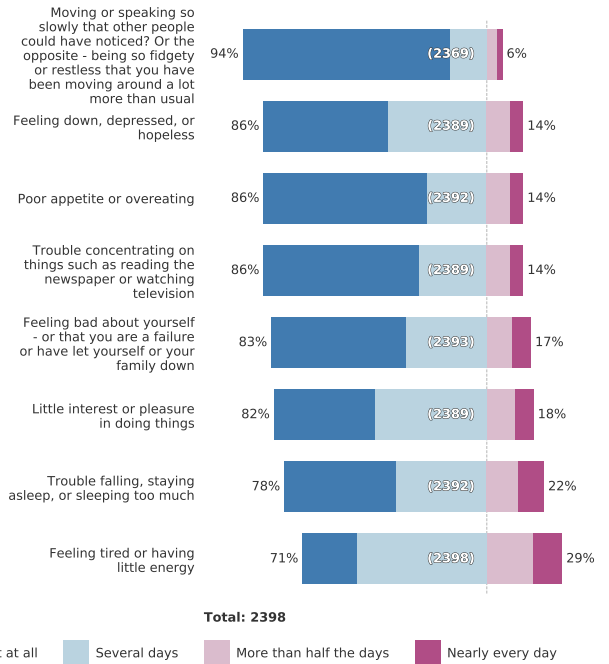
Figure E.40: "Over the last two weeks, how often have you been bothered by any of the following problems?"
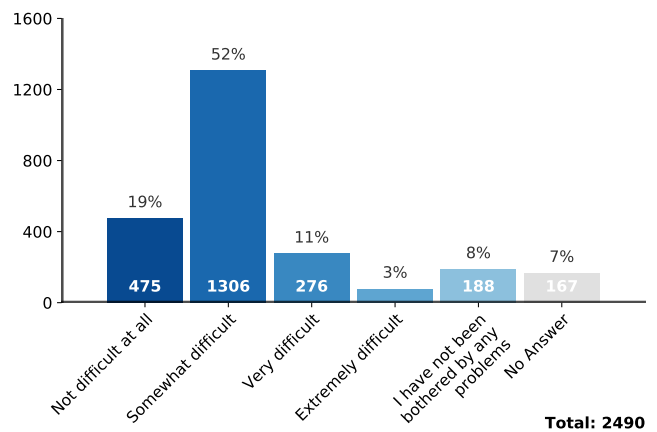
Figure E.41: "If you have been bothered by any problems, how difficult have these problems made it for you to do your work?"

