

Above all, I think of a problem list as a dedication to creativity. Try keeping your own—you may find, as I have, that merely putting a question down on paper can imbue even the most whimsical thought with the seriousness needed to pursue it further.



Alexander Perry

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## My Research is DUE Tomorrow!

*Elizabeth Milićević*

In the heart of most academic semesters at Haverford, my daily calendar usually consists of the following items: two to four hours of class lectures or problem sessions, one office hour, one thesis meeting, two on-demand individual student meetings, and one of the following: department meeting, colloquium, college committee meeting, or full faculty meeting. These daily events typically total four to eight hours—and this is only *scheduled* calendar items! Given the vast array of teaching and service demands—which renew themselves *daily*—*where exactly does research fit?!*

My goal in this article is to provide concrete suggestions for *regularly* incorporating research into your own incredibly busy academic year, and to help you ensure that even limited research time packs a punch. But first, we need to figure out how much research time we should realistically add to that calendar. I'll do a simple back-of-the-envelope calculation, which you should adjust using your individual parameters.

Haverford faculty are expected to split their time approximately 50/50 between teaching and research, using Julianna Tymoczko's convenient algorithm for partitioning 100 based on the annual course load [Tym20]. The typical 14-week semester at Haverford is followed by one week of exams, totaling 30 weeks of full-time academic instruction

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per year, during which my calendar looks roughly as described above. Assuming I take four weeks of vacation per year, this leaves 18 weeks available for full-time research, parsed approximately as 16 weeks in the summer and two weeks over the winter break. At 40 hours per week, I can thus manage to collect 720 hours of research time during breaks between semesters, but this is still less than half of my 1920 annual working hours. To make up the deficit, **I commit to eight hours per week of research time**, throughout my 30-week full-time teaching period.

### Research Lessons from the Calendar

To cultivate strategies for carving out research time, let's reflect on why my calendar looks as described during the academic year. Although I would joyfully do nearly all parts of my job without any extra structure or incentives, there are simply lots of things which are out of my control: classes meet for a specified number of hours per week, advising year-long senior theses is part of my annual course load, students have certain expectations of my availability, and basic functionality requires that regular department and college business be conducted. But even shadow items which are NOT specifically written into my daily planner also manage to get done *every single day*—why?

As humans, we typically do things *today*—even those phantom to-do items that aren't scheduled directly in our daily calendars—because we face the consequence tomorrow: I'm giving a lecture tomorrow so it needs to be prepared, I'm meeting a student concerned about their performance in the course tomorrow so I need to finish grading their midterm, and the deadline for that NSF letter of recommendation is 5:00 p.m. tomorrow. On the other hand, each of these activities behaves like a gas, expanding into any and all available space and time! Here's a tip to change its state of matter:

- **ALWAYS put off until tomorrow what doesn't need to be done today!**

That's right: a license to procrastinate! The more efficient you're required to be, the more efficient you'll become. Your students are very unlikely to appreciate the additional four hours of effort you poured into making your 1:00 p.m. lecture 5% better by preparing the day before instead of that morning. To *correctly* quote several relevant adages: **done is good**, and perfect is the *enemy* of the good! If you **plan** to be rarely early but never late on all teaching and service tasks, you'll find more openings in your schedule today, for research. So leave everything until the last possible minute—*except your research*.

Research is rarely an emergency. That's not to say that pressing research deadlines don't exist—they occasionally do! Examples include having a collaborator on the job market, an undergraduate research assistant applying for graduate school, a coauthor going up for tenure, a grant proposal or project report due, or agreeing to submit your article to a themed special edition of a journal. You might also

feel an acute need to claim ownership of your intellectual property by a fixed deadline, such as if you have committed to speak about the work at an upcoming conference, or if you are in danger of getting scooped. *Lean heavily* into every opportunity to schedule an arXiv submission date on your calendar, and treat these deadlines with sacred reverence!

