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Future of Publishing

Publishing papers while keeping everything in balance: Practical advice for a productive graduate school experience

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Abstract

Pursuing a graduate degree is difficult. To succeed, students must overcome a myriad of ill-defined, and often unforeseen, challenges. One major obstacle lies in publishing their work. In this perspective, I provide a detailed description of my own working system that matured late in my graduate career but still paid dividends in terms of my publication record, funding success, and work-life balance. I also include brief vignettes of other topics that were crucial to my own scientific development. While I organized this essay as a series of "rules", I don't mean to imply that graduate school nor academia has a specific formula for success. Not only does it not, but as a first-year postdoctoral researcher, I can only speak to what works in graduate school through the lens of my own experiences. My experience is particularly relevant, however, because unlike many who have offered similar advice in the past, I drafted this perspective in the months that followed my degree. Rather, I offer these rules as a starting point for you to take, consider, and mold into your own framework. I am confident, however, that there is commonality among the ideas described here and the general habits of successful academics. In writing this perspective, I had three primary goals: (1) To add a more detailed, recent perspective to previous, more general essays on this topic. (2) To bridge an apparent disconnect between successful faculty and graduate students. Essentially, the advice in this essay may be obvious to a seasoned academic while simultaneously highly relevant, and interesting, to an early career student. And finally, (3) I hope to help dispel myths graduate students may hold about the innate talent or expertise needed to succeed in graduate school and to demystify the day-to-day work side of the equation. Simply put, I'm not a scientific outlier. But with good organizational skills, a diligent writing habit, and some invaluable mentoring, I made it to the light at the end of the tunnel (and into a career-progressing position). You can too.

Keywords graduate student productivity; work-life balance; graduate training; publishing; scientific communication; career perspective.

Graduate school is hard. It's confusing, challenging, and can feel like walking into a party where everyone knows each other and you didn't realize there was a theme. It's hard to know how to succeed or even what success looks like. Much of the oft-cited graduate school misery stems from this uncertainty. I don't think it has to be this way. Mentorship and experience, often of the trial-and-error variety, are key in gaining a better sense of knowing what to do, when to do it, and what you hope to achieve. Through a clearer understanding of where to spend your time and how to be most effective when you work, you can transform the mountain of graduate school into a series of more manageable molehills. So we're on the same page: my long-term goal, like many others, is a tenure-track academic job at one of the 222 R1 or R2 research universities in the United States (McCormick and Zhao 2005). As a 1st-year postdoctoral researcher, whether I achieve that goal or my trajectory shifts remains to be seen, but it won't be for lack of commitment. Perhaps that's my first piece of advice for having a productive, successful graduate school experience: fully commit yourself to your efforts.

Figure 1. A summary of the 12 rules for having a productive, well-balanced graduate school experience outlined in this perspective.

In this perspective, I outline 12 rules (summarized in Figure 1) that helped me wade through the chaos of graduate school to settle on a healthy, productive path that will (hopefully!) form the foundation of a successful academic career. While I focus heavily on academic "success", it is important to consider (and re-evaluate often) how you define success for your own experience. Your definition will likely be different from some of your peers and it should evolve with you as needed throughout graduate school. While many of the rules described here were developed in the moment, others only came into focus through the lens of retrospection. By "productive," I mean that during my PhD, I met my degree requirements, developed and funded a research system of my own, and published a dozen or so papers. Over my six-year tenure, this productivity wasn't as nicely balanced as it sounds. Rather, it all came in the final two years of my degree when my "system" was maturing—an outcome that I don't think was a coincidence. I would argue my newfound productivity stemmed from an increasingly refined approach to *how* I worked, a glut of data, flourishing collaborations, and a bit of luck. This bucks the notion I had early in my career that outsized productivity must stem from similarly outsized intellect or research talent. I'm sure it does in some cases, but I'm proof that it doesn't have to.

Still, my own path isn't fully resolved; it is, and will continue to be, a work in progress. By writing this article, my primary aim was to demystify what it means to work effectively through a detailed account of my own experiences. Tied into this was the need to address a disconnect between seasoned academics and early career researchers. Because academia has already self-selected for the general concepts included in this perspective among senior researchers, this essay may feel redundant and largely unnecessary to anyone reading it from that perspective. I'm also not the first person who has attempted to convey advice to future graduate students (e.g. Gu and Bourne 2007, Huey 1987, Stearns 1987). I am, however, a rare early career voice in this discussion having finished my degree less than a year ago. Similar perspectives are also largely rooted in broad pieces of advice and lack crucial specifics. While I don't avoid this entirely, my goal was to provide a combination of both specific strategies for working effectively alongside broader ideals. My final aim was to add my own perspectives to questions that I don't think are discussed as widely as they should be. Does getting a lot done in

graduate school have to come at a major cost to work-life balance? Is it possible to be both happy *and* productive in graduate school? Based on my experience, I would argue the answers are "no" and "yes, definitely." While this guide is focused on graduate students and academia, the general ideas aren't necessarily career, professional stage, or path-specific. Anyone in a professional setting can take something away from this discussion and/or a thoughtful examination of their own working habits.