E.5   Section E

Figure E.42: "Do you have one of the following (multiple answers possible)?"
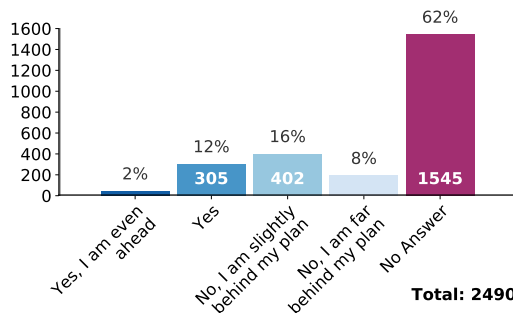
Figure E.43: Is your project progress according to your (reviewed) project plan?"
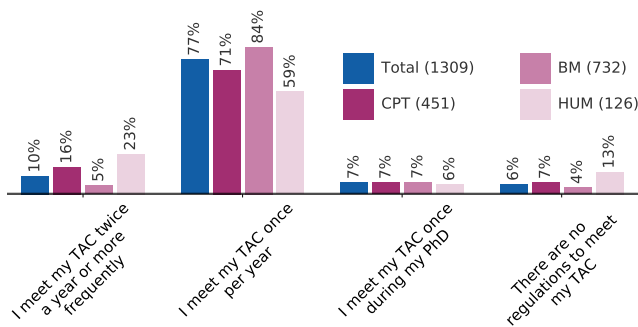
Figure E.44: "How often do you meet your thesis advisory committee (TAC)?"
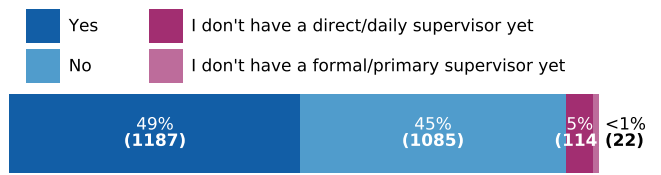
Figure E.45: Is your formal/primary supervisor your daily/direct?"
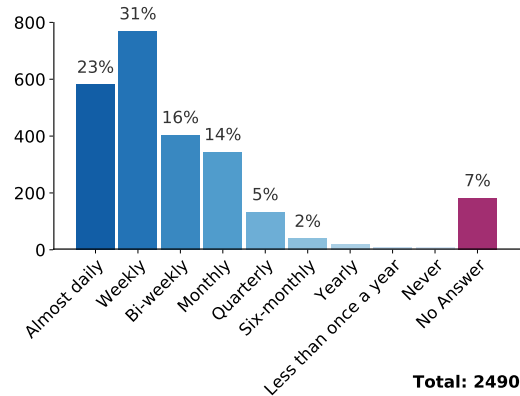
Figure E.46: "How often do you communicate on average with your daily/direct supervisor about your PhD project?"
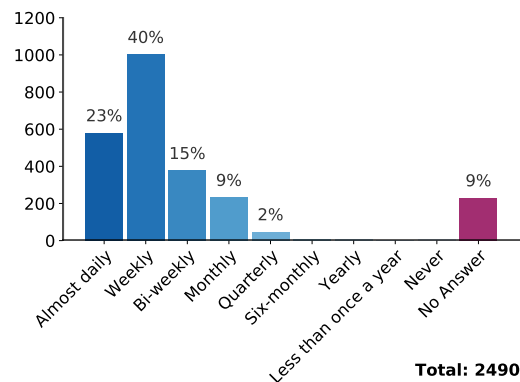
Figure E.47: "How often would you like to communicate with your daily/direct supervisor about your PhD project?"
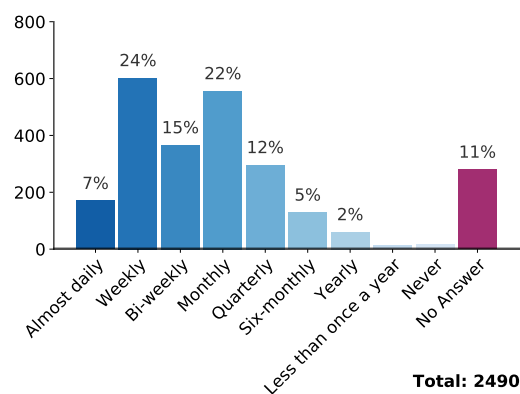
Figure E.48: "How often would you like to communicate with your formal/primary supervisor about your PhD project?"
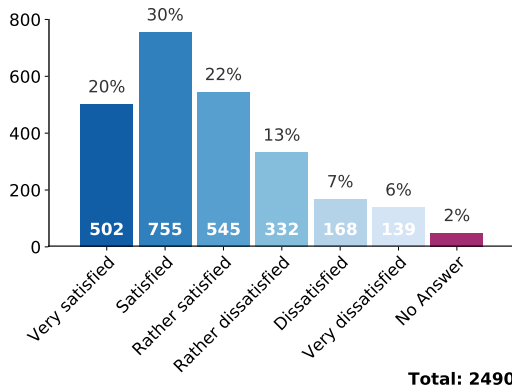
Figure E.49: "How satisfied are you with your PhD supervision in general?"
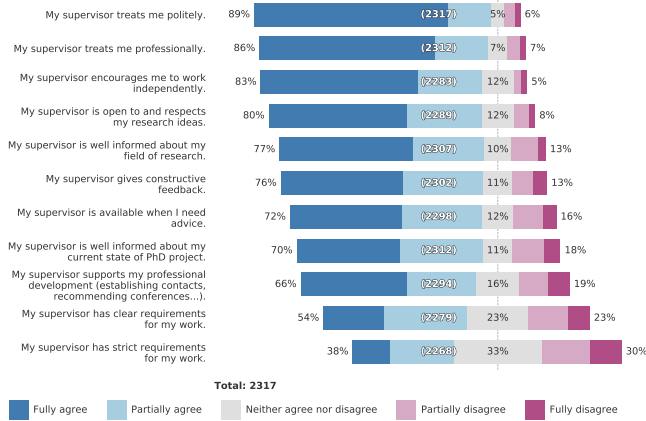
Figure E.50: "Please rate the supervision provided by your formal/primary supervisor?"
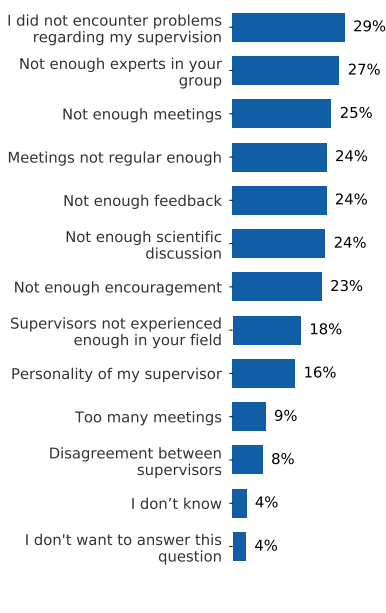
Figure E.51: "Did you ever encounter problems regarding your supervision?"

