Doing a PhD

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Doing a PhD is primarily a journey of personal development while pushing science forward. In general, this is a very individual journey, and things you find challenging might be easy to others and vice versa. By sharing insights from my time as a PhD student, as an advisor, and by sharing insights from my own applications for awards and positions as well as reviewing applications for awards and positions, this document tries to provide valuable information and practical advice for your PhD journey. Of course, I'm also not at the end of my career and therefore I am still gaining experience myself, so I expect this document to have some changes over time. Some of the document refers to numbers and expectations in my group but I tried to keep it generic so that without the concrete numbers and expectations the advice in here is generic for anybody doing or starting a PhD.

This document is not a guide or tutorial on how to do a PhD, but rather a comprehensive overview of what you can expect during your PhD and the subsequent expectations placed on you as a graduate. These are mainly not formal expectations or requirements. Instead, one goal of this document is to show why a PhD is only driven by *your own ambition* and *the goals you set for yourself*. It also explains why doing a PhD is tied to pursuing ambitious goals. Any formal expectations and requirements can only be a subset of your own goals. This document provides perspectives of what to consider for your own ambition and your goals to align them with how others will see them. Expectations only really become relevant when you leave your research group to embark on your own journey after your PhD. But when you're about to reach this point, it is not about meeting your advisor's expectations. Instead, the advisor's role is to prepare you for this journey by equipping you with the necessary skills and experience, as well as the track record attesting these.

Why do you consider doing a PhD?

When talking to PhD graduates you will find that quite a few of them say that this was the best time of their life. But of course, this comes with an immense bias.

A PhD is different from a Bachelor or Master programme. It is not just a further specialization into an area. You see this also in the course work, which is the main part of a Bachelor and a Master, but usually a completely negligible part of a PhD. Unlike the courses you've taken before, in a PhD you're not working on something where the professor has a sample solution. That also means, you cannot be graded in the same way as in courses before. This can be exciting and freeing for some people but stressful and frustrating for others. It also means that after finishing your PhD, when applying for positions (or awards, funding, etc.), people will not be able to compare you against other candidates or peers based on grades. Instead, your track record has to look convincing in other aspects and there are many of them to consider. This is what this document is about and how you should read it: It tries to convey aspects you might not have been aware of.

Most importantly, you need to be aware that you do a PhD for yourself. No one “needs” a PhD. If you just want a title, buy one, lots of politicians do that. If you really want to do a PhD, there must be something beyond this, for your own, some intrinsic motivation. Maybe you want to contribute to science and humanity in this way, maybe you want to gain the perspectives and experience of being a part of the scientific community, maybe you want to build up a career where these perspectives and experiences are required, or maybe you even envision yourself in a position where you teach this to others later on.

If you don’t have this intrinsic motivation it is unlikely that you will do or finish a PhD successfully. The expectations for the PhD depend as much on yourself as on your advisor. And this already starts by choosing a university and an advisor. If you cannot find this intrinsic motivation and reasoning why you want to do a PhD and then start a PhD at an institution that focuses on research quality indicators such as research institution rankings, publications in top-notch conferences and journals, or highly prestigious grants, you might find the PhD to be the most dreadful time of your life. Choosing an advisor is the next step, and there the same question arises on a finer level. Each advisor has different expectations, be it the amount and type of project work, the amount of teaching, the level of independence, the number of publications, and many more aspects. Before you join a group it will be difficult to tell how each of these factors will work out for you. However, meeting the expectations across these aspects is crucial for your own success. It is not a description of **how** a group gets to papers, but an explanation of **why** you want to work on **what** to optimize your own track record and how this aligns with the goals of the group.

Doing a PhD changes what people expect from you

Over the years I had the opportunity to talk with different employers and learn when they hire PhDs, why they do so. The obvious aspects are deep knowledge and understanding in a specialized area of research and that this might help with the concrete problems that this organization deals with. But the true value, and I heard this many times, are the skills that make a PhD independent[1]. The ability to research any specific question, whether that is figuring out the state of the art on a specific topic, or conducting or guiding experiments or studies in a specific context, and then drawing conclusions from it. Becoming a PhD will change what your tasks at your future employer will be from tasks with more guidance to tasks with little guidance. One aspect that plays a significant role here is **resilience**. Companies know that someone who did a PhD demonstrated that they can bite through difficult times and get to a successful outcome after all. That they do not drag down the team if the tasks are difficult but take a view that is solution-oriented, focused on solving the problem. PhDs know from their own studying experience that any problem will be solved sooner or later and that they go away the fastest by working on these problems; identifying

[1] The TU Graz PhD curriculum actually says “The graduate is capable of performing high-level scientific work independently. The graduate is capable of team work in the field of engineering and scientific research, in both the university and industrial sectors, and can assume coordinating and leading functions”. This description is essentially what is expected from a PostDoc or academic research group leader - and that is what, by definition, the PhD degree qualifies you for: to lead a scientific team at a university or in industry. For a PhD student that means, you want to and need to demonstrate these skills in the process of doing a PhD, especially towards the end of the PhD, showing that you could take over a PostDoc’s or academic research group leader’s job. Other universities have very similar or even identical definitions for their PhD curricula of what a PhD degree constitutes.

what makes the problems tricky, and developing creative solutions that take burden from the team rather than shying away from annoying work. This aspect alone makes PhDs incredibly valuable for any team. A PhD has proven that they are **resilient** enough to complete annoying and difficult tasks and go through times of intense workloads without anyone having to hold their hand or constantly work on keeping them motivated and going.

Increasing independence and reducing guidance for any employee of course comes with a catch, that somehow others in the same organization need to be informed about their ideas and findings. This is something that PhDs have learned and practiced during their studies as they have worked independently and constantly had the task to inform and convince their advisor about their ideas and findings. The presentation of ideas in writing and in oral presentations plays a significant role here. I have seen a small number of situations and heard about a lot more, where an unsuccessful presentation in writing within a company led to a disappointing outcome for the person. The same happens with ideas presented in oral presentations. Companies need PhDs for these roles as they have practiced this for years and managed to convince even very critical committees, such as the program committees for their numerous peer-reviewed papers.

Another factor that comes with increased independence and reduced guidance is the reduced amount of management. If you get the opportunity to work more independently, you need to be able to manage yourself, manage your own team if you then lead one, manage your team members, and -- management seminars often discuss this point as well -- managing your advisor. None of these people inherently know what your plan is, so you need to tell them when what will happen according to your plan and integrate them in your plan rather than the other way around. PhDs are great for such a role as they have practiced this for years, where they needed to manage what they work on at which time and for how long to meet deadlines, allocating resources like other PhDs, or master and bachelor students to involve, and to manage their own advisor so that the advisor does not lose track of what they're doing. Setting up goals for a paper and later on prioritizing what can be finished for a paper is not far from managing projects and working on project deliverables. Many PhD students even had this experience with various types of research projects during their PhD already, which is another big point for hiring PhDs for such a role.

Where you see yourself in the future is up to you though.

Doing a PhD is not a Job

In many research groups you are employed as a PhD student, but the number of hours varies across institutions for various reasons. One misconception here is that "Doing a PhD" is a job with the number of hours that you're employed.
This is about as true as saying that a bachelor's or master's program is equivalent to a 40-hour job for the according number of semesters, namely not all. A PhD is a studying program and same as with the bachelor's and master's the effort to study this program is highly individual. I found it helpful to see some separation between the job parts and the studying parts. For project tasks, teaching tasks, administrative tasks, things that need to be done to keep your group running, your advisor will not task you with more than 40 hours per week (on average, sometimes exceeding this can happen and is fine), usually it should be much less. This is the part that is very important, the job part of your PhD does not exceed

the 40 hours. However, the studying program part, similar as in your bachelor and master, has no upper or lower limit, but this will define your success.
Now, going back to the intrinsic motivation: you want this for a reason, you want to be successful at doing a PhD, and there are tasks which contribute to this and these are all tasks that demonstrate that you have the skills that merit awarding a PhD degree, including demonstrating the ability to manage project tasks independently, manage teaching tasks independently, manage administrative tasks independently, but most of all manage the conduction of research independently. Over the years of a PhD you will gain more independence. For some of these tasks, you may not immediately see how they will benefit you later on, and maybe not all do directly, but indirectly they do.
I had weeks during my PhD where I certainly worked less than 32 hours and I had weeks where I invested about 100 hours into research - not because anyone made me do that, but because of my own ambition. I wanted to achieve something, I wanted my great idea out there, shared with the community. At this point the line between work and not-work gets blurry and I could easily say that I would have done exactly the same if it was not my job. This is also one perspective I can share: Imagine you would have enough money not to become rich but to live comfortably, enough to not have to worry about money. Would you do this research thing, contributing to science, getting a degree as a hobby? If not, I would consider it an indicator that you could get frustrated when doing a PhD. If yes, if you would use that opportunity of having no economic worries, then the PhD is not a job but it's more similar to a hobby or a sport where you want to achieve something. And then the term "working hours" becomes rather vague. For most of my PhD I would say I worked less than 20 hours per week, but I surely spent more than 40 hours per week with my hobby, the PhD studies. Therefore, the biggest part of how much time you spend overall with your PhD studies is completely up to you. 40 hours will certainly be a lower bound and how much time you spend with your hobby beyond that depends on how much you love your hobby and how much energy you can draw from the hobby. The more time you spend with your hobby the easier things will be for you but on the other hand forcing yourself to work more than 40 hours will also not work. Like with a hobby, it all goes back to the intrinsic motivation.

One phrase I often bring up when talking about what a PhD means is "**Getting Things Done**". Success most often comes from you successfully meeting and exceeding expectations. If you get things done in time, meeting a deadline, if you are efficient, producing good results in little time, then people will want to work with you or continue working with you. If you shy away from tasks, people will not want to continue working with you as you leave more for them. Now you might think that this is something that people will not see after your PhD anyway, but having reviewed numerous CVs and applications, it is remarkable how much the CV reveals about the efficiency of the student already.

Increasing your Efficiency

Efficiency means doing as much as necessary to achieve your goals but not doing anything unnecessary beyond. That is, besides not delivering the necessary quality it is equally dangerous for your efficiency to be perfectionist. In management you often will hear about the 80:20 rule, where for 80% of the work you only need 20% of the time, and for the remaining 20% you would need 80% of the time. The problem with this rule is that no one magically knows what 80% or 20% is. Who decides that even? It is not your own decision, not the one of your supervisor, but the collective decision by everyone in the audience of

your work, e.g., readers and reviewers. In situations like this it always makes sense to consult with someone more experienced on what their assessment is, where you stand with your work, i.e., ask your advisor.

During your PhD you might experience both sides of this: In one situation you might feel that you're delivering something that is basically perfect but your advisor might tell you it is not perfect enough. In another situation you might feel that you're not doing enough and your advisor might tell you that it is enough. No paper will ever be perfect. Every paper will have a limited scope. Just ask your advisor. If they say "part X of your paper is not good yet", try to revise it, and ask them again. If they say "the experiments to support claim X are not convincing" make an experiment that is more convincing. Trusting someone with more experience helps you calibrate your own scale, you will then need it after your PhD.