### Choose Research Hours Wisely

Many people (including earlier iterations of myself) embrace the “research day,” defined as an eight-hour day dedicated entirely to research, on which nothing else is permitted to be scheduled; e.g., no pop-up student meetings, no discussions with department colleagues, and no dentist appointments. While I actually still *nominally* embrace this model to set aside at least one day per week which cannot be consumed by the same torrent of daily calendar activities as on class days, I have since converted to the model of scheduling **daily research time**. In particular, I try to:

- **AVOID clumping all eight hours of weekly research into a single day!**

One key reason that I abandoned the “research day” is practical: in ordinary times, roughly half of this dedicated “research day” is actually consumed by attending my local research seminar at the University of Pennsylvania, which doesn’t (usually) directly contribute to finishing active research projects.

But the most important reason to spread this time throughout the calendar is that *it benefits me mathematically*. Keeping daily contact with a problem embeds it sufficiently deeply in my brain that random (disjoint) times in the day can lead to the critical “aha moment” required to push a project forward. Thinking about the same project multiple times per week also minimizes the start-up cost required to remind myself of what on earth I was thinking whenever I pick up the project again (not to mention the incredible amount of “cosmic energy” I need to resume a project cold turkey after a 15-week hiatus between mid-January and May!). Moreover, bingeing on math research just doesn’t reliably work—technical writing doesn’t flow as quickly as composing an email, and it’s difficult to confine generating an original idea to a prescribed narrow window of time.

Even if you insist on adhering to the “research day” model, I would strongly encourage you to consider breaking it up into one six-hour period on your official “research day,” in addition to four 30-minute research sprints on the other weekdays, to maintain more consistent mental contact with your project(s).

### Create Research Emergencies

Once you’ve optimally scheduled your eight hours of weekly research, it can still be tempting to let other things creep into that time—when *else* will I ever get the chance to go to the dentist? To combat this temptation, I use the same trick that makes it so hard to schedule any research time in the first place; namely, by creating many intermediate research-related deadlines for tomorrow.

Having collaborators is especially useful in creating minor frequent research “emergencies.” (For this purpose, it can be especially helpful for at least one collaborator to be in an academic position in which their personalized weekly number of research hours is strictly greater than yours!) More specifically:

1. **Schedule a weekly meeting** with your collaborators (which then counts toward your eight research hours!) to discuss your current progress.
2. **Make sure every collaborator has explicit “homework”** when the meeting concludes, with a concrete assignment deadline.
3. **Maintain contact on the collaboration between weekly meetings**; e.g., raise new questions in a group email, or work directly in an online platform which syncs to your coauthors’ files and notifies everyone of recent changes.
4. **Treat your collaborators as you would a student** whom you’ll see tomorrow in class—*prioritize them!* For example, respond to your collaborators’ email messages within 24 hours.

Conversely, if you have a solo project you need to prioritize, turn this advice on its head to minimize your distraction by time-consuming collaborative projects. In this case, you should also be up-front with your collaborators: precisely how long do you expect to put your joint project on the back burner, and what *can* you realistically contribute in the interim?

If you’re getting back into that solo project or haven’t yet started a collaborative one, you’ll need to create regular research emergencies yourself. One method I wholeheartedly endorse is converting certain scheduled contact hours into stimulating research discussions (students enjoy this more, too!). For example, I now frame most of my year-long undergraduate thesis projects around current research problems on which I am momentarily stuck, need more data to formulate a conjecture, or otherwise might not have time to prioritize in my own eight hours of weekly research. But the most effective way to trick myself into picking up my research again tomorrow is to *leave loose ends*:

- **QUIT working smack in the middle of an example, before the pattern emerges!**

It’s much easier to leave for the day *after tomorrow* (or sadly, even much longer) a research project which is in a tidy holding pattern, having thus perhaps lost a bit of its luring mystique. Be sure to leave yourself sufficiently many breadcrumbs that you’ll be able to quickly resume this example tomorrow, however!

