1 Introduction

Writing a Ph.D. dissertation is a daunting task. But my experience was not that extremely hard; for my case, the hard part was not with the writing, but with the research process. This was much, much harder than I had expected — and I heard similar things from my friends who got their Ph.D. degrees ahead of me.

But for the writing part, believe me — it can be *strangely* fun. Writing is a great process that conveys your thinking to other people. Of course, there are other ways to convey your thinkings; presentations, discussions, lectures, and so on. However, the point of writing is that it is like a construction process that eventually leads to a *great* building. If I rely on analogy, presentations and lectures are similar to creating small rooms and facilities *inside* your building. Only with writing, you can organize them into a huge building.

In this manuscript, I intend to lay out my lessons while I was writing my Ph.D. dissertation. Well, to be frankly, I do not think that my dissertation writing turned out to be a quality one. But my writing experience has been felt great most of time. And I want to share my experience — particularly in terms of what you need to prepare — with other ABD[1] students out there. In addition, I want to talk about technical tools out there for dissertation writing. Different people use different tools but the using them was effective on me during my dissertation writing.

1.1 Other guides and tutorials

Some popular ones are:

- Tomorrow's Professor: Preparing for Careers in Science and Engineering

  This book is a classic. Actually, I did not buy this book for the simple reason of "being-too-expensive." Instead, I subscribed for the e-mail list which turned out to be pretty helpful. Check out the link at `http://cgi.stanford.edu/~dept-ctl/cgi-bin/tomprof/postings.php`.

- Getting What You Came For: The Smart Student's Guide to Earning an M.A. or a Ph.D.

  This is another good book for any graduate students, particularly for Ph.D. students. And I hear good praises about this book from my colleagues too. Personally, one problem I found later was that I had not quite fully understood what the book was actually talking about; only after I met the situation myself and went it through, I could fully understand what the author really meant. (for example, explanations on the experience examples for a comprehensive exam. The highlight on the miscommunication issue — between what committee look for and what students tend to go for was good in the book, but somewhat abstract to apply to your own case.)

[1] Informal acronym for all-but-dissertation

2 Thoughts and tips for writing

2.1 What is a Ph.D. dissertation?

The answer can be simple: it's a Ph.D.-level research work. But what exactly is this Ph.D. level work?

Actually, there exist a number of great guides about Ph.D. research itself — The "Tomorrow's Professor" and "Getting What You Came For" books will be good references and you can google with the keywords like "research methodology." My opinion is that I am not in a very good position to discuss about the details of Ph.D. research — you do need a mentor here.

However, I might write some about how you do this "research stuff" based on my own experiences. So make sure to read other good materials or talk to other great reserachers around you.

2.1.1 Study vs. Research

For my case, and including my colleagues around me, a Ph.D. students often experience a number of difficulties in case they simply think that research is an extension of study to a higher-level; if you keep working hard, then you will eventually reach the goal.

But this is not. Research has a number of aspects different from study — or learning process.

With research, *direction* of your work is very important. If you passed your comprehensive exam, you already sensed it many times since the exam is primarily about whether your work is heading into a *right direction* or not. That is why your committee members spend a long time discussing your research question before the exam since those questions shape the direction of your research work.

In analogy, planning your Ph.D. research is similar to a case of a traveller planning on a long trip. You may want to go to New York City; or you may want to visit Chicago or Los Angeles and so on.

Suppose you decided to go to New York City. Then what kinds of things do you need to prepare for the travel?

First, you need to consider your current location. The direction to New York City differs *depending on your current location*. For me, I live in State College, PA. Then I need to travel east. Suppose you are in Washington, DC. Then you need to travel northeast. What about London, UK? The direction now becomes west.