(1) *Identify your priorities*

Rarely have I encountered a graduate student who doesn't work hard. Unfortunately, hard work doesn't necessarily translate to useful productivity. The most important decision(s) you'll make throughout your career, especially in the first few years, are of priorities. This isn't where you *want* to spend your time, this is where you *should* spend your time. Start by having explicit conversations with your advisor(s) and committee. It is important to trust these people (you selected them for a reason!) while also remembering that you know yourself, your own skill set, and aspirations best. You should come away from these discussions with clear ideas about where to devote your effort. For instance, if you're a 2nd-semester teaching assistant working on a PhD, you may need to spend 40% of your time on teaching, 40% on coursework, and 20% on reading the literature and developing your specific dissertation plans. That's okay. Your priorities should be re-evaluated whenever your professional situation changes (e.g., you receive a research assistantship) or every ~6 months, whichever comes first.

(2) *Develop a system for working effectively*

Careful planning is essential to academic success. It's easy to spend time on tasks that don't matter in the long run while neglecting those that do. For the most part, we like to do things that are easy and/or straightforward while avoiding tasks that are difficult or unclear. Often, however, those more difficult tasks are exactly the ones that we *should* be spending our time on. For me, I chased far too many threads early in my career and wasted my fair share of time by not buckling down on the most promising ones. I also waited too long to sit down to write my first paper or even fully commit to becoming a better writer. Some of that was waiting for the right data, but a significant portion was simply not realizing just how important publishing (and writing) would be to my career. In this section, I lay out the foundation for how I work. There is certainly no one size fits all strategy. My approach is just an example, and ultimately, your goal should be to identify what works for you, then refine and improve your method as you climb the academic ranks. For additional insight into the diversity of ways that academics work, I recommend perusing the "How Molecular Ecologists Work" interview series (http://www.molecularecologist.com/tag/how-molecular-ecologists-work/).

For me, staying on track begins with an overarching rundown of the major writing projects I have in process or planned, the current status of each (e.g., complete draft, submitted, in revision, etc.), target deadlines for submission (if applicable), and brief progress notes (see Figure 2A). These writing projects are typically linked to empirical data sets so this list doubles as an outline of major research goals. I re-write my list four times per year (January 1st, April 1st, July 1st, October 1st) and manuscripts that were published or grants that were submitted are removed. All remaining items are re-ordered according to an updated timeline. When a new project arises, it's added to this list and carried forward until finished. To plan my weeks, I use an online tool (Google calendar is my preference) that includes scheduled commitments, both personal and professional, and a rolling task list spanning the next two weeks or so.

Each working day, you have a set amount of time "currency" to spend. And like money, it's best to spend wisely. For me, I have found it works best to explicitly account for where I spend my time, letting priorities for the day inform how I structure my efforts. I begin by transcribing the day's tasks from my online calendar to a handwritten list, ranking them by their importance as I go. A typical day consists of 6-10 "tasks"—some are easy to accomplish (e.g., sending a specific email), some require a set amount of time (e.g., attending a seminar), and some are large, long-term efforts (e.g., working on a manuscript). After making my list of tasks for the day, I look at my scheduled commitments and consider *realistically* how many hours I have available to work. Next to meetings, seminars, etc., I note how long I expect them to take and subtract these pre-committed amounts from my working total for the day. So, say, after scheduled commitments, 5.5 hours remain, next I subtract another two hours for general work day activities (interruptions, eating, etc.). This leaves 3.5 hours of time to "spend" on what really matters. Since I lack the attention span for long periods of sustained effort, I break this total into 30-minute intervals which I allocate to tasks based upon importance (see Figure 2B). For instance, if a particular manuscript is my top priority for the day, it may get 4 of 7 intervals (two hours), while responding to emails, a teaching plan for next week, and a funding report only get 30 minutes each. If a task doesn't get completed when planned (and doesn't have an imminent deadline), I don't worry about it. Instead, I move it to a future date to be revisited. No task gets removed without careful consideration. Is it finished? Has the situation changed and it's no longer important? If the answer to either question is "yes," it's gone.