Another threat to efficiency is being afraid of some tasks. For instance, your work might involve modifying the kernel, a compiler, or a simulator. Dragging this work along and hoping that someone else will do it is an easy way to reduce your efficiency. From my own experience, it always takes me a lot of effort to push myself to just start doing it. The more you practice this and the more you adopt the "I'm a PhD (student) I just get things done" attitude, the more efficient you will become. Your experience will help you there as you will see that just starting often reveals that the task is not that unpleasant after all and you can draw a lot of energy from getting it done. I'm pretty sure you also have experienced that already, with a challenging game, a LEGO set, a half-marathon, or anything else that you get done, and this gives you a positive feeling, some kind of feeling content, sometimes even proud of your accomplishment.

One thing that also gives me the same feeling is having an empty inbox. I have a calendar, I have a TODO folder in my mail account. Deadlines are entered in the calendar (just convert the corresponding mail to a calendar appointment). Then delete the mail. Every mail where it's not up to you to do something, delete it. Simple answer to an email? Do it, then delete it. If the Inbox is not empty, these are immediate TODOs. The TODO folder is for later, always accompanied by an entry in the calendar until when this should be done. This way, you will have an empty inbox most of the time, keeping it very clear what's only your TODO list currently.

Working as a team with your advisor

Very often tasks will pop up that need to be done by the team. Avoiding tasks and hoping someone else will pick them up is usually not a good strategy. Your own success will be influenced by the successes of your team members. If they have more papers, that's more opportunities for you to co-author that substantiate your own PhD. During their PhD, PhD students would typically co-author as many papers as they have written as first authors but there is usually no sharp cut-off, having fewer is usually fine but it should be far enough from zero, having more is better as long as it doesn't affect the number or quality of your first-author publications significantly. First-author papers are the main priority of your PhD.

Now, the goal as a team is to optimize things for the team. That also means avoiding bottlenecks that could fire-back on you. The most impactful bottleneck in your team is your advisor. Especially in the beginning of your PhD you will need a lot of help with structuring

your research and writing, the more you progress through the PhD the less you need help and at the end maybe some discussions on the idea, a bit of polishing here and there may be the one thing you need from your advisor for your research paper. Taking off tasks from your advisor helps to avoid this bottleneck. Avoiding tasks and leaving them for the advisor will amplify this bottleneck. This is quite dangerous as it will slow down feedback loops on papers, it will reduce the frequency with which your advisor can discuss your research with you, it will reduce the time your advisor has to acquire new funding that has few strings attached, increasing the risk that you have to do more project work in the future. So the goal of the team as a whole and every team member is to take over tasks from the advisor in a way that makes the team overall more efficient. Your advisor will tell you if they consider you taking over that task is not a good idea anyway. From my own experience, the PhDs not shying away from tasks also have more individual success (the statistics also show this), possibly because they open up resources to then receive help from others in turn and by creating an atmosphere where people will gladly help them.

In general, you will collaborate on papers with team members. Naturally, the question arises who becomes first author and who is “just” a contributing co-author. I have worked both in collaborations where this was determined right on the first day of the collaboration and in collaborations where it was decided minutes before the submission deadline. My experience is that deferring the decision on who will be the first author only increases stress and the potential for conflict. Now, in our group we try to make this decision immediately. If the first author later decides that they don’t want to first-author the paper, the roles can be reassigned. The first author has the task to stay in front of any other author in terms of text in the paper. The other authors should not overtake the first author in terms of contributed text. Some universities and groups allow joint first-author papers, but there is no consistent handling of these wrt. taking these into theses, which parts, and whether this excludes the possibility of a cumulative thesis for either author. It is even less clear how they should be counted in terms of papers required for a thesis. Therefore, I would strongly advise against them and generally want to avoid having these in my group. Instead, take into account that you work as a team. You should try to help other team members to use everyone’s skills efficiently, so you will play both roles, first author and co-author, on different papers.

One mistake around these first-author and co-author situations is assuming this to be a quid-pro-quo situation. As a first author, you get help with your papers from older PhDs, PostDocs, your advisor, and other PhDs. Especially for older PhDs and PostDocs, very likely you will not reach a “balanced” situation in terms of papers where you helped each other. Assuming it would be like this and treating it like someone else would owe you something for your contribution to their first-author paper is not the right way to approach this. Rather look at it as a team: A helps B, B helps C, and C helps A is a balanced situation although no one helped the author they got help from, but the overall balance within the team should be fine. Still, more senior PhDs will likely provide more help to more junior PhDs. This is fine as they also got help from more senior PhDs when they were more junior. Similarly, PostDocs that helped you also got help from someone before, and the PhD student you helped, will also help other PhD students. This balance will never be achieved on an individual basis, and it will also never reach a perfect balance.

Another central aspect of co-authoring is that being co-author on a paper is a significant advantage for your own track record, substantiating your PhD and contributing to your CV.

Naturally you need to contribute something to be a co-author on a paper. Whether you contributed enough to be a co-author or just acknowledged is primarily up to the first author, but usually the advisor(s) of you and the first author will have a say in that as well. Still, from this perspective co-authorship is something you gain, it is an investment you make to brush up your own track record rather than a gift to someone else. Very few or even no co-authored papers over a multi-year time frame may look odd in your track record.

One person co-authoring virtually all of your papers is your PhD advisor, but there might also be a senior PhD or PostDoc co-authoring all or most of your papers. In general, this is good for your track record. Virtually all groups have the formal requirement that the PhD advisor is a co-author. I have rarely seen people deviating from this rule, and not for first-author papers. One reason where I have experienced PhD advisors asking to not be on the paper was when they were questioning the quality of the research, had concerns about misrepresentation of data, or concerns about misleading presentation to the extent that they rather did not want to be an author on the paper. Thus, papers without your advisor might not indicate something positive but rather something negative about your work, from an outside perspective. Having a well-renowned and established advisor on your work can be perceived more like a quality badge. Even in external paper collaborations where you contribute to a first-author paper of someone else, the default is that your advisor will also be part of that, and the advisor of the first-author. However, such situations are the ones where exceptions are possible and co-authoring a paper without your advisor can strengthen your track record. One exception is if you're interning at another research institution and write a first-author paper during the internship. In that case, your internship advisor is your advisor during that time and they will be co-authoring the paper, your PhD advisor might, depending on the type of collaboration.

You will often come across the phrase "When in Rome, do as Romans do". This is also true for your team. Before you try to change how they work, learn how they work. If you want to change how the team works, take into account that your time in the team is temporary and the only constant in the team is the advisor (and possibly some long-term employees if you have any). That means, if you want some change to happen, you need to convince the advisor of it. If you cannot convince the advisor, maybe your idea is not good enough or maybe there are aspects that you don't see yet. Maybe it is also just not compatible with their working style. After your PhD, when you build up your own group in industry or academia, you can play that role and others will have to adjust, inside your advisor's group you will have to adjust.

While going through the years of a PhD your role in the team also changes. Think of this like a learning group you may have had in the bachelor or master. You will spend a lot of time with these people and they might become close friends. Either way, it will be important that you contribute to everyone getting along with each other. In the bachelor or master, if people do not get along well, people might just leave the group and join another learning group. In a PhD this is much more difficult as additional hurdles such as opportunities, topic choices, advisor choices, and funding are connected to this. Therefore, it is important that everyone in the team tries their best to make the team feel like a team, a learning group, or a group of friends. In the beginning you might feel overwhelmed with how much everyone knows more than you. Having a welcoming atmosphere in the team is crucial for new PhD students here, as the perceived stress due to the overall situation (many new things to learn, many things to

do, many tasks, and challenging goals) is already high enough. In a later stage of your PhD you will have more of a mentor role. As outlined in the beginning of this document,[1] getting a PhD degree means that you have demonstrated that you can take over team leading tasks in an academic context. The best way to get there is to try and demonstrate that in your everyday work. In the best case, you will take over team leading tasks exactly like a postdoctoral researcher would. And at this point your advisor will also tell you that you achieved the goals in this aspect of your PhD.

When a person is newly introduced to a learning group or a group of friends it is important that especially the older people from that learning group or group of friends make sure that everyone is welcome and integrated. Difficult situations also do not go away by not talking with each other. The other person might not even be aware that it is a difficult situation from your perspective or might not understand why it is a difficult situation for you. Expressing your feelings about a situation, if necessary with other people from the group involved, is important to make sure that everyone is aware of difficulties and that you can work together as a team to resolve them.

Through the years in your team, there will be times where you meet the expectations to a lower or higher degree. This is also true for your team members. Similar as in a sports team, you need to make sure that people get up to the same level and stay there. That is, it is important to keep an eye on the current performance progress of the others in your team and support them (to some extent) if they struggle with meeting the expectations.

Meetings and Seminars

During your PhD there will be many meetings and seminars. Seminars have multiple goals such as being informed about who is working on what at your institution. A PhD is not just you becoming an expert in the topics you wrote your first-author papers about, but also the ability to contextualize things. For this you need to know what others work on. Another aspect is that you will be able to tell who at your institution might be the right person to ask about a specific topic. Often seminars have even led to new paper ideas as combining two comparably distant topics often yields interesting new insights that have not been studied yet. Another aspect is to practice the perspective of the reader or listener of an idea. Soon enough you will review papers and project proposals and with every year the scope is getting wider, up to the degree where you are not an expert on the topic but people still need your view on it. Practicing to get at least a high-level understanding of a topic from a technical talk from another area can help you personally build up this skill and sufficient contextual knowledge to assess other works.

Finally, feedback is of importance. Since all PhD students want to improve their presentation skills, group meetings and seminars offer an opportunity to present ideas in an informal or formal way, and obtain feedback. Especially for internal seminars, ask the attendees also for non-technical feedback on your talk. Vice versa, be available for providing feedback to others as others have been available to provide feedback to you. Question and answer sessions are also a great practice for question and answer sessions at your conference talks or PhD defense and various presentation formats you will participate in in your later career.
Your attendance will also be noticed by your peers and likely your advisor. Missing a seminar is not a problem, especially when it is a stressful time. But if this happens more often, your

peers and your advisor will more likely perceive this as insufficient time management from your side. Sometimes people also skip seminars for other reasons. Attending meetings and seminars can sometimes feel like a waste of time. However, by experience, the PhDs engaging the most in meetings and seminars are also the most successful individually, which seems to counter the perceived waste of time argument.

For meetings, some groups have policies such as “no phones”, “no laptops”, etc., but the root of the problem that leads to these policies is that attendees do not see the value of the meeting but should. I also did not see the value for a long time and what really changed this was not a change of the meeting style or topics but a change of my own perspective. A meeting can serve multiple purposes but most importantly it serves the attendees. Informative meeting points serve a similar purpose as seminar talks, namely sharing knowledge across the group. If you feel that you already have this information, it doesn’t mean you’re wasting time. Check whether you really understood things correctly. Fill knowledge gaps and figure out how others share information effectively, there might be communication strategies to adopt or to avoid. Brainstorming and team building are other important aspects. Without joint activities you won’t feel like a team. Status updates are another aspect that might seem boring as it is just an update of what did or didn’t work in the research line of someone else. But there’s multiple things in there, first of all: providing the status update shows others what your progress is, hearing the status update from someone else gives you feedback on how much progress they made. If you feel there is a gap in efficiency, maybe you can jointly figure out how to increase the efficiency - the team will benefit from it.

Teaching

Teaching is a central component of academia. We do not create knowledge without sharing it. Teaching gives you great practice in organizational skills and presentation skills. It is practice in assessing someone else’s work. This is crucial and something that people expect from a PhD graduate to be able to do. That means your track record needs to show that you are able to do it and that you gained experience and independence through the PhD. My experience again is, the people who engaged more in teaching also were more successful in their PhD overall.