E.6 Section F
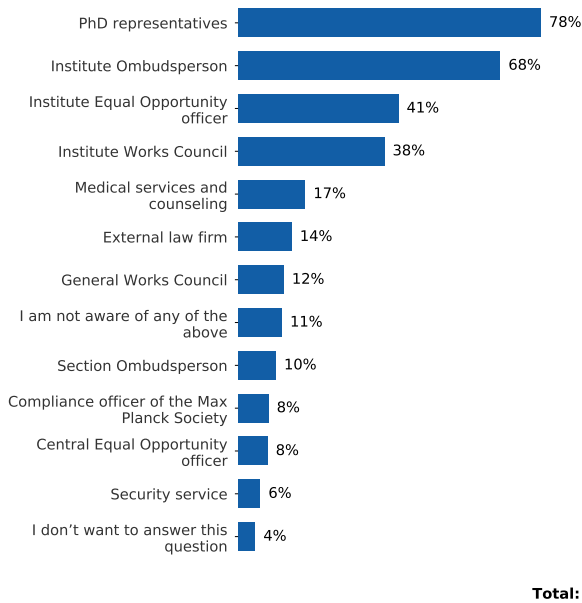
Figure E.52: "Which of the following mechanisms are you aware of that can help you in case of a conflict with a superior?"
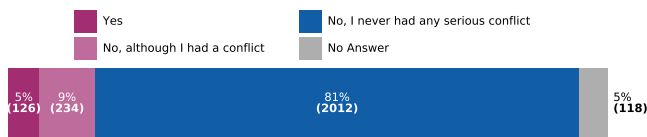
Figure E.53: "Did you ever report a conflict with a superior to one of the institutions above?"
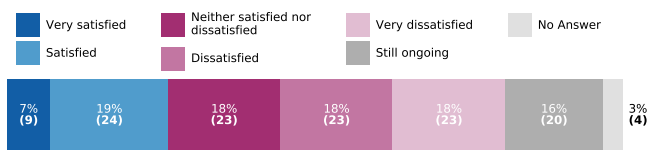
Figure E.54: "Please indicate the level of satisfaction with the consequences of your report?"
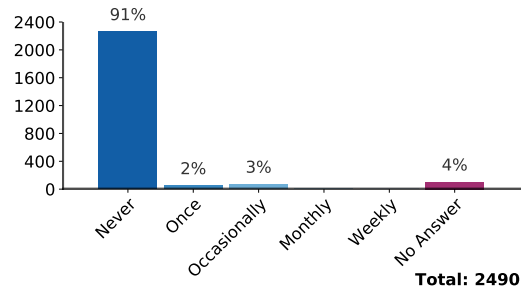
Figure E.55: "While working at your institute/center, have you at any point experienced unwanted behavior that you would call 'sexualized harassment' from a superior?"
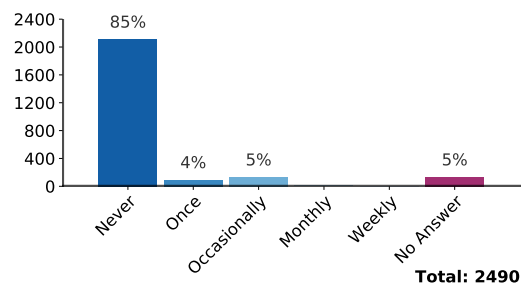
Figure E.56: "While working at your institute/center, have you at any point witnessed any unwanted behavior towards a colleague that you would call 'sexualized harassment' from a superior?"
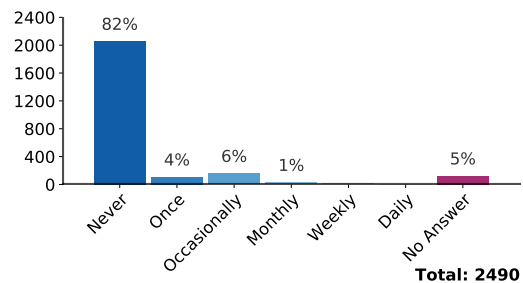
Figure E.57: "While working at your institute/center, have you at any point been subjected to bullying by a superior?"
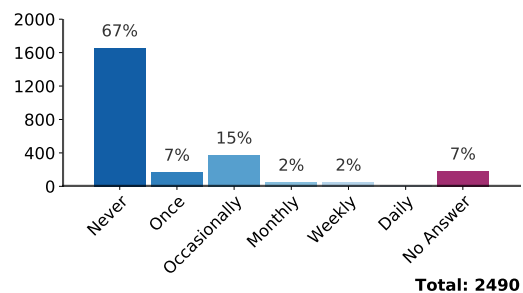
Figure E.58: "While working at your institute/center, have you at any point witnessed bullying by a superior?"