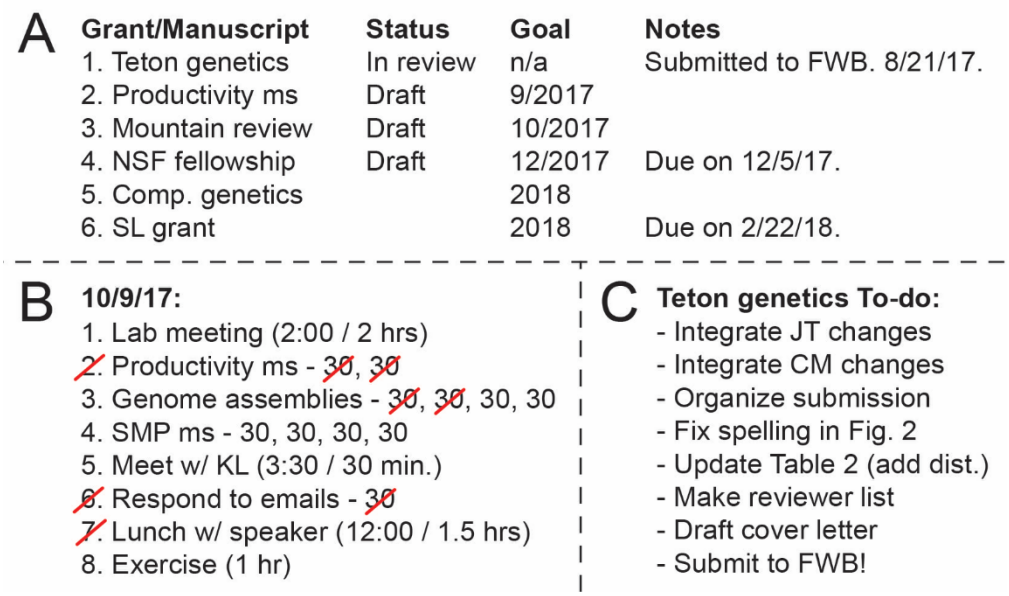

Figure 2. I make three lists to stay organized, manage my productivity, and track progress. A) My writing list is updated quarterly and keeps big picture research, manuscript, and grant goals on track. B) Each morning, I transfer the day's tasks from my online calendar to a journal and allocate how much anticipated free time to devote to each task (in 30-minute intervals). C) Every study, grant, or presentation gets its own project-specific list. When finished, project-specific lists may span just a few to hundreds of tasks.

(3) *Cultivate a writing habit*

At the end of the day, we're professional writers (García-Granda 2013, MacDonald 1994). The sooner you take that to heart, the better off you'll be. I recently asked a prominent figure in my field what piece of advice they'd give to early career scientists. Without hesitation, they replied: "Develop a writing habit." When I look back at my own grants and papers, I can't agree more. When I started writing with a purpose every working day, my career trajectory shifted. Writing grants and papers are daunting tasks. They require mountains of effort with hard-to-define progress. Regularly scheduled effort is the only way to get them done in a timely fashion.

Let's focus for a moment on the "habit" part. This is key because it's more than just writing—that's a great start—but it is equally about developing a routine that allows for plenty of writing time in a productive environment. For me, I'm most effective early in the morning so I write for around two hours every day, typically from 7:00–9:00 AM. There's a ritual to this work. I go somewhere with the right ambience, I drink my tea, decide which writing project(s) needs the most attention (see rule 2 "*Develop a system for working effectively*"), put in my headphones, and dive in. Above all else, I absolutely defend this time. I consider it an appointment I have with myself every day. Only my supervisor or an emergency can impinge on it. I don't schedule meetings or appointments during it, I don't take phone calls, and I try to not respond to emails or let small tasks get in my way. For me, it's important that I *don't* work in my primary office or lab space during this time as it's too easy to be distracted. As I see it, there are three main benefits to this approach: (i) Because it's early in the morning, social engagements don't affect my writing time as seemingly always happens if I try to write in the evening. (ii) There is an undeniable mental health benefit that comes from progress early in the day; often, success in my writing window jumpstarts success in other areas of my day. And (iii) I get *a lot* of writing done. When I'm starting a paper, I can usually get ~500 words down per hour, which adds up quickly. To be clear: when I say "writing," I'm not always referring to *actual* writing. It's more about doing whatever is necessary to make progress on projects that will result in either a submitted grant or published manuscript, so this time can also include figure making, editing, formatting, etc.

For the actual act of writing (here I do mean putting words on the page), many tomes have been written about being effective at it generally (e.g., King 2002, Kress 2003, Silvia 2007), as an academic (e.g., García-Granda 2013, Sword 2017), and for publishing scientific papers (e.g., Bourne 2005). I have summarized the published resources included in this perspective in Table 1. To this body of work, I'll add four brief thoughts. First, practice doesn't make perfect, but it *does* make you a more efficient, thoughtful writer. Early in my PhD, I started writing a review of my field (see Hotaling et al. 2017a).

Table 1. A summary of the resources for early career scientists included in this article.

Author(s)	Year	Topic	Type	Focus
Huey	1987	Advice	Article	Graduate students
Stearns	1987	Advice	Article	Graduate students
Lawton	1992	Advice	Article	Graduate students
Erren	2007	Advice	Article	Doing your best research
Gu & Bourne	2007	Advice	Article	Early career scientists
Smol	2016	Advice	Article	Early career scientists
Hotaling	2018	Advice	Article	Working and publishing effectively
King	2002	Writing (general)	Book	The act of writing
Kress	2003	Writing (general)	Book	Learning to write
Silvia	2007	Writing (general)	Book	How to write a lot
MacDonald	1994	Writing (science)	Book	Thoughts on academic writing at large
Bourne	2005	Writing (science)	Article	Publishing scientific papers
Garcia-Granda	2013	Writing (science)	Book	Writing impactful papers and grants
Pautasso	2013	Writing (science)	Article	Writing review papers
Zhang	2014	Writing (science)	Article	Writing research papers
Weinberger	2015	Writing (science)	Article	General thoughts on scientific writing
Mensh & Kording	2017	Writing (science)	Article	Structuring a paper
Sword	2017	Writing (science)	Book	The act of writing