Teaching can comprise bachelor and master courses for instance. My experience is that the better your teaching is, the more talented people you will attract. This was a significant multiplier in my own PhD as I was able to delegate a lot of work. Still, they are students with lots of different tasks and they are not doing a PhD (yet, maybe) and don’t necessarily feel any responsibility to contribute to your success as a PhD student. Hence, relying on students can be dangerous. Ideally you integrate them in your work but always plan for the case where the student doesn’t achieve anything. Basically, schedule all tasks for yourself, hand out the tasks that are the furthest in the future but still doable to students. Maybe even let them work on tasks for papers that you planned for later in your PhD.

More often than not you will not be able to decide what you teach. This is a quality that a PhD brings, they can teach a broad variety of topics that are closer or farther away from their own research. I remember a discussion about what one can expect from people applying for tenure track positions. It was clear that the expectation was that if they apply for a CS tenure

track “they can teach any CS bachelor course from the entire CS curriculum”. “Expert in side channels? Sure, but now you got to teach databases”, just as an example here. People applying for tenure track nowadays don’t have multiple years of PostDoc experience, and maybe you also don’t want that because PostDoc contracts are usually rather limited and if you want to stay a PostDoc because your track record is not good enough to apply for tenure track yet, then you very likely also have to move between locations, which each offer you short contracts. With a good track record from your PhD you can avoid this, but this means showing in the CV already that you can teach different topics, including topics that are closer to your research and further away. So, this will be a point that people look at in your CV: Which courses? Did the course load and the number of students taught increase with experience? Did it go down? Especially when dropping some teaching activity, a reviewer of your CV might be wondering why you did so.

Teaching can also personally be of advantage to you. Sometimes even when writing 2 or more papers per year, they just constantly get rejected and you have to resubmit them. In cases we had in our group this was between 1 and 2 years for a single PhD student that they went without a paper acceptance. Such a time frame can be frustrating, especially in stage 2 or 3 where you already had accepted papers and “know how the game works” but somehow it still doesn’t work out. In this situation, teaching can be a backbone where everything is under your control, where you can change things and make improvements so that students are happier, results are better or the quality of teaching is increased in other terms. In that sense, teaching will make you more resilient to obstacles in other aspects of your PhD.

Teaching also includes thesis supervision of bachelor and master students. In the ideal case, you will build your own research group not consisting of a professor and PhD students, but of you, the PhD student, and bachelor and master students working on projects with you. The students just get credits for their work and even if their work is not publishable because the topic just didn’t yield something, it doesn’t really matter for them in any way as long as they can still write a nice systematic document about what they found out, i.e., a thesis. Therefore, engaging several bachelor and master students is a nice way to multiply your own research output. After the first half-year, you may already try to get some bachelor theses, in the second year you want to have maybe 2-3 active bachelor students and a master student. These are just ballpark numbers, that could also be higher or lower. During some point in my PhD I had more than 10 active bachelor and master students and it was actually quite productive. By building and maintaining this team of bachelor and master students in a productive way, you demonstrate that you have mastered this part of being a PhD student. The challenge with bachelor and master students is to break down problems into tasks they can solve. If it is a task where you don’t know how it would work, it likely will fail. If it is a task where you have a very good intuition how it works and you can break it down into easy steps, then it is more likely to work. For my bachelor and master students in the past I had a clear idea of *what I would do next and an intuition on the expected outcome*. That is generally not the case anymore on a PhD-student level, as PhD students have to be much more independent. There, the PhD student rather has the task to teach the advisor on what they figure out and the advisor gives advice, it is not the fine-grained task-by-task supervision a bachelor or master student usually needs.

Opportunities and Balancing

You can see teaching as an opportunity to gain practice and experience. Each class size comes with different challenges. Each subject has its own challenges in teaching. Seeing this as an opportunity to practice and master this skill, and by doing so also having proof on paper documenting that you have gained experience, is quite valuable. That is also true for other opportunities that arise, such as giving an invited talk at another research group, another university, a company, an industry event, a workshop, an industry conference, and many other occasions. Other opportunities are reviewing and also contributing in an administrative role (maybe to a conference). Taking these opportunities, volunteering for them, again has multiple benefits. Each opportunity you take gives you more experience, and it makes you more visible. Once you have been invited to one event, if you do it well, you will be invited to more and more prestigious ones. By giving talks you extend your network. You get to know other academics and people from industry which helped me on many occasions, often only years later, e.g., when trying to get keynote speakers for a venue in whose organization you are involved, when you need project partners to apply for funding, when you want to responsibly disclose a vulnerability and you already know each other, so the PSIRT team doesn't immediately discount your report but instead handles it with a high priority because this employee you know said that "it comes from that person, they know what they're doing, prioritize it".

There are countless other situations where this might come in handy. That taking an opportunity can be valuable for you and pay back years later, is something that might not be immediately obvious.

Many things in the PhD are like this. That is why it is important to pick up opportunities even if the "return-of-investment" is not clear yet. And it is an investment: especially industry talks but also invited talks may not be the priority of your advisor or not even possible to fund from the project you're working on. Thus, it might end up being an investment of free time rather than working hours. In general, picking up extra opportunities and tasks doesn't mean you have to do less on the tasks you already have in your PhD. If you need to get work on papers done but instead you prepare and give industry talks, you will be falling behind expectations. So, only pick up opportunities if you can fit them in your schedule without neglecting the existing tasks. At the beginning of your PhD, opportunities will primarily be local, where you can pick up more tasks in the group, the institute or the university, but over time you will be more visible and external opportunities will come up. Now, of course you can go and give 30+ talks a year. I gave a lot of talks during my PhD. But then the question is always how to balance this with all the other requirements and tasks: teaching, publishing, project work, giving talks, reviewing, and more. In general, there are synergy effects where giving a talk opens up the door to a lightweight collaboration resulting in one more publication, or resulting in lightweight funding freeing up more of your time to focus on research rather than project work. I have observed both for myself and for others that taking more opportunities leads to getting more things done and being more successful overall. A reasonable point to say no to an opportunity is if you have already taken opportunities on that level (e.g., a talk at another university or an industry event) within the last few months. One aspect can also be that, if these are people who you would like to meet, even or especially when you know them already, letting yourself be invited is a great opportunity to meet them again.

Another aspect can be if the people are far outside of your area (e.g., I once gave a talk at an industry event of a bank) so they'll likely not extend your network in a reasonable way.

Then it can still be valuable for the other reasons provided (experience, track record, increasing the probability to be invited for more relevant events, etc.) earlier. Through your PhD, opportunities change but also which ones you consider a good opportunity will change. Where in the beginning you might accept reviewing for some journal you never heard of, when you stepped up to reviewing for a more prestigious journal or conference, you likely don't want to go back, unless your reviewing activities are stalling otherwise. For visibility, poor opportunities are better than no opportunities.
Some opportunities offer better visibility than others and some opportunities might be better for the scientific community than others. The issue is of course that you have limited time and you need to balance what you do with your time. Investing more time into publishing code, frameworks, or research artifacts, or into giving more talks, may increase the visibility of your work, but it also consumes time that you don't have to explore further ideas and work on papers. Thus, finding a good balance is important and it is a good idea to ask for advice on a case-by-case basis.

Skill	Capable of working on **small tasks within a** research/**paper project**	Capable of working on larger **tasks within a** research/**paper project** under close supervision	Capable of **carrying out research** under supervision (writing papers)	Capable of independently **leading** your own scientific **research** and leading/guiding others	Capable of **acquiring funding**, as well as finding and hiring PhD students
Level you need to demonstrate this skill on	Bachelor	Master	PhD student	PhD candidate	PostDoc
Level you fall behind expectations without this skill	Master	PhD Student	PhD candidate	PostDoc	Group Leader
What you get after showing this skill clearly	Bachelor degree	Master degree	PhD candidacy	PhD degree	

Progress through the Years

Like the entire document, a lot of this is specific to my own perspective, this part here even more as it directly covers aspects such as the degree of independence that PhD students work with. Above you can see a table showing the broader context of where a PhD student and a PhD candidate are in the path through academia. You can see that to get a degree, you always need to demonstrate abilities that you will need a lot on the next level. Therefore, towards the end of one level, it will already feel more like the next one and the transition becomes more blurry. You might have realized this already by slipping from a bachelor project/thesis into a master project/thesis, or if you already were employed as a master student right before starting your PhD, it may also be the case that your tasks don't really change in that transition moment. That is because you were already demonstrating skills required for the next level. However, with every level the expectations from the lower levels are not reduced, they still persist and you are expected to demonstrate these skills from lower levels to a higher degree.

In the beginning of your PhD you are basically a just-graduated master student, so you don't happen to magically have more skills than a master student. The goal of your PhD is to build up a skill and experience set, typically represented by a track record and thesis, that qualifies you for what comes after. Signing up with a PhD advisor means signing up for their assessment about when you have reached this point. Take into account that they almost surely have been in academia longer and have gained more experience, they will have seen many theses, thesis defenses, as well as applications for tenure-track positions and applications for industry positions when they are asked as external reviewers. This means they will know when you have reached the level that constitutes a PhD degree. In this time, a PhD goes through multiple stages which are usually represented by a 1-1.5 year time frame and about 2 papers.

1. **First Stage:**
   You get a topic to work on where your advisor already knows it will be a publishable paper. This should usually be immediately, or at least in the first 6 months such that you have a chance to submit your first paper well before the first year has passed. The advisor or other senior co-authors will be heavily involved in shaping the story, the paper structure, deciding what experiments to perform, what argumentation to use in the paper, which parts to not include anymore as they would be too much. They will also ask collaborators and other PhD students to join to assist you. But keep in mind that they also need their own papers, so delegating tasks to other PhD students does not solve the bottleneck on that level. Delegating to bachelor and master students can solve the bottleneck but it is still early in your PhD, so most likely you have to do the work on your own. In this stage, you will contribute a lot of experiments, a lot of text, but more senior co-authors such as your advisor will work over the text a lot. In principle, the goal is to still have more text in the final paper than any other single person. You need to take care that you stay in front of the others by text, the others need to make sure that they stay behind you. The advisor and senior co-authors will likely do a lot of polishing in the end.

   Again the principle "when in Rome do as Romans do" applies. When you come up with a plan on what experiments to do or what to write about and how to write, don't invent your own style but mimic the one by your advisor or from others from the community, e.g., by using another paper as a close orientation point. In general, never just go by your own style. I would go as far as saying, if you're asking yourself, e.g., how you should write something, you're asking the wrong question. The right question would be: how would others from the field write this? And this transforms your writing task into a task of looking up how others write it in their peer-reviewed papers on the topic and describing it in the same way. Use precisely the same terminology and the same phrases. This way, your readers will understand you better, increasing your chances of getting your paper accepted.