E.7 Section G

Total: 2490
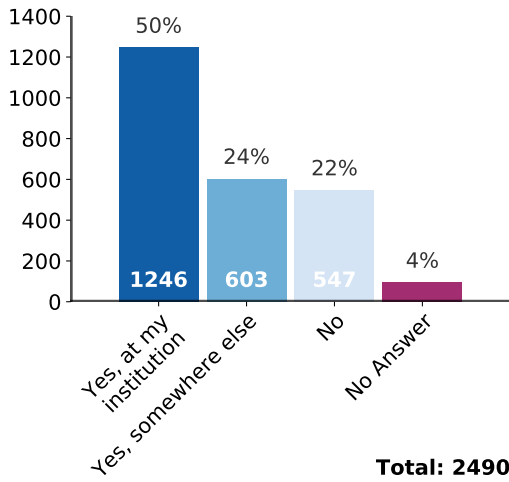
Figure E.59: "Are you currently registered in a gradu–ate school?"

Total: 2490
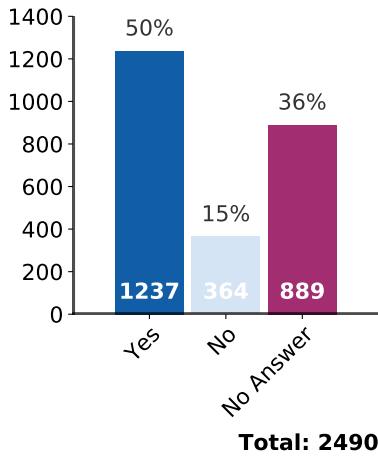
Figure E.60: "Do you profit from being enrolled in a Graduate School?"

Total: 425
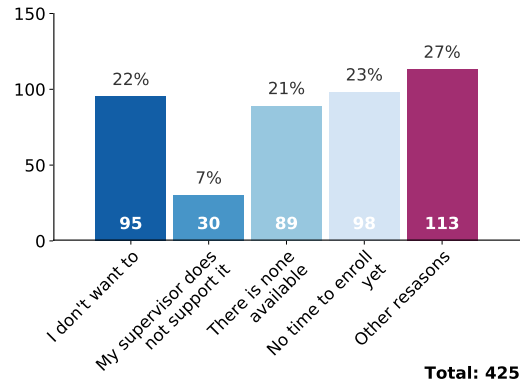
Figure E.61: "Why are you not enrolled in a Graduate school?"

Total: 2490
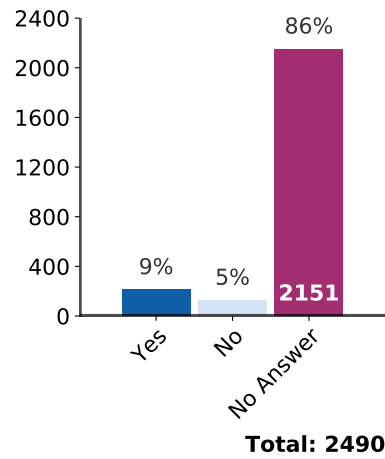
Figure E.62: "Do you think you would profit from en–rollment in a graduate school?"

Total: 2435
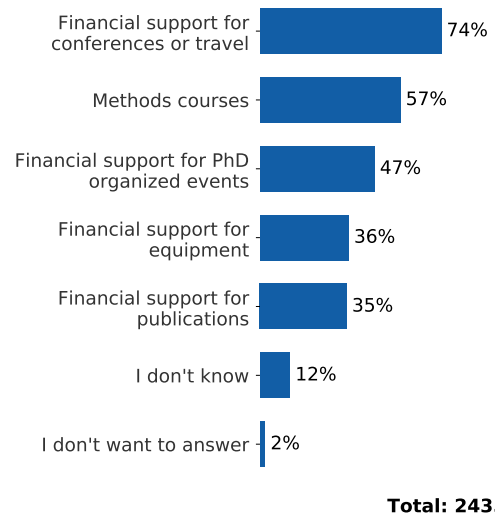
Figure E.63: "Which of the listed items are offered to you either by your institute or graduate school?"