### Generate a Research Feedback Loop

Even after you’ve scheduled eight effective hours of weekly research and you’re faithfully sticking to those calendar appointments, how can you make the most of this precious time? To deepen the impact of each research session, the first thing I suggest is (re)reading the excellent advice that

David Zureick-Brown has offered on maximizing research productivity amidst all of the competing demands of the academic year [ZB20].

But I do have some additional concrete recommendations for working in a manner which will more fully engage the emergency feedback loop that helps any research project maintain a sense of urgency. In the absence of a more brilliant scheme, here's my recipe:

1. do one more example,
2. share the notes with my collaborators, and
3. immediately TeX it up in the cloud.

In particular, I recommend some implied organizational structures. First, keep all of your notes online, easily accessible, with files intuitively labeled for all collaborators to immediately view. If you work on a tablet, either enable autosync or regularly export your files to a shared cloud location. If you work on paper or a board, scan your notes religiously, or respectively, export photos of each board as you erase. Regular activity in shared folders, photos of additional examples, and handwritten notes sketching ideas for proofs will spur collaborative dialogue between scheduled weekly meetings. As an added bonus, you're always equipped to maximize random cracks of time (e.g., waiting in that dentist office on a non-“research day”), since you'll always have the latest research updates at your fingertips. Of course, this assumes your notes will actually make sense to your collaborators—and your future self—so do work as legibly as you can, and include explicit citations to references where possible.

Conversely to my suggestion to **STOP** examples early, I also suggest to **START** typing things up early (but leave loose ends between work sessions here, too!). Even before you know what the theorem statement is or how the eventual proof might go:

- **TeX early and often!**

Writing will refine your own ideas and stimulate discussion with your coauthors. Having one central document to which everyone is contributing at least once per week (ideally more) provides excellent scaffolding to sharply focus your precious research time.

More concretely, all of my TeX files—no matter how far from the finished product—are vibrantly color-coded with clearly articulated to-do lists. Each coauthor is assigned a color (for making any comments, but also for requesting specific “homework” of other coauthors). Each anticipated edit is also assigned a distinct color (red = mathematical gap, blue = expository change, orange = missing reference, yellow = example needed, and so forth). When all color has disappeared from a working TeX file, it's ready to post to the arXiv, by definition. Whenever I open an *unfinished* TeX document, depending both on exactly how long I have to work and what state my brain is in at the time, quickly skimming for certain colors enables me to immediately dive in where I can have the most impact that day.

## Find a Research Juggling Pattern

There are other global pitfalls which can prevent my eight weekly research hours from being productive, in the sense that they don't converge sufficiently quickly into a finished paper. One possible obstruction is if you don't really like the problem and/or the chemistry is off in the collaboration. If you're not in too deep to wonder about falling prey to the sunk cost fallacy, *you should probably just abandon ship!* If you can see a path to actually achieving a publication out of the project, on the other hand, I suggest you simply **rip the bandage off** as quickly as possible. After the paper is *done*, you can reflect on the experience and apply any lessons learned to your future selection of projects and/or collaborators.

More commonly, my productivity suffers because I am simply trying to juggle too many projects simultaneously. The formula that works best for me is to focus on exactly two projects at a time—any more and I find I'm just “faking it” on (at least) one project, cramming the night before my “homework” is due, with correspondingly (and noticeably) subpar results. To guarantee that there is always something in the pipeline to completion, it works best if this pair of projects is comprised of:

- **one project where the math is “done”** and we're simply trying to write everything up; and
- **one project which is more preliminary**, in the exploratory (fun!) phase.

During the semester, I try not to work on projects which are still rather speculative more than one day per week (though limiting time on an exhilarating new idea is admittedly difficult!). Conversely, for the one project nearing the home stretch, **I modify my TeX file five days per week—like a freight train!**

Overall, I have found that if I maintain an appropriate balance in the nature and number of active research projects, if I work on problems that I find fascinating, and if I generally enjoy both the company of my collaborators and the solace of working solo, these eight hours of weekly research time provide a delightful respite from the daily grind imposed on me by my calendar, even during the most chaotic points in the academic year.

## References

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## Credits

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