   It is also crucial at this point to not overlook the shaping of the idea for the next paper and possibly even starting to work on it before you get the decision for the previous paper. Otherwise there is the risk of running into a strictly serialized way of approaching the publishing business which will slow you down in your progress. Two papers in this stage demonstrate that you have the things you need to proceed.
2. **Second Stage:**
   The second stage is the transition from a PhD student to a PhD candidate. The PhD

candidacy at the IAIK comes with an increase in salary but also you get more tasks, responsibilities and the expected level of independence is much higher. In other words, while as a PhD student you showed that you can do good research under supervision and with a lot of guidance, the PhD candidate needs to show that they can do work independently. The PhD candidacy usually takes place around the end of stage 1, but if you get a lot of papers rejected it might be delayed up to the end of stage 2. In stage 2, either you get a topic to work on that is more vague than in stage 1, or you come up with a topic together with the advisor, more rarely people just come up with their own topics. However, you already get a lot more freedom, which means that you keep the tasks you mastered on stage 1, and now also are expected to structure the paper on your own, decide on experiments, come up with good arguments to use in the paper. You decide whom to collaborate with at this stage and you are expected to build up a network of peers that you know and that you could collaborate with and maybe even do. You integrate more bachelor and master students into the work to delegate easy-to-delegate tasks, so that you have more time for focusing on structure and deciding what to put in the paper and what to leave out. This part is important, as you cannot arbitrarily speed up how fast you work, delegating always wins in terms of scaling up the workforce even if it has a higher ramp-up cost. The expectation here is that you are clearly in front of others by text and that substantially less polishing is necessary to bring the paper into shape. Connecting back to the initial "job" comparison: In a job if you do a task, some deliverable, well and on time, if you do it again similarly for the next task, the next deliverable, this tends to work out fine as the expectations did not shift. This is different in a PhD studying program. With every step you take and stage you master, the expectations are raised. Meaning that you continuously have to improve to just keep up with the expectations. This is also the case for other studying programs, if you learn C in the first semester, the expectations on how well you can code in C in the 5th semester are higher. During studying programs expectations only go up, never down.

In this time frame you will come up with more and more ideas on your own and likely already set up your own paper ideas for the third stage.

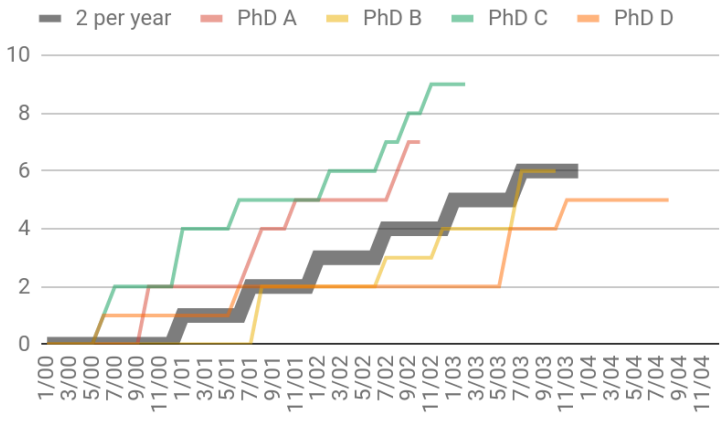
3. **Third Stage:**
   In the third stage you have to demonstrate that you deserve the PhD degree. You will work on your own ideas, come up with your own paper structure, choose your collaborators. The collaborations within your team will change, where other PhDs might contribute less. The expectation is that you primarily involve bachelor and master students more if you need additional workforce (showing that you can lead a scientific research team), but other PhDs can also contribute if they want to but you have to be more careful with their time and role in your paper. The expectation is that the text, structure, and experiment schedule is all yours. The collaboration with other PhDs and the advisor will be more on a discussion of ideas level, but occasionally may involve hands-on writing or experiments. You may notice that this is not so different from a PostDoc role in some aspects. That's expected, as you demonstrate in this last stage that you can do the things a PostDoc does.[1]
   Still, at this stage your main goal is still to write papers, but more under your own leadership, showing that you can lead paper research to the point where it passes peer-review (as if you were a PostDoc already). Now, don't try to trick yourself here:

the solution is not to work without your advisor and other PhDs but to use them as internal reviewers. If other PhDs or your advisor would not give your paper a clear "accept" rating, then maybe it needs some more work, but it always depends and using those internal reviews is most valuable here to also build up your own experience on how others see your writing. In the end, the advisor may still do a bit of polishing but the goal here is clearly to demonstrate that you're ready to continue without the advisor. That is, when you are done with a PhD, and you start your own group in industry or in academia, there will be no one to do the polishing for you, you will be the person doing the polishing for others, and you have to teach it to others.

In the third stage, you should make a plan on which papers you still want to include in your thesis and which paper ideas not. Use those paper ideas you don't need yourself to other PhD students to demonstrate that you have the potential to lead a scientific research team and, thus, have achieved the goals in this aspect. You still gain a lot from being a co-author and even more from the experience of leading the team on this paper project.

Overall, it is crucial to master each stage. That is, to finish a PhD, you need to have papers in each stage, supervised students, researched your own ideas, etc. as outlined above. Skipping a stage, e.g., no papers in the last stage, would mean that you missed out on some important experience and have not demonstrated all skills that are expected from a graduated PhD. Also, the journey shouldn't stop with the decision to hand in. The time frame from the first thesis draft to the defense is roughly 3 months if everything works well and most of the time is waiting. Of course, the expectation is that during this time frame you continue working on some paper project. Typically 1-3 first-author publications still spill over from the PhD into the PostDoc, as they are only completed, submitted, or accepted after the PhD defense. **That is, when aiming for 6 first-author papers in your PhD, you should aim for 7-9 first-author papers in total and just hand in when you've reached a nice set of 6 papers.**

To measure your progress it is good to keep an eye on your accepted papers. The gray bar in the figure below shows where you are when you are absolutely on the expectations of the group: 2 papers per year, starting with the first accepted paper after about 1 year into the PhD.



I added curves from PhDs from our group.[2] Sometimes people think about finishing earlier or later, and this again seems like a misconception. The goal is to become a PhD, how many years that takes is secondary and not something to optimize for. The rule of thumb is to build

[2] All of this is public information, as it is public who first-authored which papers, where they were accepted, whether or not they were accepted with or without shepherding (final acceptance counts, papers do get rejected from minor revisions if you don't take care of it properly, but that happens very very rarely), and thus exactly *when* the paper was accepted.

up experience and a track record that constitutes a PhD, the demonstration that you can work as an independent member of the scientific community. If you happen to achieve that very clearly in less time, you could finish, but that also means that your track record has to be above the expectations that people have towards you after a regular time frame. This may be counter intuitive, but that means that after 2 years the expectation might include more papers, more teaching, more project work, in absolute numbers, than after 3 years. The reason behind this is that a PhD is not just the collection of numbers but also experience you gained. Going through the stages outlined before. Looking at your CV someone else should be convinced that you mastered all stages, that you have gained the experience. This is easier to believe for a PhD student with 5 papers, spread over the entire PhD, than an absolutely impressive 4 papers in the first 2 years. Therefore, shorter duration of the PhD, means a higher bar to cross.
Another aspect for the PhD is: Look at publication lists of people that did their PhD. After the PhD the time for first-author papers is over. Maybe there's one more, two more, maybe three more. Maybe there are some exceptions, but for almost all people graduating their PhD, even if they continue in academia, they are not writing first-author papers anymore. Finishing the PhD means also saying goodbye to this and embracing the next stage, which is advising others on how to do that. And on that next stage you take responsibility that your advisees learn how to write papers, that they master all the stages, that they become independent members of the scientific community.
And one final aspect: internationally PhD durations are not standardized. People looking at your CV will find anything below 3 years weird. I got many questions during my applications both to industry and academia that wondered if this is below 3 years, how much can it really be my own ideas? Maybe I'm still in stage 1 or 2 and I was just really productive there, but who knows whether this was my own research agenda for the last two papers or not? By taking more time in your PhD you build up a stronger track record and no one will care about how many years it was as long as the track record is strong.

Now from my own experience, the curve above, especially the gray one, is very artificial and doesn't look like what it will be in practice. Most of the time the curve will look rather flat at the beginning, and then go steeply up in year 3 and 4. Take this into account for your planning, that this very likely will be the most productive time of your PhD. Producing a few very nice papers there will have a tremendously positive effect on your track record. I had students with just 2 papers accepted after 3.5 years who then had 5 papers half a year later. And this looks very nice and impressive then because people looking at your track record know that this was in a later stage of the PhD where you had more independence and your own research agenda.
On the contrary, if you start out with 6 papers in year one and then publish no more papers, it would look very bad: In the first stage, your tasks are different, you get more structure, more help, more guidance. Your CV (or track record) would show clearly to anyone that you absolutely mastered the first stage with tremendous success, indicating an extraordinary ability for this stage. But it would also show that you were not able to carry over this success to the later stages and raise doubts about your skills for stage 2 and 3 then, and consequently, whether you could take over post-doctoral or group leader tasks. If you take a look at CVs of people you will also often see that just before the PhD is completed the PhD student just got more papers accepted, creating a positive outlook. Like in other places as well, you should end on a positive note: If the last larger research idea in your PhD does not work out, and this disappointment leads to the decision that you want to stop doing the PhD,

that does not show resilience but resignation. On the contrary, experiencing such a situation and showing that you can progress and continue from there, is exactly what people look for in a PhD graduate.

Every research group and also research fields are different, which makes it impossible to compare formal requirements. Some advisors pursue a roam-free approach, where they provide the PhD student with a desk and have a brief meeting with them once per year. The other extreme are advisors that provide ideas and structure for the first papers. While the former requires substantially more drive, independence, and perseverance, the latter may require a higher number of publications to demonstrate that the same level of independence was reached in the end. Thus, regardless of the environment, the goal in the end is to become an independent member of the scientific community.

Conferences and Networking

Becoming a part of the scientific community also includes becoming visible in the scientific community. Meeting people at conferences is one important part, other options are workshops, summer schools, project meetings, and research stays. For all of these, they cost money and therefore you very likely have to justify *why* you want to go there. You might have to go there if you are involved in the corresponding project, or if you have to present your paper. Conferences today often have multiple tracks in parallel so it will be impossible to hear all talks. Also if they run from 8am to 8pm, it is impossible to pay attention this long. Therefore, when attending a conference, look at the program beforehand, choose a small number of talks, maybe 3-5 per day. Make sure to attend these and if you see an opportunity for a nice question, ask it at the end of the talk, this makes you visible, and also it is a nice service to the speaker, as it is most awkward to not get any questions yourself. Besides these talks, also try to sit in a random session or stay seated in a talk you wanted to attend, listening to the next talk. This is great to add context, similar as with the seminar talks I mentioned, that allows you to put your own research into perspective in the broader area. And you might even learn and understand something about the topic then. Often you come up with new ideas there. Someone presenting an attack? Well, how could you defend against it? Some stupid ideas are not stupid when you think about them more. Someone presenting a defense? How can you break it?
But the most important element of conferences is the networking with your peers, which very often is referred to as the “hallway track” in contrast to the lecture hall tracks with talks. Meet with peers, talk, eat and drink with them, so that you get to know them, and they you. Often this sparks collaborations, but maybe you get to know someone you want to visit for a research stay or who would like to invite you to give a talk. Maybe you can just exchange views about what a PhD is in different places, what funding situation they have, what work they have to deliver, how much guidance they get, these are all aspects you can ask others about and it helps you to contextualize where you yourself are. It also helps with your well-being if you can talk with others about challenges you face.
When you give a conference talk, many conferences have talks online. Quickly click through them, search for the best one, search for the worst one. Share it with your group colleagues, they will also be interested. Figuring out this scale is great to help you figure out where you should be. Preparing a conference talk can be time-consuming and the 80:20-rule again applies. Some people like to give practice talks before going to the conference, ask your advisor or your PhD colleagues or integrate into a seminar. People will be interested and will

give you feedback. At the conference, make sure you have a timer and do not go over time. Finishing too early is no issue, so don't worry about that. Also, put your social media handle on the slide, this is the best moment you have to make people want to follow you, make it easy for them. Social media is great to advertise your own research and this way stay in touch with the community.