E.8   Section H
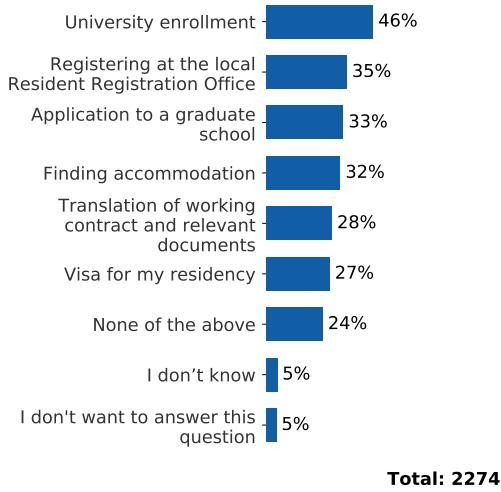
Figure E.64: "For which of the following aspects did you receive support from your institute (multiple answers possible)?"
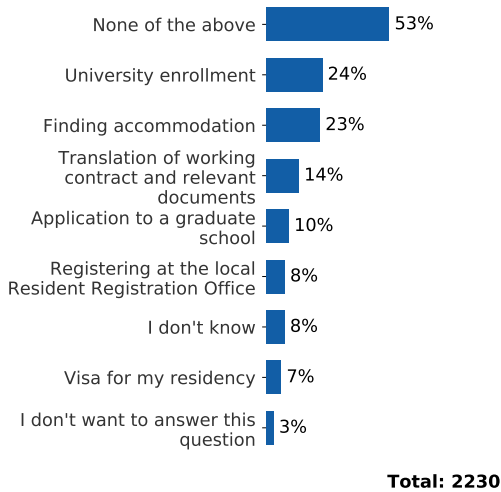
Figure E.65: "For which of the following aspects would you have needed more support from your institute?"
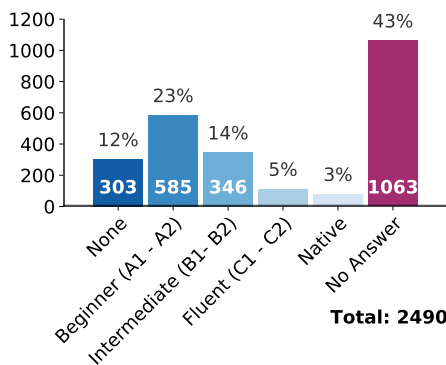
Figure E.66: "Do you speak German?"
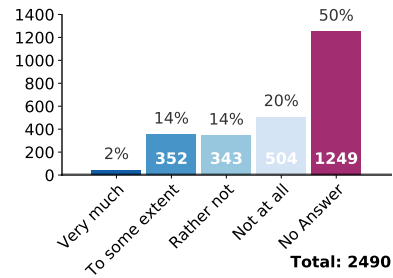
Figure E.67: "Is language an obstacle for communication with people at your center/institute?"
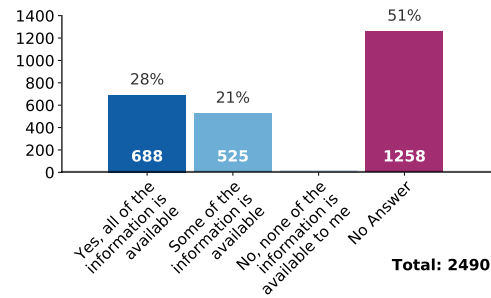
Figure E.68: "Is all the important information (group internal, administrative, your contract/stipend) available in a language you understand?"
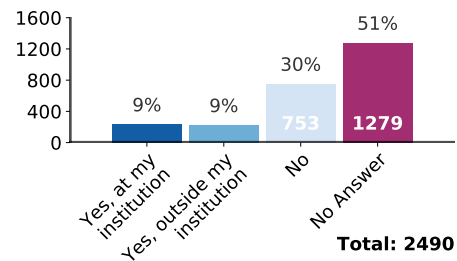
Figure E.69: "Are you currently taking German language classes?"
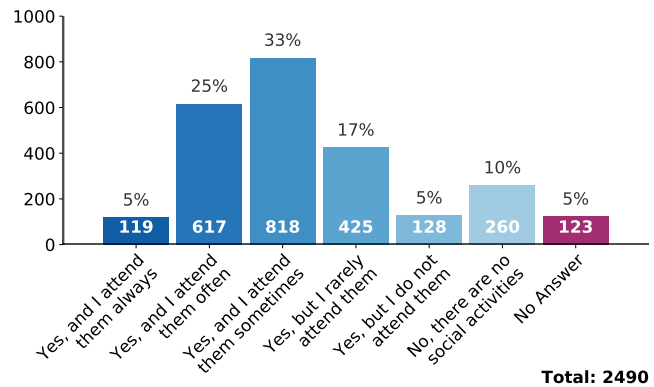
Figure E.70: "Are there regular social activities in your group or at your institution (e.g., sports events, going out for dinner/drinks, discussion forums, movie nights, etc.)?"