It didn't require any data or money to write, and I found several experienced co-authors [see rule 5 "*Build (and take advantage of) a strong network"* below] to help in the process. While it would ultimately take years to be published, the lessons in writing and collaboration I learned from it were invaluable. Later, once my working approach was more refined, it only took a year to write another, related review with a new set of collaborators (see Hotaling et al. 2017b). Second, recognize honest, thorough feedback for what it is: someone cares enough to sit down with you and your writing and tell you what's wrong with it. Without saying it, that person is telling you that they care about your success. Embrace that and them (see rule 9 "*Embrace feedback*" for more on this point). Third, and perhaps most importantly, write a shitty first draft (SFD). Don't worry about minor details, do only minimal editing, just get the words down. You can fill in details and refine issues in subsequent drafts. When the SFD is complete may be a good time to solicit quick feedback from your advisor or a collaborator—make it clear you aren't asking for edits, but instead you'd like them to give the paper a quick look for any obviously missing components. Finally, track your progress! When writing the SFD of a manuscript, I track my daily word count. This psychological trick only takes a few seconds and can transform how you feel about the time you spend writing (I've written 376 words today!).

(4) ***Manage your projects (and deadlines) effectively***

It's difficult (at best) to succeed in academia if you only work on one project at a time. As your network and collaborations grow, you'll be involved in projects on many fronts, often with non-overlapping sets of collaborators. This is a good thing, but, as a general rule of thumb, you should always be wary of spreading yourself too thin. To manage your projects effectively, consider three goals: (i) Carefully identify your role in each project and prioritize which ones you should spend the bulk of your time on (hint: whichever ones you are lead-author on and/or those that contribute directly to your thesis). These decisions are best discussed with your advisor(s) and collaborators you trust. (ii) Next, identify some appropriate deadlines. Early on, it's best to take your own estimates of how long something will take and at least double, if not triple, them. Remember that for some deadlines (e.g., submitting a proposal to your committee) you should ask those involved how much time in advance

they would like to have it (two weeks minimum) and aim for that. (iii) Once you've established which projects should take priority and key deadlines for each, your next goal is tracking the tasks for each project that you're responsible for. Again, I make project-specific lists (I use "Notes" on my MacBook Pro) and write down everything from structural changes (e.g., re-frame/broaden Introduction) to small details (e.g., fix typo on map; see Figure 2C for an example). When a task is completed, I put a check next to it and move it to the project-specific "Done" list. This serves as both useful accounting to keep track of what still needs to be done and another important metric of progress. Looking back at the growing list of completed tasks and the dwindling list of things to do reminds me how far the project has come and makes it easier to see it through to the end. For manuscripts, this "end" is not when the paper is submitted for peer review, but when the corrected manuscript proofs have been sent back to the publisher, the copyright agreement is signed, and there's nothing left to do but wait for publication.

(5) ***Build (and take advantage of) a strong network***

Collaboration and network-building are key to long-term success. Networks can extend your productivity, yield the necessary resources (human and otherwise) for solving complex problems, and provide an important support structure during trying times of your academic career. However, the template for *building* networks is rarely discussed beyond generalities (i.e., "networking is important!"). To be fair, it's a hard subject to pin down and for some, the networking side of academia comes naturally. For others, it's a major struggle. Here are some general rules for establishing and maintaining connections throughout your career. First and foremost, make time for socializing with your colleagues. If that sentence makes you shudder, take a moment and listen: being a good colleague who plays well with others is half the battle in academia. Like anything, your social skills improve with practice, so say "yes" to that next invitation. Go to conference mixers and happy hours. You may be pleasantly surprised. Also, there is no need to limit yourself to face-to-face interaction. Scientific networking on platforms like Twitter is an increasingly common, and effective, part of the modern research experience. Second, don't treat people like economic equations. You never know how someone's expertise, connections, or friendship can benefit your own path (or how you can influence theirs). In an often too cutthroat academic landscape, I, perhaps naively, still believe that a rising tide lifts all ships. There don't *have* to be winners and losers in every situation, and you'll do well to avoid treating interactions that way. Third, don't be afraid of people. You didn't wind up where you are without many people thinking that you deserved to be there. Internalize that knowledge and remind yourself of it the next time you're wondering if you should send that email or introduce yourself to someone. Go do it.

Similarly, don't be afraid to propose an idea. Have a review you want to write and you'd like a more senior person in your field to be a co-author? Ask them. One useful tip: when emailing a potential collaborator, discuss it with your advisor first, and perhaps have them give your introductory email a read before hitting send. Last but not least, follow through on your commitments. This cannot be stressed enough. Doing what you say you'll do, when you said you'd do it, will endear you to collaborators in a way that little else can. For me, it also helps that I don't mind doing the "dirty work" on manuscripts my collaborators and I are working on—managing revisions and co-author comments, putting together the SFD of sections that need it, any reference or journal-specific formatting, etc. This is another way to build goodwill while keeping things moving forward, as these are often sticking points where publications stall because people don't have the time and/or inclination for them.