Conferences are also attended by a lot of folks who are hiring, both from industry and academia, for group leaders, tenure track professors, postdocs. Talking to people makes those connections that you later can leverage. The primary goal of your advisor is to help you building up a CV where you don't have to rely on this networking to achieve very strong career steps right after your PhD, and even in such situations, your track record will be better than the ones of your competition but the advisor only takes an advisory role in this, you are the one actually building up that track record.

While traveling to conferences and also during conferences (e.g., uninteresting sessions or even days) you will find a lot of time where it is up to you what you do. This can be great if you use it for networking but also, as you want to build up your track record and use your time efficiently to get there, to use this time in a productive way. I used most of my travel time to work on papers. With little to no connectivity during flight just doing some paper editing makes the time pass quickly and you can get a lot done. Also during conferences you may find very productive time to work on papers, for instance, if a session is not interesting. For instance, a significant part of 'Flush+Flush' was written **during** USENIX Security 2015 paper sessions, a significant part of 'Another Flip in the Wall of Rowhammer Defenses' was developed and written **during** Breaking Bitcoin 2017. More recently, I spent several hours during conference sessions polishing a paper draft for USENIX Security 2023, similarly at a recent Dagstuhl seminar. Still, if I work on papers at conferences, I would do so in public areas or sitting in a session, to maintain the possibility to see and be seen by people, and to pick up opportunities then. Another aspect to consider is that not working on your paper project for a week or even more will typically cause you additional ramp-up time to get back to the project and also might cost you more energy to get back to the hard work.

Formal Expectations

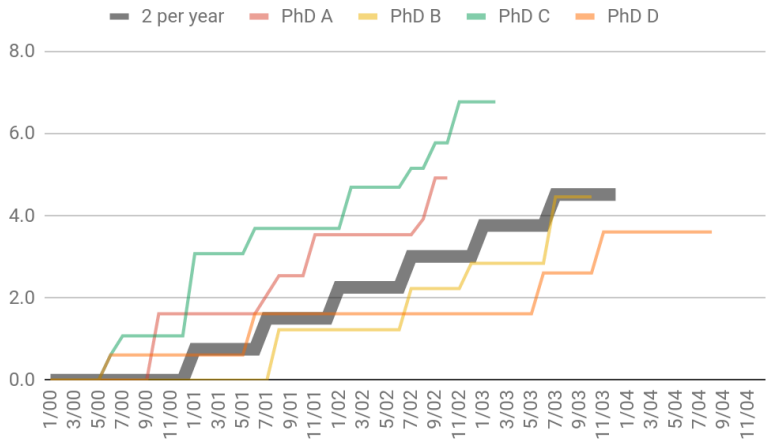
Now for the formal expectations, there are the university law, the university statutes, the curriculum, the doctoral school statutes, the institute's policy, and your advisor's own policy. All of these will state different minimal requirements and, unsurprisingly, the further up you go, the more people are affected by a policy and thus the broader the consensus must be.
In the best case, formal expectations are nothing to worry about and everyone involved, the university, the institute, the advisor, they are all investing in you, they want you to succeed and pass their formal expectations.
One issue is also that formal expectations miss the main part of doing a PhD: becoming an independent member of the scientific community. All numbers should therefore be treated as "necessary but not necessarily sufficient" conditions. At the time of writing, our doctoral school expects 3 peer-reviewed publications (conference, journal, workshop but it must be peer-reviewed), the institute expects 5 peer-reviewed conference or journal papers, in my group I expect **6 peer-reviewed conference papers** (journal papers are not that relevant in our area and so it's difficult to make a generic statement about them), all of which as a first-author.

The doctoral school and the institute's policy expect that at least one of the first-authored papers is an A* paper. A* is the top-most rank in the *Core Conference Ranking*, followed by A, B, C, and son. Papers *typically* require more content, a higher research quality, and better ideas to be accepted to an A* conference, than to be accepted at lower ranked conferences. On the other hand they have lower acceptance rates, and you may have to invest additional effort when the paper is rejected or gets a revision decision i.e., it is more effort to aim for A* papers.
Now, if someone would have an A* paper right away, this might create the incentive to never try A* conferences again as their acceptance rate is lower, if they just want to go for minimal effort. The thing is, at this point in the document it should be clear that aiming for the minimum formal criteria is besides the point of doing a PhD in the first place. A PhD intrinsically means going for more than the minimum academic achievements.
A* papers are usually considered much more valuable and, hence, many of the top research groups focus primarily on research that could be accepted at an A* conference. We also follow this idea and, hence, want to incentivize A* papers. A* papers also are usually longer and more dense than papers at lower tiers.
Now, while my recommendation is quite clear to aim for a good number of high quality papers, i.e., **at least 6 papers** and **at least one A* paper**, sometimes it doesn't work out. For instance, some papers don't get accepted for a longer time than the PhD should take. **Writing** at least 6 papers is fully under your control and this number should not be reduced unless external factors such as financial or project constraints do not allow for it. The standard case in this situation is to keep writing papers until you've reached the bar and not to lower the bar (i.e. aiming below the minimum the advisor communicated). Still, if there are constraints preventing you from getting there, more A* papers may get you closer to it: for instance, 5 papers in total with 2 A* papers, or even just 4 papers, if you have at least 3 A* papers can still be considered acceptable despite being below the expectation of 6 papers. In any case, your track record will look better with more papers, and a thesis with just 3 papers, all of which A*, will look weaker than a thesis with 6 papers, where only one of them is A*.
In my own experience, a short PhD duration (in contrast to a long PhD duration) also does raise questions about your track record and how much experience you can possibly have gained in that time frame - yes, interviewers ask questions like that. An average or above-average paper count will help you as you have a track record showing more experience than with a below-average paper count.
In summary, **while the paper count can be seen as an indicator for experience, the number of A* papers is an indicator of excellence**. You don't want to trade one for the other but maximize both.

Another aspect is that the decision where to submit should not be made without your advisor. As many prestigious research groups primarily focus on papers for A* conferences, papers that are initially submitted to not A* are rather the exception. I keep this similar in my group: we should primarily work on papers that could make it to A*, and only in rare cases work on papers that we estimate could never make it to A*. That being said, one can often improve and extend papers so that they become strong enough.
In general, the expectation is to publish regularly, finishing a paper and starting a new paper every 6 months is a good schedule. There will be overlaps due to peer-review, which is very beneficial in my experience as it limits the time you can spend on presentation, artifact

evaluation, revisions, and media work, as you already are working and want to continue working on your newer paper.
For A* papers, some group leaders in my area have 3 months of actual time investment until the submission as a target. However, 6 months for a paper in my area is still good. In most cases, approaching 12 months (or even exceeding it) is not great anymore and you should figure out with your advisor how you could optimize the process. If you are working on a paper project that requires longer time frames, you should pair it with other paper projects that can be realized in shorter time frames. This way your track record will have a more constant stream of papers listed in the end. Also note that, when you start and when you finish a paper is less relevant than the time it keeps you busy, so if you schedule things in between that is often better for your own efficiency. Papers for which you do not target A* initially, should take less time accordingly.
In general, as a PhD student you are aspiring to become an independent researcher, managing their own research. That also means that it is your responsibility to manage and keep track of time - but that does not mean that you cannot ask for help. On the contrary, if you see that a paper project is not progressing fast enough, ask your advisor for advice, try to get collaborators to help, i.e., take the steps necessary to such that the paper project progresses faster. Take these steps early, mitigating an exceeding paper time frame is possible if you act early, after 12 months this point has already passed.

Some advisors use a point-grading scheme for the PhD, where, instead of the number of papers, the number of points matters, and each paper gives you a certain number of points. My attempt at this would try to compute the number of “A* equivalents”, where 1 A* paper is 1 A* equivalent. When papers are rejected from A*, we often resubmit to A-ranked conferences. Very often papers are then accepted there that could also have been A* if we had continued working on it for a bit longer. So, that means that an A-ranked paper is not the same value as an A* paper but also 2 A-ranked papers are kind of more than 1 A* paper.
Hence I’d go with something like 0.6 for an A paper. Similar reasoning for B, I would go further down to around 0.45, and maybe still a bit lower for C and so on. I found that $\frac{1}{x^{0.7}}$ is a nice approximation where x is the conference rank. The CoreSec group average over all papers ever submitted is rank 1.5, so exactly between A* and A.

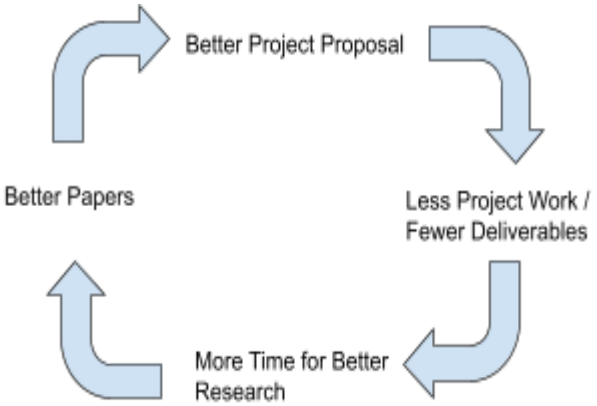


So if you adjust the average plot from above to a tier-normalized plot, you will see roughly this, where a PhD finishes with an overall score of 4.5 (= $\frac{6}{1.5^{0.7}}$). Again, you can add your own plot by taking the months of the final acceptance notification (after major and minor revisions), relative to the start of your PhD, and entering them in this plot on the x-axis with the formula above to determine the y-value for the corresponding accepted paper. Again,

this is just another perspective of how you can look at your track record. Overall, this contributes to a more complete picture of what a strong track record looks like.

As you can see in the curves above, there is a slight trend that towards the end the curves turn upwards. This is a great outlook for the future. If the curve looks more logarithmic, it would likely not be perceived as a positive outlook. Thus, for this positive outlook you want papers to be rather evenly spread across the PhD or skewed towards the end of your PhD.

Financing and Understanding the Advisor's perspective



While you are likely paid, at least to some extent, by some third-party funding, your advisor usually gets a salary from the institution and their job is not at stake with or without your success. Your advisor does not need (your) publications for their own personal success. Still, it can be important that your advisor is a co-author of your papers. There is this wheel of research and funding, where better papers lead to better funding, leading to more time for research. Of course this also works in the other way around, fewer papers, or less relevant papers will lead to situations where the group will have to pick up projects and project proposals that are more work-intense. This self-reinforcing cycle thus exists in both directions. Whether you have many great publications thus is more relevant for the future funding of the group and the future PhD students, than for your advisor whose position and salary usually is not affected by any of this. Still for the aforementioned reason, your advisor should still be on your papers. Another aspect can be if multiple PhD advisors are involved and one needs papers without the other to build up their track record to then be able to get better funding and open up more time for good research. In such situations, it is important to clarify upfront whether or not a collaboration is possible while meeting the requirements both advisors have to keep the research-funding wheel of their group running.