E.9 Section I
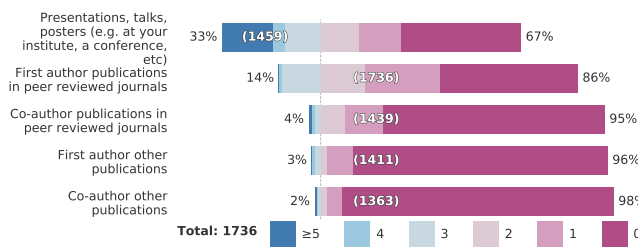
Figure E.71: "Please specify the number and kind of publications (whether published, accepted for publica–tion, or submitted) your institute/university requires you to obtain your PhD?"
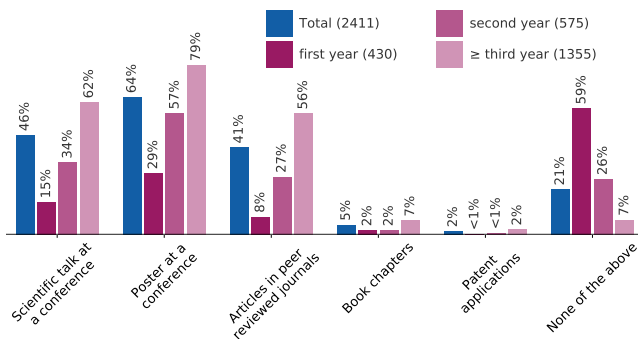
Figure E.72: "Which of the following types of scientific output have you published so far during your doctoral research?"
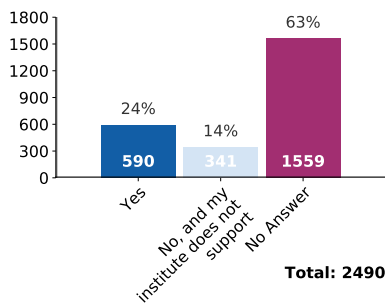
Figure E.73: "Have you been an a research stay abroad?"
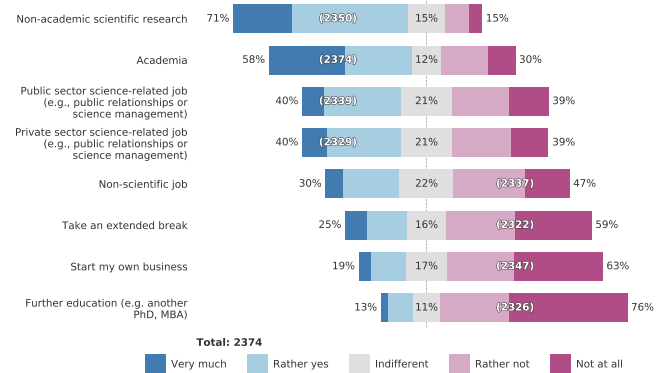
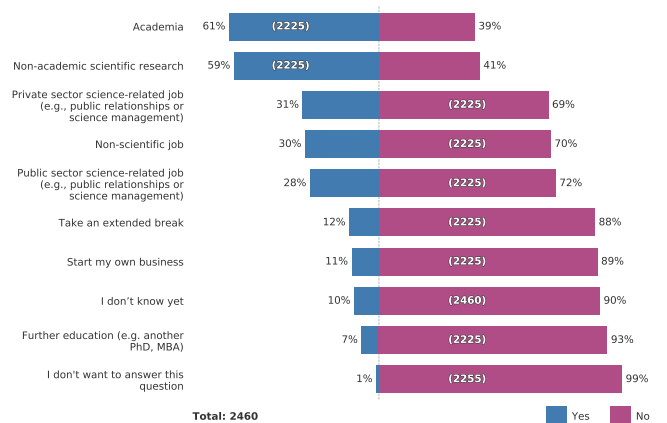**Figure E.74:** "Which field would you like to work in after completing your PhD?"