Tied into this networking discussion is a common graduate student pitfall: the perception that you need to do everything on your own. This feeling is partially based in a useful ideal: struggling is an important part of the training process and helps cultivate perseverance, which is likely the most important skill for academic success. But, there comes a time—probably around the 3rd or 4th year of a Ph.D.—when some self-evaluation is in order. At this point, it's time to stop struggling for the sake of struggling and start thinking critically about the skills you possess. There's no place for being humble or underestimating yourself in this discussion; you need to be realistic about the skills (there are many!) you've acquired. I encourage you to first take your own internal measure, then reach out to your mentors (your advisor, collaborators, etc.) for added perspective. Me? I'm an efficient project manager, fast writer, and I make a heck of a figure. I'm also adept at developing and maintaining productive collaborations and I'm usually a quick study of new things. Notice anything missing? Lots of things! I'm rarely, if ever, the most knowledgeable person in a scientific discussion, I don't possess encyclopedic knowledge of anything, I'm not particularly creative or thoughtful about experimental design, and my statistical talents are passable at best. That's okay. I'm still learning new things, I have collaborators and peers who excel in the areas where I'm weak, and we rely on one another for success.

Finally, remember that many—if not all—of the struggles you experience in graduate school are shared by others. Networking isn't just for CV-building, networks are also important reservoirs of support and easily accessible pools of additional perspectives that you can learn from. Since academic research has no one-size-fits-all strategy, it may also be useful to reach out to more senior

students or postdocs for a casual meeting to get their perspective on a specific issue you're having or ask about how they approach their work. I have never turned down one of these meetings and I doubt many others have. Your network also doesn't need to be limited to people at your home university, conference friends, and collaborators. We, scientists and humanity, are more connected than ever before. While this age of connectivity can have negative impacts (e.g., it's easier than ever to compare your CV to everyone else's—I'm looking at you, Google Scholar), there are positive aspects too. On Twitter, a myriad of tips, ideas, and relevant discussions are shared among scientists every day, and early career scientists should check out the hashtag #phdchat (and similar) for a curated experience aimed at students. A wealth of resources for scientific development are also being produced and shared freely. For instance, the Broad Institute's CommKit is a collection of resources designed to cultivate successful communication across the sciences (http://mitcommlab.mit.edu/broad/use-the-commkit). Similarly, the *PLOS Computational Biology* "10 simple rules" collection contains dozens of short articles focused on specific, useful topics (http://collections.plos.org/ten-simple-rules): rules for structuring papers (Mensh and Kording 2017), writing science (Pautasso 2013, Weinberger et al. 2015, Zhang 2014), doing your best research (Erren et al. 2007), advice for graduate students generally (Gu and Bourne 2007), and many more. I'd also recommend reading Stearns (1987) and the reply from Huey (1987), as well as Lawton (1992) and Smol (2016) for additional early career advice from a range of perspectives (see a summary of these resources in Table 1).

(6) *Seek an existing data set*

Early on, it can be particularly useful to seek out an existing data set—perhaps something small (but still interesting) that your advisor or a collaborator doesn't have the time to publish. This won't be possible for everyone, but if your situation and network allows, it can be rewarding on many fronts. Above all, it provides a hands-on, publishable training opportunity that doesn't require time or resources to collect. I have a difficult time devoting myself to purely learning-based pursuits so it helps immensely if the learning opportunity will translate into something tangible for my career (beyond a new skill). In this regard, an existing data set provides a perfect fit, as the experience gained spans data analysis, making figures, writing, and ultimately, the publication process (e.g., drafting a cover letter, responding to peer reviewers, etc.).

During my career, I've been lucky to form a close professional relationship with an aquatic ecologist who spends much of her time collecting data for specific management objectives. These data go into reports for funding agencies and would form the basis for solid publications if she could find the time to write them. Her situation provided ample opportunity for a motivated graduate student (me) to collaborate and help her move projects forward. This relationship yielded invaluable training in the nuts and bolts of scientific publication, the analysis of community ecology data, and spawned my first publication (Tronstad et al. 2016) which was followed by two more the next year (Hotaling et al. 2017c, Tronstad and Hotaling 2017). Our relationship has been successful because we enjoy working together (we are now close friends outside of science), I had a data-deficit and she had a glut, and I was highly motivated to learn from her and support what she needed. In turn, she looked out for my best interests as a student. This last part is essential to such a collaboration. The person you are working with must recognize that you are a graduate student, that you have extensive commitments beyond your shared project, and that you're still learning. It's best that the study not be something that is time-sensitive, as it can (and likely will!) take much longer to finish than you expect at the outset.

(7) *Have something "fun" to work on*

This rule can be a key, but often overlooked, facet of long-term success. You should, of course, generally be working on research that you are passionate about. But, day-to-day, even the most inspiring research includes enough minutiae, roadblocks, and mundane tasks to swallow your excitement if it isn't regularly stoked. Aside from surrounding myself with passionate, interesting people, my practical solution for this is to spend one or two 30-minute blocks each day on something that is enjoyable, easily progressed, and career building. The second part of that bears repeating: this is something that you can make progress on with relative ease. There's an important mental health benefit tucked into that idea. My darkest academic times have always come when I felt I was spinning my wheels and not accomplishing anything. Having one or two projects on the back burner that are interesting and easy to move forward gives me crucial small victories while bigger projects play out in their necessary, albeit frustrating, start-and-stop fashion. For me, fun projects are typically writing-focused—whether a commentary like this (you're reading my current fun project right now!), a popular press article, or a review. For others, this could be an interesting coding idea, a website, an outreach project—really anything that is professionally beneficial but not too complex. It's imperative that the fun project not become another burden weighing you down. When I get stuck on a prioritized project, I switch to the fun project, make some progress for half an hour, then switch back, usually with a refreshed outlook. And when a fun project sees the light of the day (e.g., Hotaling 2016), it's just icing on the cake.