Your comprehensive exam is primarily for checking your direction is correct or not. A number of people make mistakes of saying "I need to go west" while they are in Washington, DC. Some people are too ambitious — then they make a mistake of announcing "I want to go to Atlantis" which is almost non-existent.[2]

Note that this game is totally different from study. When you study, you do not need to worry about whether the materials in front of you might be totally *useless*. However, for

[2] Of course, this person might make a historical achievement of finding the lost continent somewhere down the sea. However, you cannot try this with your Ph.D. research.

research, this direction is very important since you might waste years and years with a wrong direction!

Therefore, even if you passed the comprehensive exam a long time ago, you need to double-check if your research direction is correct. And you need to present the justifications in your dissertation. This is very important — nobody wants to work hard for years, later to find that those efforts were useless.

2.1.2 Importance of your research question as a correct direction

Did you notice this when you were at any academic conferences? Why did people ask you questions like "Hey, what is your research question?" In short, this is the number-one method that Ph.D. people use to communicate with each other — even without any common backgrounds or prior knowledge on the research topics.

Note that this is the same process with writing your dissertation. Your research question needs to be narrowed down as a workable Ph.D.-level research question. And your research question shows what kind of direction you are heading into; it conveys the "directionional" information to other researchers.

And remember that your research question can be changing as time goes on. The big theme will remain mostly the same, but you will have several sub-questions from the big theme question. As your research goes on, you will update your research questions (especially sub-questions) based on your findings and learnings.

[REWRITE LATER]. And this update process shows your research journey very well — and can be a good storyline for your dissertation *in terms of* directions you took at important milestones.

2.1.3 An everyday example of a research case:

You might think research process is complicated and difficult to learn. But, interestingly, most people are good at research in their daily life. I wan to show you one example from my own experience: fixing my old 98 Altima with 200K miles on.

Symptom from observation: one day I noticed that my car is having a problem. I was cruising on a highway at 65-70 mph. When I was climbing uphill, the engine sputter a little and lose power momentarily. The tachometer showed a drop about 100-200 rpm and quickly recover to the normal level. When the uphill becomes flat of downhill, the problem went away.

Obviously, I had a problem with engine combustion. But how can I solve this problem? You now need a research process.

What is your question? high level question and narrowed-down question?

From some engine problem to some temporary engine combustion problem

How do you "narrow-down" this problem? More observation, data collection.

Refinement of your research question: more narrow-downing on the "combustion"

based on the theory, combustion needs three elements: fuel, air (oxygen), and fire (ignition).

One data collection: When the fuel tank is full, the symptom gone. It returns when less than 1/4 remains.

Question refinement: what kind of combustion problem with “fuel” does the engine have? (since it is related to amount of fuel in the tank.)

Question further refined to: test: pressure from fuel is causing the problem? Assuming that: other things (fire, oxygen) are fine. How do you know? Spark plugs replaced 3 months ago, air filters clean, no error code from oxygen sensors or air-related sensors.

Let us test the hypothesis. How?

Idea: Something is blocking? then what can block the fuel and lower the pressure?

Going back to manual, fuel pressure is created by fuel pump. Other blocking elements to the combustion chamber? There are fuel filters and injectors.

What about filter? Since the data show that I replaced it 4 years ago.

Hypothesis to test: Clog in fuel filter might be creating lower fuel pressure.

How you test this hypothesis? Replace the filter with a new one.

The methodology: go to a mechanic’s. Ask him to replace the filter. Cost $70.

Experiment: Empty the fuel tank up to less than 1/4. Go the same uphill on the I99. Keep 65-70mph.

Result: No futher engine sputter. No power loss. RPM stayed as normal.

Discussion and conclusion: We found a symptom related to simple fuel filter changes as a proposed solution. For engine sputter problems, there might be other sources, but to identify the fuel filter clogging problem, fill up the tank and check the fuel pressure.

2.2 Write regularly, but not that much

One thing you will realize after you are done with your first dissertation draft — is probably that you have been writing one page per day on average (double-spaced, 12 pt.).