Figure E.75: "Which field do you think you will work in after your PhD?"
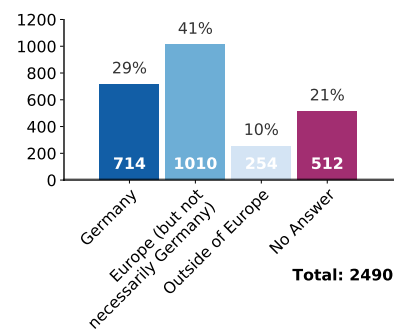
Figure E.76: "Where would you like to work after you complete your doctoral degree?"
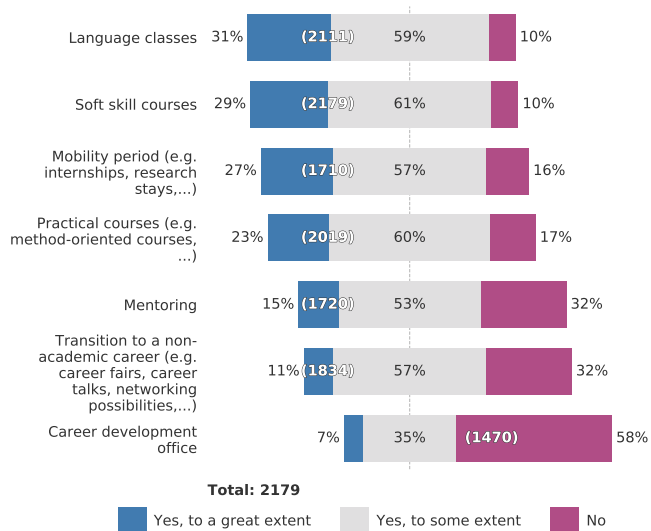
Figure E.77: "Which of the following measures for your career development are supported by your center/institute?"
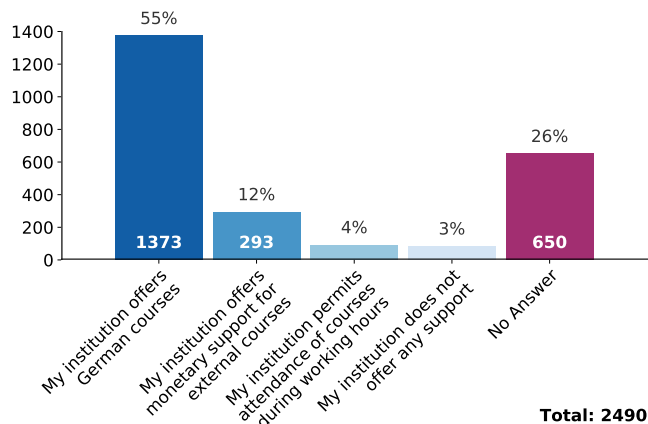

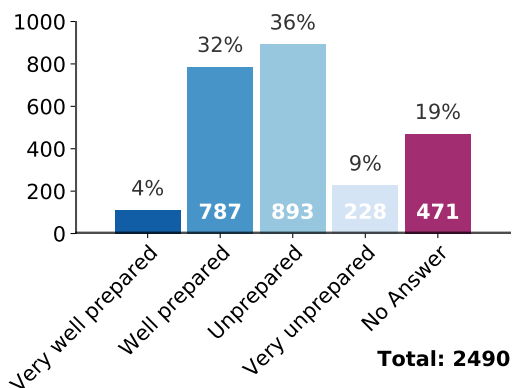**Figure E.78:** "How does your institute support you in learning German?"

Figure E.79: "Do you think that you are well trained for a job outside science?"
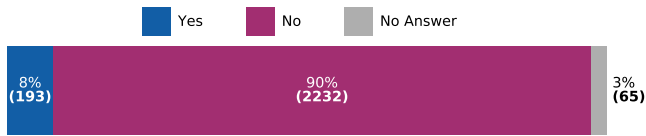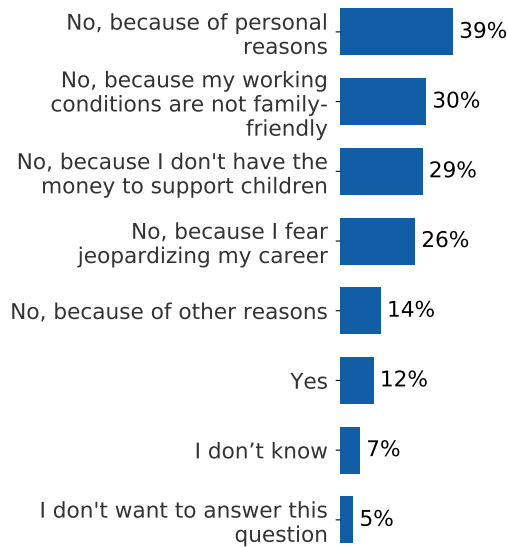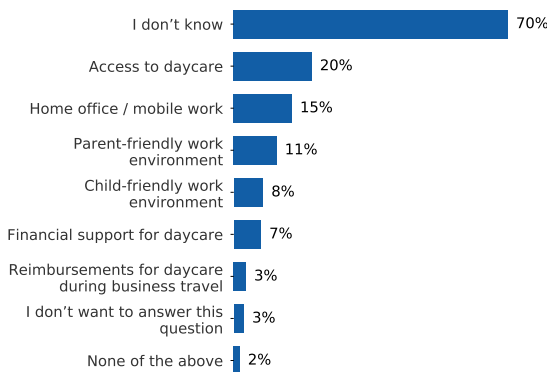
E.10   Section J