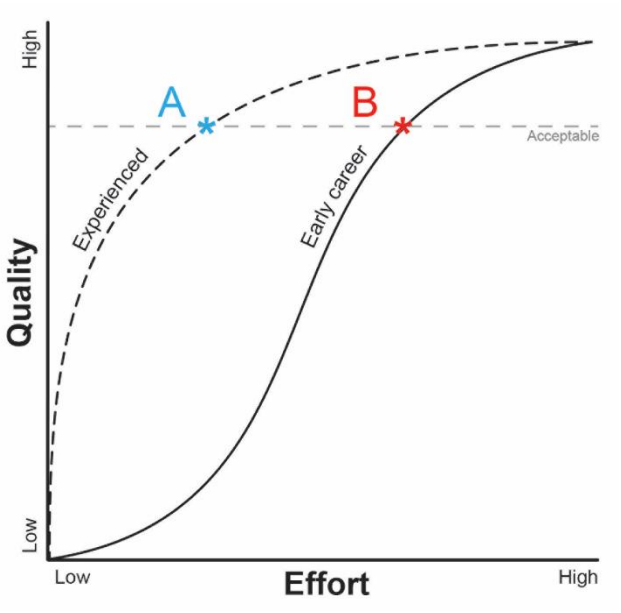

Figure 3. A theoretical plot of effort versus quality for early career (e.g., graduate students, solid line) and experienced (e.g., tenure-track professors, dashed line) researchers. A and B) Experienced researchers can reach acceptable quality of a manuscript, for example, with much less effort than early career scientists. This is normal and as training continues, the curve for early career researchers will increasingly shift left. This difference is largely rooted in practice. With every iteration of manuscript or grant-writing, you will learn to write more efficiently, anticipate reviewer comments, and generally become more adept at creating higher quality products more easily.

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(8) ***Recognize when it's good enough***

One vital skill you'll develop during your career is the ability to gauge when something is good *enough*. Let me be clear: I don't mean you should take shortcuts and submit manuscripts or give talks before they are ready. Don't do that. Rather, there comes a time in every project where more effort will add, at best, only incremental value (Figure 3). Your goal is to learn to recognize this inflection point and either pass the project off to a collaborator when you reach it or move on to the project's next phase (e.g., journal submission). Early on, you'll *think* you've reached that magic point—and perhaps you have for your ability!—only to discover from a colleague's feedback that there is still plenty left to do. This is normal. It's part of the process. As you become more experienced, your sense of "finished" will increasingly align with that of your colleagues and community.

(9) ***Embrace feedback***

I alluded to this earlier, but it bears repeating: embrace feedback and the people that give it. Aside from persistence, you would be hard-pressed to find anything more important to long-term academic success than taking feedback well (spoiler alert: there will be a lot of it). First, it's imperative that you recognize criticism (even when it doesn't feel constructive in the moment) for what it is: someone cares enough to tell you the truth instead of taking the easier road of smiling and nodding. All feedback and criticism will not be constructive, but the instances of critique just for the sake of critique are few and far between. Even if someone's delivery isn't ideal, they have something useful to say. Instead of trying to figure out why they are wrong, you should listen closely. Ask them to clarify if you don't follow their point and do whatever you can to help them help you. No perfect paper has ever been written, and the perfect talk is yet to be delivered. No matter what stage you're at, there is *always* room for improvement. Early in your career, your ability to self-diagnose issues is particularly limited and sets you up for disappointment. Where you see a polished, well-crafted manuscript that you spent tens (or hundreds) of hours on, your colleague may see neon signs of misplaced hypotheses, run-on sentences, and murky points.

This is a normal juxtaposition and it's two-fold in origin. First, your colleagues haven't spent weeks obsessing over every detail. They are seeing it all with fresh eyes. Second, and more importantly, your readers will typically have much more experience than you do. They've written, edited, reviewed, and received feedback on orders of magnitude more writing than you have. And, luckily for you, they are going to tell you about it. It will be tough to hear. You'll feel like you're not good enough, or that they made some kind of mistake when they decided to work with you (see "imposter syndrome": Parkman 2016). Don't listen to those voices. You're plenty good enough, and they didn't make a mistake. You just have a lot of room to grow. You'll look back in a few years and feel incredibly thankful that they took the time to help, and you'll pass those lessons on to the next group coming up behind you. Finally, if a culture of feedback doesn't exist at your institution or within your laboratory group, you can be the seed that helps to establish it. Talk with your advisor about incorporating feedback on presentations or budding manuscripts as a regular part of your group's interactions. And if that isn't in the cards, reach out to your peers and see if they would be interested in helping you create a group for regularly scheduled, supportive feedback.