Your perspective as a student on different topics, such as the relevance or progress of your work or the bar you need to pass to complete your PhD, will necessarily be different from the perspective of your advisor. For instance, about the relevance or the progress of my work, or the bar I need to pass to complete my PhD. What I found helpful as a PhD student in this situation is to think about myself not in the same situation as my advisor, but in a situation where I am a PhD student supervising a bachelor and master student. Usually it is not the bachelor or master student deciding whether they're finished, but it is you making this decision. It is also you grading their work, judging how independent they were, and whether or not you would recommend to someone hiring them as a PhD student. Now this situation is more like the one of your advisor. If there's a disagreement between you and the bachelor or master student about the extent they mastered their studies, you immediately see that it is a matter of perspective, that you ask them to extend, revise, or restructure their thesis for their own good. Keep this in mind when getting feedback. An advisor who just doesn't care about

the quality of a master or bachelor thesis could also just let students pass with whatever they hand in. This is not different for the PhD.

In German, the PhD advisor is called “Doktorvater”. There is a reason why it is called like this and some PhD advisors I talked to, which are also parents, found parallels between these roles: you take over responsibility for someone, you make sure that you have the financial situation that you can support the person you took responsibility for, you show them how to get through (academic) life, you feel with them when they suffer from rejection, and yet there are many cases where leading this person that you have responsibility for to their own success requires setting up boundaries and providing guidance in ways they do not agree with in all situations. Most likely you can remember situations where your parents set up boundaries that you found too restrictive, that hold you back in life. I had many of those situations ranging from not being allowed to use the computer before homework is done to not being allowed out at night while my friends were. It seemed unfair and not right and not helping me move forward in life at the time but years later one can see how it maybe did and I can understand many of their decisions better now. Most importantly, I can understand that any boundaries and guidance they gave to me, even when I was really frustrated with them at the time, was just in their best interest to help me succeed in life. You will find situations where your advisor will set up boundaries and provide guidance that you do not (fully) agree with or that might even frustrate you at that moment. Then, keep in mind, their perspective certainly will be that they want the best for you and the boundaries and guidelines they set up are what they are convinced is the way to achieve this.

Most important, in my own experience, is to communicate with your PhD advisor on a regular basis in an advisee-advisor relationship. Ask the advisor regularly, what they think, where you are, whether you already should hand in, or not. Based on the communication with your advisor you will develop an increasingly precise understanding of “when you’re done” during your PhD. When you talk about this with your advisor and they still have concerns, take this as feedback to calibrate your understanding of the expectations. That’s what the PhD advisor is there for, to ask for advice, in this case: “Do you think I should hand in already or not?”. Not asking for advice is a lost opportunity here. Not wanting advice from your advisor or slipping into a mindset where you think your advisor cannot give you valuable advice (anymore) is also dangerous and, again, my recommendation is to think about yourself in a situation where you are advising a master student and the master student on the one hand still has to learn something from your perspective, and they believe they have nothing more to learn from you. My experience over the past 10 years is: We all gain our experiences at roughly the same rate, so I will never catch up to my former advisors. Even if I have more papers, citations, projects, etc., than someone who was more senior than when I was a PhD, I still look up to them and ask them for advice.

Project Work

When financing gets tricky, you pick up projects that are more work. Project work is something that the group needs to do, and as a group you should figure out who does the project work. In general, the same issues still apply, if you task your advisor with more project work they will have less time to apply for better funding that would free up your time to do more research. I have seen various types of project tasks: pure software development tasks, even where the software afterwards is just thrown into the garbage bin, leading bigger

software projects, doing consulting for project partners, producing MOOCs (in the form of a sitcom in our case). The time frames for this vary from very few hours per week, to full time work. In general, the less time, the better, as it leaves you more time to do research. I've spoken to many people from the community and the models here vary a lot. There are PhDs that work 40 hours a week on project tasks, and do research and work on their thesis in the remaining time. There are PhDs that spend 1 or 2 days a week on-site at companies working on tasks there that have nothing to do with their research or thesis work. It's difficult to make a generic statement but my own goal would be to keep the amount of teaching and project work per PhD student below 25% of their time, so below 10 hours. Whether you can offer such an environment depends on the financing and projects you have. Whether you can go much lower even more so. But even in a perfect world where financing is no problem, going to 0 hours is also not optimal, then I would recommend engaging more in teaching, as a PhD should be more than just paper publishing all day long, and you want to have more than just papers in your CV for that time frame. Project work can be beneficial here and it will be recognized by hiring committees you apply to, at least as an indicator of resilience and "this person knows how to get things done".

Sometimes you will hear that you should invest as little time as possible in project work but that is not really catching it. In many of the above cases you cannot arbitrarily shift around your hours. And if you have a project with more flexibility you might still not want to go for the minimum (as always). If your project partners are happy with your work, this opens up potential for new funding. Otherwise, this possible source of funding is likely gone. In some cases, your group might even have more direct financial disadvantages, e.g., if you don't deliver what was promised. So the solution here is to again follow something like the 80:20-rule. Do the work properly, but avoid perfectionism. Learning how others see your work is crucial here (and also for your later career). It takes some time to find your own 80:20 spot, i.e., how far you stay away from your own measure of "perfect".
Once you have project work to do in the group, it will not go away except if someone does it. Try to make sure that you don't create bottlenecks. Leaving more tasks to the advisor unavoidably fires back as this means less time to assist you with your papers. Also, you are a team, make sure to not push too much on one person, try to balance it - everyone in the team should feel that it is sufficiently balanced. If you feel you're doing too much, talk about it, come up with a proposal on how to rearrange the workload and see if that works better. But also, keep in mind that your own work will usually look to you like it is more than what the others have to do, if it doesn't that would be a sign to ask around whether you can help someone (and this asking whether someone needs help is also very good for the team spirit). Try to approach it as a team, since as a team you can get a lot of things done. Adopting the "Getting Things Done" mindset helps here as it allows you to push through annoying work, and it will reflect positively on the team. This will have a sustained effect on you, making you more successful when running into annoying work in the future.

Reviewing is Important, also for your own Success with Writing

Like a lot of things, having to review papers may seem as an additional burden. But there are a bunch of reasons why you should try to review papers when you get the opportunity.
When you submit papers for peer review, you get maybe 2-5 reviews. Someone has to write these reviews. This peer-review system of course needs some balance, meaning that it is a good idea to aim for writing at least as many reviews as you get yourself. At the beginning of

your PhD this will be less, towards the end of your PhD you should get closer to this amount, more senior academics then write more reviews than they get on their own papers. Your advisor likely will have a bunch of papers to review, depending on the group this may be anywhere between 20 and 200 papers to review per year. Typically, there are two different ways you can be involved in the reviewing: Either as a sub-reviewer, meaning that you're officially invited as a sub-reviewer into the online reviewing system and write your own review in there. Depending on the system your advisor may or may not see your review then, but this makes you more independent and more visible here. The other way is to "help with a review". Most conferences permit that another person is involved in the review. Typically they would read the paper, write a review. The advisor then also reads the paper (maybe less thoroughly) and makes up their mind on what to do with the paper, which scores to give, what recommendations to make. Then the advisor merges the review from the PhD student and their own notes. At this point the PhD student can get feedback on whether their judgment was too soft or too harsh, whether they focused on the right points, whether some issues they identified are not really issues. Typically you would be mainly "helping with a review" during your PhD and rarely, and rather later in the PhD or as a PostDoc, be invited as a sub-reviewer. After several years in your PhD you might even be invited as a PC or editorial board member yourself, first for smaller conferences or journals, and then for larger ones.

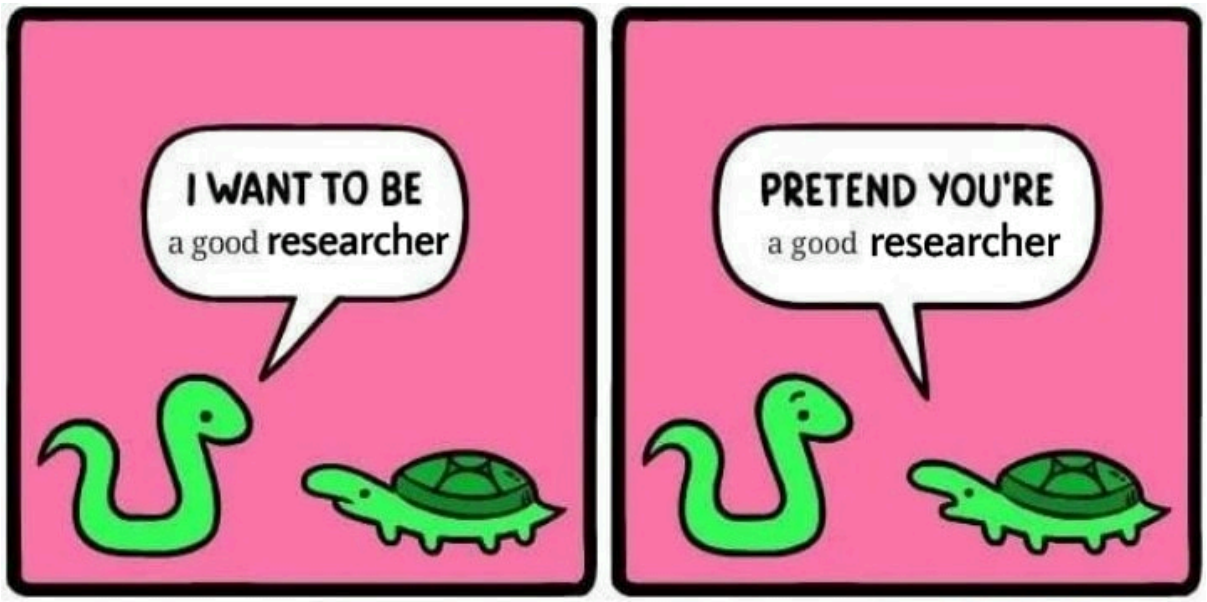
Like with the advisor-advisee relationship, switching the perspective from author to reviewer will also help you understand the other perspective. Reviewers are not malicious, but reviewers may see issues with your paper that you don't see or they see a higher significance for some issues while seeing a lower significance for contributions you made. Being yourself in the reviewer perspective helps you understand how a reviewer approaches the paper, what they look for and at which point of reading the paper the decision was basically settled and only slightly adjusted by anything later. This helps you again to write papers that are more convincing to readers (including reviewers) because you bring across points more clearly. In papers you review you might find that they do not cite your work, or some other work you are familiar with, properly. This is a problem, because this will reflect badly on the authors. Who knows what else they also forgot. Even worse, on one occasion some other researcher presented an idea in a paper that I had in a pre-print but had to remove because of page limit constraints for the final version. They did not cite me and when confronted about it, they said, well it's not peer-reviewed so we don't have to cite it. This is very problematic. Giving credits, also to pre-prints, is crucial. Comparing in a fair way, all of this boils down to respect for the other person who did the work. On one occasion I mixed up two references and got a paper rejected because the reviewer correctly noted that in the paper I cite, there is nothing about what I claimed would be shown in there, so they doubted my entire expertise on the topic and couldn't trust any of the remainder of the paper. When reviewing papers you also will find that sometimes authors cherry-pick numbers or present the best numbers that are complete outliers from their data set. Usually this is misleading and as a reviewer you would criticize this. Thus, also as an author you want to avoid this. Even worse, of course, is manipulating or faking data. Sometimes you notice in papers that something is off. You want to make sure that for your own works, things are transparent enough so that readers and reviewers can understand how you got the data and how they can reproduce your experiments to get to the same data.