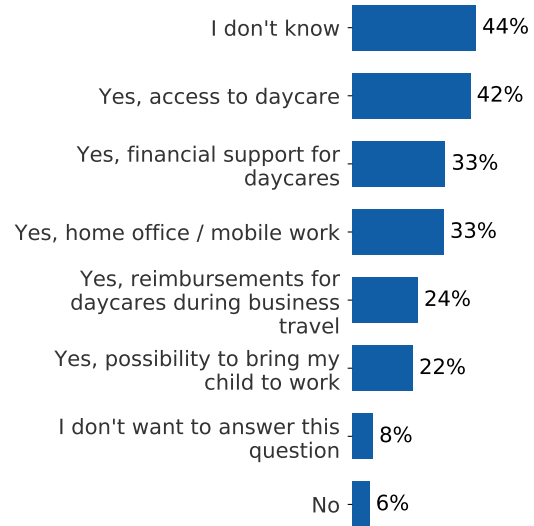**Figure E.80:** "Do you have or are you currently expect–ing children?"

Total: 2380

Figure E.81: "Would you consider having (more) chil–dren during your doctoral research project?"
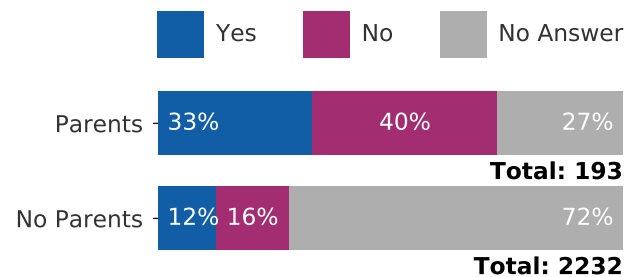

Total: 2315

Figure E.83: "If your center offers childcare support do/would you use it?"

Total: 2388

Figure E.82: "Does your institute offer support in childcare services?"

Figure E.84: "Do you feel that there is sufficient sup–port (financial and organizational) from your institute for raising a child?"
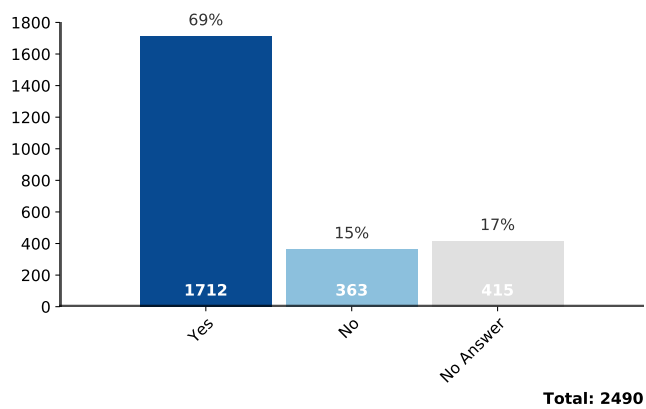
E.11 Section K

Figure E.85: "One last question: Would you recommend doing a doctoral research project at your center/institute to a friend?"

THANK YOU FOR CONDUCTING THIS SURVEY AND FOR FIGHTING FOR PHD RIGHTS AND MENTAL HEALTH. I MORE THAN HIGHLY APPRECIATE YOUR WORK!

THANK YOU FOR ORGANIZING THIS SURVEY! MENTAL HEALTH AND HARASSMENT ARE PARTICULARLY IMPORTANT TOPICS THAT I'M THRILLED YOU'RE ADDRESSING.

VERY NICE SURVEY! THANKS!!

THANKS FOR ASKING THESE QUESTIONS. I THINK ASKING, BY ITSELF, MAKES A DIFFERENCE.

HAPPY THAT MENTAL HEALTH IS GETTING ATTENTION. KEEP UP GOOD WORK FOLKS.

THANK YOU FOR YOUR CONCERNING.

I APPRECIATE THE BREADTH AND DEPTH OF THIS SURVEY – VERY WELL DONE!

THANKS FOR MAKING THIS SURVEY REALLY ABOUT US FOR THE FIRST TIME! VERY MUCH APPRECIATED!

THANK YOU FOR GOING THIS AGAIN. ☺ WE REALLY APPRECIATE THE INCREASE IN HOLIDAYS AS WELL!

AMAZING WORK, KEEP IT UP, IT'S IMPORTANT!

THANKS FOR CONDUCTING SURVEY. NONE OF MY SUPERVISORS HAVE ASKED ME EVEN ONCE HOW MY PHD IS GOING OR HOW I AM FEELING

IT'S PRETTY LONG, BUT I APPRECIATE ITS EXISTENCE. THANK YOU!