But please note that this measure is “on average”. Sometimes you might be writing a lot, with your fingers gliding smoothly over the keyboard. Of course some other times you might be looking at the blinking cursor for hours and hours without typing anything at all.

The point of writing, in my opinion, is to realize that this is a mental process of pouring down the flow of your thought into an organized form. And like it or not, your mental process is dominated by your cognitive state at this moment. First comes your subconsciousness. You cannot control it but somehow you will notice that your subconsciousness plays a big part with your writing performance; sometimes you have a lot of thoughts but sometimes not. This is because not all of your thoughts are created from your consciousness. If your subconsciousness is not feeling well, you will be facing a strange paucity in the amount of any thoughts in your brain.

Therefore, you cannot avoid writing almost nothing when you do not have any thoughts to write. This is actually very natural; when there is almost nothing in your brain, stop writing. Do something else. A good news is that your subconsciousness is still working even when you are sleeping. When your subconsciousness creates sufficient amount of thoughts, you will be naturally writing a lot.

Second, your thoughts have water-like streaming characteristics. They are not like a stack of materials stored inside a closet, as we typically imagine. When your thought comes up, you need to “save” it somewhere because it is flowing and going away soon. Of course you can

retrieve it from your memory later, but a lot of time it is hard since it requires a queue (or a key as in a key-value pair in computer science) to access the stored memory.

For this reason, when thoughts are coming up, try best not to let them flow away. Sit down and write — at least several words (which can be a queue for easily retrieving all the thoughts you are having right now). If you don't have computers nearby, use a pencil and a piece of paper.

And a habit of writing down right at the moment when thoughts are coming up helps the current flow keep going. This is important. If the stream dries up completely, you will be having a hard time taking the water from deep down the well of ideas. But if you keep writing — not too frequently but sufficient enough to keep a very shallow thought stream — then your brain will keep rollin' on.

So the point is that you do not stop writing completely, especially for a long time like a week or so.[3] If writing your dissertation feels like too stressful, work on "writing" something else. Keep your brain warmed up — but just enough to avoid complete freezing.

2.2.1 Working hard for writing?

However, sometimes, actually more than frequently, your brain needs a break. If you observe yourself carefully, you will see that your writing performance pattern shows a lot of fluctuations even for a day. One strange thing is that your brain needs a lot of energy to work on writing. The brain can be energized only when you have (i) sufficient amount of quality food *and* (ii) a lot, lot, lot of break (such as sleeping).

So working up too late and getting up early to meet other schedules is not a good strategy when you need to write some important things. From my experience, it was better to sleep say, for 10 hours, and efficiently work on my writing for two hours, than to trying hard to write something for 6 hours after getting 6 hours of sleep.

And another strange thing is that you need a get-away break sometimes to keep your brain fresh. What you notice at this point is that you actually cannot write anything. And you will probably see that you cannot do other things easily as well and even reading a gossip story about a celebrity will feel like a burden. Then you do need a reboot as you do sometimes with your computer. For me, if I keep thinking about driving four hours to New Jersey for a Korean hot spa trip, then it is usually time for a "reboot" myself.

But most students, including me, make a poor decision of working harder and harder to overcome this situation. Well, it might be needed for a military exercise where a failure might mean life or death, but this only make the situation worse when you work on research. Even in a military setting, I think generals planning strategies must sleep sufficiently. That's the way brain works.

[3] This can be different when you are writing a paper instead. For paper writing, a process of "stop writing for fermentation" can be helpful to upgrade your work into a quality one, as if fermentation transforms milk into tasty cheese. Refer to Varian [1] for more information

2.2.2 Write some other stuffs

Unfortunately, becoming a *good writer* takes a long time. I am experiencing this as well; as an international student with English being my second language, this is much harder for me than my English-speaking colleagues. To make matters worse, my native language (Korean) is quite different from English in every aspect; to be frankly, I sometimes envy my Chinese colleagues because Chinese is closer to English in terms of its similarity of grammar, not to mention people from countries speaking Indo-european languages.