Naturally, the peer-review system is not perfect. There was a recent paper saying it's like democracy, not perfect, but still the best option. In general, the idea of peer review is that it is a proxy for your future audience. The goal is not to make sure that everything that the paper says is 100% correct, which is impossible to achieve. The goal is to make sure that we don't distribute results in the community, among the potential readers that are rather clearly irrelevant, trivial, duplicate or erroneous results in the community, it is kind of like a spam filter. That means that results that are accepted and published can be irrelevant, trivial, duplicate or erroneous, but if you compare the set of all papers that are peer-reviewed and the set of all papers that are not peer-reviewed, you will find a much higher share of irrelevant, trivial, duplicate or erroneous results in the non-peer-reviewed set. You will find more cases of improper citations, of data that looks misinterpreted, misrepresented. I even have seen cases of blatant plagiarism where someone copied my entire paper, changed the authors, and published that in some shady pay-to-win journal (a journal with no peer review but you just pay to be published) - they even still had my acknowledgements there thanking the funding agencies who paid me.

Peer review is confidential, but there are some things to consider. When you submit a paper, hundreds of people in the program committee will be able to see it. But they all must treat it confidentially. If you review a paper, treat it confidentially. Therefore, you need to be careful when talking about these results to anyone. In general, nothing under peer review is to be shared with anyone. Exceptions exist for instance when involving someone in the review of a paper. You can also ask some other expert for an opinion (someone with whom you have an NDA, e.g., someone from your own institution), but make clear that this is under peer review and should be treated confidentially. Still, I would try to avoid this in general. No matter how you talk about it, think about what you would say if you would hear someone treating your paper the same way, sharing information about it during peer review, if the level of abstraction is very high this can be unproblematic, but the more concrete it gets the more problematic it gets.

For the review system, the declaration of conflicts of interest is very important. The idea of declaring a conflict of interest is *not necessarily* that you have a conflict of interest, but that in hindsight, someone could believe that you have one. So, even if you believe you can review the paper impartially, that does not mean anything for the declaration of a conflict of interest. The goal is to make sure that in hindsight, after the review happened, no one can say that the work was just accepted or rejected because this conflict of interest existed. Therefore, typically you have to declare your conflicts of interest: your (former) advisor(s), colleagues, co-authors from the past few years, friends, etc., but conferences typically provide a more extensive list of what constitutes a conflict of interest. Importantly, knowing who the authors are, by coincidence, does not automatically constitute a conflict of interest. Yes, this may introduce bias but you are also not the only reviewer. If you know who the authors are and they are your friends, they should be a conflict of interest because you're friends. If you know the authors and there is some lingering animosity, or an open fight between you, it should be marked as a conflict of interest anyway. The declaration of the conflict of interest is independent of whether you know the authors or not.

Managing a Paper including the Timeline and Structure



There is a truth to this. The thing is, you want to become a part of the scientific community, that means you have to assimilate, adopt methods and approaches by others. In some talks from our group you may have heard us joking about first deciding about the paper title and the logo and video before actually having the paper. There's of course some truth to this as well and I want to explain this here.

Science means sharing knowledge on a regular basis and 6 months is a good time frame to share what you have. Our team is strong enough so that in a 6-month time frame (on average) we produce results that often enough appear at A* and A conferences (on average). Hence, and this is something I experienced both from the student and the advisor perspective, it is important to first decide roughly when the next time to share your knowledge has come. One of the first things in my own PhD was the advice to focus on the USENIX deadline which was 5-6 months in the future at the time. No results, no clear paper idea, nothing. But this gave me a clear goal. When deciding what to do, it is not a great idea to work for several weeks or even months without a clear goal. After choosing a deadline, come up with a plan with milestones, until when you want to have done what part, what percentage of the text is there until which date, what percentage of the experiments. Try to stick to the timeframe and check with your advisor and your co-authors on whether to drop experiments if the timeline is in danger.

In the beginning you will get more advice on the choice of topic, but the best topics are topics that you come up with yourself and that you want to work on, that you would work on as a hobby anyway. It can be a valuable experience to work on a topic you don't like, but it is a much better choice for the papers during your PhD to come up with a good topic on your own that you want to work on, rather than a topic that you feel you have to work on but don't want to. If you don't come up with a good topic that comes with a convincing story for a paper (you need to convince other PhDs, PostDocs and most importantly your advisor!), your advisor or more senior PhD students and PostDocs will usually help you find a good topic. In particular, rather than working on nothing concrete for some time it is better to have any topic. Often, if you come up with a better idea for a paper in the meantime, you can

switch back and forth and balance your energy between the two and write two papers, the one you like more and the one you like less.

Different people have different approaches to papers. I would recommend starting with a speculative paper title and a name for the attack or defense technique. Give the child a name, then it is easier to talk about it. Then draft some speculative contribution points, speculative as you don't know yet whether you will be able to deliver on all of these. But that is fine, if you lose some on the way, you will find others instead. What is a contribution point? Check out papers that are peer-reviewed and accepted at your target venue and check out what contributions they claim in the abstract and introduction - many papers now have these contribution bullet point lists. Typically there is a claim like "we are the first to show that something is possible", "we provide the first systematic analysis of something", "we present the first end-to-end attack on something". This is a *novel idea contribution point*, it pinpoints what the new idea of your work is compared to the state of the art. Having a clear claim of what you are the first in is very helpful. You can have one or more of these, but you will also have others, namely *science contribution points*. Novel ideas need to be backed by science. So, some contribution points will focus on the scientific support you can provide to your idea, this could be an evaluation of the idea, an implementation, a design, some reverse-engineering, an end-to-end attack, a systematization, a user study, and many other things. The idea of these contribution points is only to support that your novel idea is valuable and that you can scientifically support it.

The next step is to do the practical work (e.g., experiments, implementation) and continue writing. It is important to not defer writing to the end. Writing an introduction draft should be possible at this point already and is a good idea. This helps you shape what you actually need to implement and which experiments you need. In my own experience, the most productive was a fully interleaved way of working, where text was frequently referencing yet-to-be-done experiments, and new experimental results influence again what text I write. In one case I even only did the initial experiments for a few days, enough to be able to tell what the outcome for each of the evaluation points will roughly be (maybe I got the numbers wrong but the general statements were mostly correct). In that case, I wrote 80% of the paper before actually doing any of the evaluation. This was very efficient as I didn't do any experiments I didn't need in the end. Of course, this approach is not always possible as you cannot always estimate the outcome of the experiments this well after initial experiments.
On the other side, in my experience it is far less efficient to strictly focus on experiments first for multiple months and only on the writing afterwards, as you will have many experiments that end up nowhere, clearly not in the paper, and this will be many hours of work that end up in a git repository maybe, where no one will take a look at the experiment, maybe also because it just is not that relevant after all. Being able to tell beforehand that this is an experiment that definitely has to be in the paper, because the paper story would greatly benefit from it, is a great help for deciding whether or not to invest time on that experiment. And that is something you don't know before writing down the paper story.
Going back to the meme above, approaching paper writing, I would recommend copying the style of other papers. You want to write a USENIX Security paper? Then make it look like a USENIX Security paper. Find maybe 3 papers that have a compatible story to yours and check how many sections they have, how long each of them is, how many figures, where the figures are, how long paragraphs are, how paragraphs are structured, etc., and choose one of them as a blueprint, take the other 2 papers as suggestions on where and how to deviate

from the blueprint. While learning, never just come up with your own way of doing things. After having written multiple papers you might have a paper which itself makes a good blueprint for a new one. But still then, I still went several times for other papers as blueprints, as they were fitting the story I wanted to write better than my own previous papers.
Structuring papers is one thing, structuring research the other. One danger is to try too much at once. Once I had a student who wanted to build a cache covert channel in JavaScript and instead of taking baby steps from native histogram, to influencing the histogram with a sender application, to a native covert channel, to a histogram in a modified JavaScript engine, to influencing that one with a native sender application, etc., the student wanted to build the full covert channel in JavaScript right away. That's doomed to fail, it is basically impossible to take this many steps at once. When working on Rowhammer.js I was in a similar situation where I wanted to induce bit flips with eviction but trying to take too many steps at once. There Clémentine Maurice advised me to take baby steps and first focus on the eviction, make sure it works, by measuring time, by measuring hits and misses, by using performance counters, only after that works, continuing with the next baby step. This is really important in research. Try to come up with super small incremental steps. Think about whether you can take a smaller step. Divide and conquer indeed works really well.

Especially for defenses but also for some attacks you can sink endless amounts of work into fully implementing your idea. It is crucial to remember that a paper presents an idea. It is not documentation for some piece of code. It is not describing some implementation, it presents an idea. If implementing that idea fully is too much work and your advisor agrees with you, then don't do it, write it in there. Separate idea from implementation. Papers get accepted for ideas not for implementations. It can still be a contributing factor but the nicest implementation gets you nowhere if they are not convinced by the idea. But a nice idea can be presented even with a very poor or even without an implementation. You will find that papers typically also try to make this clear in the text, speaking of research prototypes or prototype implementations, or proof-of-concept. This is a very clear communication to the reader that this is *not* a full implementation of the idea but just some aspects to demonstrate that the idea works. And this is also what you want to do.

When the paper gets longer and longer, don't worry about excessive length. It is normal to write 10-40% more text than you can finally fit in the paper. Your advisor and senior PhDs have experience with shortening the paper without losing content. This condensing step is actually important to make the text really dense such that a reader also sees that there is a lot of content in this paper and the paper is not excessively verbose or wordy. While shortening a paper doesn't take much time, you need to account for the time the advisor and other peers need to review your draft. In general I would aim for an 80% ready draft at least a month before the submission deadline to allow for revising, editing,polishing, shortening, and proof-reading. In practice things get delayed anyway but take into account that for some submission deadlines your advisor might have other deadlines in parallel or even submit multiple papers to the same deadline, maybe 1-2 per PhD student, that is a lot of papers to review. From the first reviews you get for a paper, if someone didn't like a part or wasn't fully convinced or found it difficult to read, this is not something that needs light editing, but you need to work thoroughly on the structure. I always found this emotionally straining to receive feedback that my text is not fine, I didn't want to become a writer, and I was happy with my draft already, thinking it was good enough. But keep in mind that the feedback you get is only there to help you make your paper better so that readers and reviewers understand it

better and will have a more positive attitude towards your paper. When you draw from the feedback that there is an entire section that is confusing or not convincing or where people explicitly tell you that it needs to be rewritten, that doesn't mean you have to throw everything away but it means that you have to take a more distant step. What helped me here were two strategies, one was: invert the order of everything. Especially when you previously wrote in blog style (the order of experiments, even the irrelevant experiments, everything in the order as you tried it and learned it), then inverting the order of everything, all the paragraphs and every paragraph in itself, then you end up with a more normal order for papers where the first sentence of the paragraph already gives away what you will learn from the paragraph if you would read it. This is great because a quick read of the paper then just requires reading the first sentence of each paragraph. If you realize that the first sentence of each paragraph doesn't tell you anything but that it is always the last sentence in a paragraph, turning it around will help a lot. The second strategy is to write down bullet points. Write down 2-3 bullet points for each paragraph, what the paragraph conveys, then take all the bullet point list, eliminate any duplicates, and order them by importance to the reader. Take this new order and apply it to the entire text.