(10) ***Consider your publishing "strategy"***

If you don't already know, you'll quickly learn the gravitas that major journals like *Nature* and *Science* carry in the scientific community. These journals publish some of the highest-quality, most impactful research and publishing in their hallowed pages is admired (and coveted) for good reason. But, as a graduate student, you should try to avoid stressing over that. Instead, focus on doing the most high-quality, impactful research you can and publishing it in a timely, consistent fashion. Note that I'm not advocating for quantity over quality, nor vice-versa. While sheer numbers do matter, you'll likely be best served by repeatedly publishing high-quality papers instead of seeking out that single home run or writing many forgettable ones. A note of caution here: your publishing strategy will depend heavily, if not exclusively, on your advisor. Here, I'm making a significant assumption of student independence that may not exist. This can be a significant challenge with few solutions if student-mentor strategies are mismatched and you should pursue very open communication with your advisor to avoid it. However, should an issue arise that cannot be solved within the mentor-mentee frame-work, both your committee and other campus resources can be important resources for mediation and/or student advocacy.

Generally, scientific publishing strategies fall into three categories (Figure 4): (i) "broadcast", (ii) "Goldilocks", and (iii) "saving it for *Nature*." Of course, my names for each belie my own opinions, but let me explain. The (i) "broadcast" publisher seeks to publish every data point, no matter how small, in any peer-reviewed journal that will take it. (ii) "Goldilocks" publishers get things out when appropriate and their work commonly appears in medium to top-tier journals for their field but rarely, if ever, in the highest-end journals. The (iii) "saving it for Nature" publishers spend their early career chasing major publications. This is a particularly high-risk strategy, as unless your big paper gets through where you hope it does, you could easily be left with no published record of your graduate work. I named the "Goldilocks" strategy that because in my experience as a student in an ecology and evolution graduate program, it seems like the "just right" attitude. If you hit a home run and your study finds its way into a big journal—great!—but don't chase it. The experience you gain from repeatedly publishing papers in solid journals will not only benefit you, it may even look better to future employers.

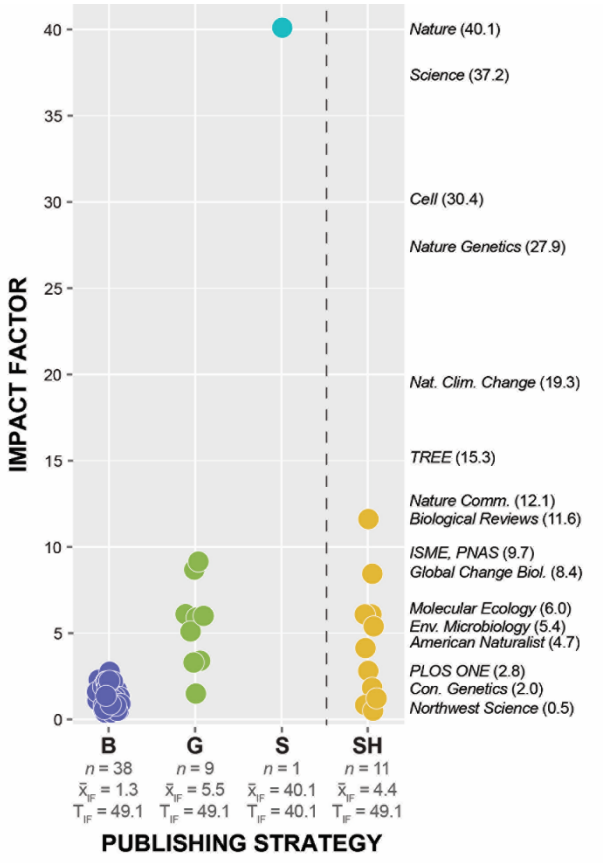

Figure 4. Three general publishing strategies for graduate students (B, G, S) and my own empirical PhD data (SH) are shown with each publication (colored circle) mapped by impact factor (a measure of the the yearly mean number of citations to recent articles published in that journal). B: "broadcast" publishers, high output with consistently low impact. G: "Goldilocks" publishers, several high-quality papers in medium to top-tier journals for your field. S: "saving it for *Nature*" publishers, holding off on publishing in pursuit of difficult-to-obtain, ultra-high impact publications. Summary statistics include: n = total publications, $\bar{x}_{IF}$ = mean impact factor of publications, T_{IF} = total impact factor "points" for each strategy. Impact factors from 2016 are shown for a subset of primarily ecology and evolution journals (right-hand side).

(11) ***Finish papers!***

What you've published matters immensely. In your first few years, you'll get a pass—as you should—for not publishing much. But as the years tick by, that pass will turn to curiosity from peers and employers, possibly manifesting as a key limiting factor in your career progression. Much has been written about the merits—or lack thereof—of the "publish or perish" nature of academia (see recent perspectives: Brischoux and Angelier 2015, Fanelli and Larivière 2016, Nabout et al. 2015). But, at least for now, publications are the game so if you're going to play, it's worth spending significant

time and effort on them. For many graduate students, the real challenge doesn't lie in devoting time to papers; it lies in finishing them. My doctoral advisor addressed this semi-jokingly with a saying: "Science isn't real until it's published." In my short career, I've seen many studies make it to the final stages—solid data, interesting conclusions, drafted figures—only to stall. Why? Publishing a peer-reviewed paper takes a ton of effort, a good deal of patience, and the capacity to get through the process with your self-confidence intact.