If you discover a vulnerability, sending a brief mail to affected partners early can be an advantage, starting the responsible disclosure. This way you can keep them updated while you work on the paper. If this process happens after you finish your paper it is an additional effort that costs time and delays your next paper. Processor vendors by now usually expect to be notified 180 days in advance, but 90 days is the default everywhere else. Make sure this time frame fits between the date you notify the vendor and the first day of the conference, where the paper by the latest goes public. Vendors sometimes also provide you with additional information, which, if they allow it, you can still include in your paper. In general, I wouldn't have too high expectations. For most of the vulnerabilities we reported, the vendors either struggled to reproduce the results, gave up after a while, or refused to even try. You can invest some extra effort to help them reproduce it but keep in mind that they are not PhDs working in a highly specialized team of experts that mounted numerous of these attacks already. And even among your team colleagues, they might also take time to reproduce your results. So there's a big factor of overhead in there that they need, and a lot of help typically. Responsible disclosure doesn't mean that you offer them free education and training (in one case we had a vendor that didn't know what to do with a 'Makefile', but there are also less extreme cases). Responsible disclosure means telling them what you know, there is no commitment beyond that, so don't let yourself be guilt-tripped into offering them free support. You are just the finder, you are not responsible for the vulnerability, there is nothing you owe them beyond telling them.

I provide additional writing hints on https://gruss.cc/writing, more focused on the writing itself, working with LaTeX, the bibliography management we use in my group, and other linguistic subtleties, which I therefore do not cover here for now. Maybe I'll merge it here in a future version.

Getting papers rejected

In general, after submitting a paper, it is important to get started on a new paper, also for your mental health. We typically submit to conferences that accept 10-20% of the papers,

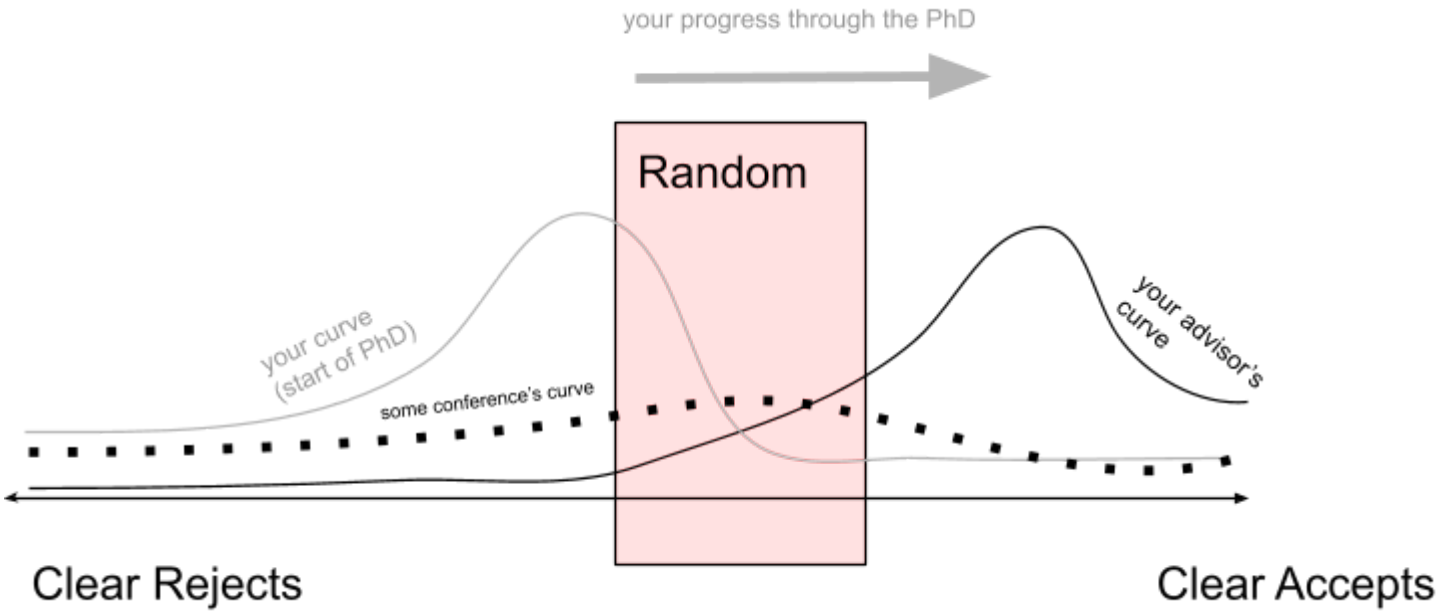
meaning that you should expect rejects. Since we are a very strong group, our acceptance rate is higher, actually close to 50% currently. Every person has an individual acceptance rate as well (just computing accepts per total submissions). For some PhD students in my group that one was very high, for others it was as low as 30%, meaning that on average their papers were rejected more than 2 times. This is a normal process and papers get improved with resubmissions. Some people also argue that during a PhD, you learn more from the rejects than from the accepts (similar as startup founders learn from every failed startup). Learning to cope with rejects is a crucial part of becoming more resilient (and thus becoming a PhD). The more papers you have “in flight”, the less painful it is if one gets rejected. If the acceptance of that one paper is the one thing that mattered for you for the past 12 months, then it weighs more heavily on you. Ranting about rejects is totally fine but you need to get back to neutral ground sooner rather than later, to get started on improving your work. As we discussed, the reviewers just try to do their best, you will sooner or later be a reviewer as well and there will be authors ranting about your review that you wrote with the best of intentions. Very often it is not fully clear why the paper was ultimately rejected. Possibly also because the reviewers weren’t able to pinpoint the core issue they have with your paper. In that case, it is up to you to reverse-engineer the reviewers and figure out where they took the wrong turn, where they understood something wrong, and then iron out those parts of the text in your paper. It is easy to say the reviewer is incompetent, or the reviewer just understood it wrong, the expectation on a PhD, especially in the later stages of the PhD, is that a PhD can go beyond a finger-pointing game and focus on a solution instead: Debug, reverse-engineer the reviews, figure out what went wrong, what they misunderstood, solve the issues in the text. The text is the only thing that the reviewers looked at, it is the only thing that you have to influence the reviewers, so use that to influence them in a more positive way so that they are convinced of your idea.

Especially long reviews take a long time to write. A longer review doesn’t mean that the reviewer liked your paper less; in many cases on the contrary: the reviewer liked the paper but found many flaws that should be fixed before publication. The more detailed feedback a reviewer provides, the more the reviewer is on your side. A reviewer who does not care about your work at all, will write a short review with little valuable feedback in there.

Improving a rejected paper is crucial. The amount of work for that depends on how clear the reject was and whether you downgrade to a lower tier conference or whether you try to fix the problems and submit to a same-rank conference again. Just resubmitting without any changes to a same-rank conference is something that rarely works. Most of the time you will get at least one reviewer again that you had the last time. And seeing that the authors did not take any feedback into account shifts the atmosphere of the internal discussion among the reviewers easily to “the authors do not care, then we also do not care”, which just wastes everyone’s time and gets you more rejects. When downgrading this can be a bit different as the bar to clear there is lower.

During your PhD you will get less and less support from your advisor and gain more and more independence, which is an important process, but it also means that in the beginning (stage 1) acceptances might feel easier and later on you have to work for them more (stage 2). On the other hand, this will become better again as you also learn how to polish papers and how reviewers read and rate your papers, improving your own acceptance rate then (stage 3).

This is also shown in the figure here.



For the papers a conference receives, some will be clear rejects, some will be clear accepts, for some there will be more randomness on whether they are accepted or not. This doesn't mean that the process is flawed. Think about this the other way around: imagine there would be a 100% clear cut between papers that will always be accepted and papers that are always rejected. That process would be really flawed as it would mean there is no way to improve a paper. This way we can improve papers from a clear reject, to a state where it has the chance to get accepted, to a state where it is very likely to get accepted, to a state where it will be clearly accepted.
When you let a PhD student without guidance write papers, their papers will be somewhere on this clear reject to clear accept scale, forming a curve if you write a lot of papers. Their curve will be quite low without help from co-authors and the advisor. The polishing from your co-authors and the advisor shifts your curve more towards that of your advisor, bringing you up into the range where with some luck you will get the paper accepted. During your PhD you learn more and more of those tricks and ultimately your own curve will look more similar to the curve of your advisor.

When working on a paper that takes a bit more time it is always a good idea to keep an eye open for short-term ideas that result in a paper faster. The most productive in my experience is to have a long-term topic that you can always work on, and then try to find short-term topics that might yield a quick paper sooner than the long-term topic. Being able to switch back and forth between those helps to not get stuck anywhere or when your progress depends on someone else making progress, then switching to the other topic where you can still independently make progress is a way to not lose efficiency.

After the PhD and Taking up the Advisor Perspective

The entire document focused on aspects and considerations that may help you during your PhD to build up a track record that is impressive and convinces a hiring committee. But what comes after that? By the latest when you get first offers from industry you realize that you

can earn a lot more there than in academia, while it may also make the impression of offering clearer and better working hour conditions. This is certainly true initially, but at least for the working hours, this appears to be more a question of hierarchy and management. Hierarchies without management typically end earlier, which also makes sense as only by running a team you can multiply your own expertise and experience. Working in a non-management position, the multiplier on your own expertise and experience will always stay 1. As soon as you take up management duties, your job is to make sure that things work. In academia, there are still PostDoc positions without significant additional management duties compared to a PhD student's, but some of them already have some management aspects, such as advising 1-3 PhD students. In a professor position, management duties are unavoidable. In industry you might be able to avoid management duties a bit longer if you want to. However, in both cases, as soon as you pick up management duties, working hours get more tricky. Of course this depends on the company and how things work out, but there might be situations where you have to invest a lot of effort over a short time span, or even be available outside your working hours for emergencies. The reason is quite simple: you carry responsibility for others. As soon as you carry responsibility it gets more difficult (not impossible, but definitely more difficult) to stick to precise working hour schedules.

In academia you also tend to earn less money, not an order of magnitude usually, but it is less. So why would anyone do that then? Same reason why you do a PhD. It is not about the money, not about getting some title, etc., the motivation must be different. A lot of professors have a deep passion for research and teaching. If spending a lot of time on these things is what you find meaning in, pursuing an academic career might make sense. Otherwise, rather not. Still, as a professor you will find less time for research than ever before. As said, the phase of writing first-author papers usually ends with your PhD. For me the teacher part was the most important one but I also enjoy research very much. And the goal then is to teach PhD students how to be successful in research, how to teach bachelor and master students, and you practice with them a lot. If you ask professors what they want to achieve in the next years, they might say something like, find some super nice research results with my PhD students, grow the group a bit, get a bit nicer funding, make the institute more visible, push the university up in rankings. Something along those lines. But these are not really personal goals, all of these have no direct benefit for them individually. When you ask them about personal goals, you hear from a lot of professors that they want to find more free time to spend with their family. This might or might not be very different from your perspective. It is certainly very different from the perspective of a lot of people, friends and former colleagues, that I talked to from outside of academia who often pursue more personal goals. If you take this into account, then it makes sense why academics opt for a worse salary and worse working hour conditions: they don't do this for personal reasons but they believe in the importance of serving society in this way. There were a lot of expectations expressed in this document, which are important to communicate, but keeping in mind that these do not serve your advisor but are only means to bring you to a track record that your advisor is proud of, a track record that fully merits an outstanding PhD degree.