But I think there's a bit more to the phenomenon of stalling manuscripts that is at least partially rooted in our own scientific predispositions. There seem to be four general groups that most of us fall into: thinkers, collectors, analyzers, and writers. After finishing that sentence, odds are you know which tribe you belong to. Falling into one group over another isn't a bad thing; science needs all four. But members of each group need to be wary of the pitfalls that come with their respective territory. As a writer, I, in many ways, move through the development of ideas, collecting data, and analyses just to get to the writing part. This generally works out pretty well because I don't linger too long in earlier stages. But if left to my own devices (i.e., without mentors, collaborators, or reviewers), key supplementary data, more robust analyses, or additional levels of investigation might get passed over. The other groups all share the same potential for getting stuck at the stage they are most excited about instead of making it to the end. Knowing is half the battle so your first goal is to recognize which camp you fall into or at least where your working pre-dispositions lie. Second, you should seek out your complements. Thinkers are great for seeing the big picture and developing new ideas. Collectors may be excited about helping to generate some data for a project you can work on together. Analyzers are important resources for sorting out what to do with your data. A writer in your midst can start framing out the manuscript while you collect that one more data point or add an analysis. No matter which category you fall into, you must publish your work in a timely manner. And, ultimately, while success in graduate school does not require you to become a master of all four groups, it *does* require you to be a sufficient practitioner of each.

(12) ***Take care of yourself, be patient, and avoid comparisons***

Throughout graduate school, you need to be realistic about your time and goals while also taking care of yourself, mentally and physically. For significant portions of my own career, I have taken advantage of my university's counseling services. As a graduate student, these services were free, easy to schedule, and incredibly valuable. If you think counseling could help you, spend a few minutes looking at the available options and give it shot. For the physical side of things, I try to find time to go for a run or exercise in some way every day, even if it's just a walk. These mental health and exercise "tasks" go on my working list for each day and are treated with the same importance as any professional item (see Figure 2B). My dissertation research included significant backcountry fieldwork, and these forced breaks, though still relevant to my work, always recharged me mentally since no matter how much I wanted to, I couldn't take my laptop into the field. In the absence of trips, I still take breaks from time to time, sometimes an hour or two, sometimes a weekend, sometimes much longer. The point is, it's important to treat your mental and physical health with the same focus you give your research. Make time for that yoga class you'd wanted to try, a Saturday afternoon hike, or coffee with a new friend. Remember that your life is happening now. It isn't starting at some future date when your degree is finished. Work hard, but make time to enjoy yourself too. These things matter, and the benefits will spill into your research.

Also, remember that you can't do it all in one day, week, or year, so don't pretend like you should. The common student stress trifecta has three axes: impatience, jealousy, and reduced self-esteem. Graduate school can, and will, seem competitive and you may catch yourself—consciously or not—feeling a twang of jealousy when your peer gets that fellowship, publishes *another* paper, or does virtually anything of note. Or, similarly, despair when you need to rewrite an Introduction *another* time. I want you to know a few things. It's okay to feel a bit jealous or bummed when things don't go your way. One key to success lies in recognizing negative emotions for what they are, embracing them for a moment if you need to, then working past them. It's also immensely helpful to surround yourself with people that are supportive and collectively celebrate successes. Academia may feel like one giant competition, but in reality, there's space for you to succeed regardless of what your peers do or don't do. Seriously. The landscape of jobs and opportunities is far more expansive than you may realize. Don't believe me? Sign up for email lists like ECOLOG-L (https://listserv.umd.edu/archives/ecolog-l.html) or EVOLDIR (http://evol.mcmaster.ca/evoldir.html) and watch the flood of opportunities arrive in your inbox every day. When the time is right, you'll find a professional home. And honestly, if you let it, being around successful people can be an inspiring opportunity to learn. Be humble and consider asking them about their success. Why do they think things are going well? Are they doing anything differently? See if they wouldn't mind giving you feedback on a proposal or upcoming talk. But, most importantly, never forget that you belong where you are. Being there is your choice, and no one is doing you a grand favor by tolerating your presence. You've already passed a litany of checkpoints to wind up in a position to even be considering your own

productivity as a scientist. So, when negative voices creep in, try to ignore them and refocus your mental energy on something productive.

Concluding remarks

Graduate school *is* hard. It's supposed to be. There will be times where it's mentally and physically exhausting, often simultaneously. But the process can also be one of the most enlightening, important, and rewarding experiences of your life. An uncertain future breeds anxiety, and there will be plenty of uncertainty to go around. The enemy of anxiety, however, is action. You have the opportunity to look at your future, identify professional goals that you want to pursue, and take steps every day to make that distant ideal a reality. In this perspective, I've outlined my own roadmap (summarized in Figure 1) for being productive throughout graduate school while also doing the best I could to maintain a healthy perspective. I failed plenty of times on both fronts but with every setback, I picked myself up and kept at it. While these rules proved particularly effective for me, like anything, your mileage may vary. And make no mistake, this guide only looks polished after considerable retrospection, feedback from others, and copy-editing; rather than being developed (or written down) with clear intention, these "rules" were stumbled upon during my own experience and have been refined since. If you're excited about what you're doing and work with purpose every day, grants will be funded, papers will get published, and jobs will be offered. It won't happen overnight, but learning to publish effectively while keeping the rest of your life in balance will help you get where you want to go with fewer roadblocks.

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