But in academic writing, it is your reasoning skill that has to come first. Training your brain into generating a stream of well-organized reasoning thoughts takes a huge amount of time. 10,000 hours? [CITE]

Therefore, write something all the time. Anything is fine. Diary, notes, e-mails, and so on. But one of the best writing practice can be keeping an online blog. Blog postings are typically longer than other form of online writing and this is the environment that induces your brain to organize your thoughts.

In addition, reading books is important for improving your writing skill. Creativity usually starts with imitation. When you read a lot, you will be equipped with raw materials for better writing. When you want to take a break, feel free to read. For academic writers, reading can be regarded as another form of writing practice.

2.3 Writing in some other forms

Some of my friends are actually very good at this. They use Powerpoint slides extensively — like writing down your thoughts, ideas, titles of nice articles, etc. onto Powerpoint slides, rather than using a word processor or other note-taking applications (such as Evernote or OneNote).

The advantage of using slides can be twofolds: first, laying out bullet-points is usually easier than writing sentences or paragraphs. Second, you will save time creating your presentation slides later when you can use these Powerpoint-based notes as a draft.

Since the flow of your thought is important with oral presentations, writing “thoughts” directly down in the form of slides can be helpful for your future presentations — and easier than creating presentation slides after going over your paper (which has to include a reorganization process of your thoughts).

Interestingly, this was not working very well for me; I guess this is due to my personal tendency that I usually write more words than are typically put into a presentation slide. However, the *idea* of laying out bullet-points can be helpful for organizing your thoughts. For me, this worked for my literature review. When I found out several interesting articles, I usually open up Microsoft OneNote window and start writing down with bullet-points using indents. (You might use word processors or other tools as well)

For my literature review note, I do not put much. I put several important keywords or describe my thoughts with several words or a sentence at maximum. When I am done with this, I just leave it there. When the time comes for writing a literature review part of my paper, this expedites my writing process; I simply take one line or two and convert it into sentences.

So this switching between bullet-points and formal sentences/paragraphs helps my writing

process in two ways. First, it makes my finger keep typing. Second, it makes easier for me to build nice sentences later — from pieces of a few words.

In spite of my limited experience, I think the Powerpoint note-taking idea from my friend is still effective. However, you might want to transform it a little bit to suit your style and needs. And remember that bullet-type writing is usually easier even when you are stuck and cannot write a single sentence at all.

2.4 Work smart, not hard

You do not want it and I do not like it either. But put the highest priority on your writing work from your to-do-list for today. Only when your brain is fresh, you can write. When you start your work, get the writing done first and do other things later. Even a small bit of fatigue in your brain will greatly hamper your writing performance. And be sure to get a lot of sleep.

2.5 Separate writing and editing

One legendary(?) tip coming from so-called "prolific" writers is that you need to separate writing from editing when you want to write a lot. It sounds simple. And it was not actually that hard when I was practicing it either. Dump whatever thoughts you have right now. Almost no need for hitting on backspace key. Do not think about grammars or whatever. Forget about any restraints until you are done with dumping. Now get a good sleep. Then do editing tomorrow.

The main advantage of this *separation* technique is that you can save a number of raw materials that otherwise would have been discarded by your editing thought process inside your brain. Simply storing the thoughts in the form of sentences help stacking up the materials for use. Note that writing is a kind of cognitive process; storing them in your brain in the form of thoughts is susceptible to volatility.

[But what was the problem with this technique??? Drafter/planner tradeoff?]

[Write more on the side-effect of "writing too much" without organizations or structures.]

3 Tools

3.1 LaTeX

LaTeXtakes care of numerous chores, particularly formatting, in your dissertation writing. For example, you no longer need to pay attentions to the layout of the figures. Table of Contents is automatically generated, and the numbering for tables, figures, math equations, theorems, and so on are all automatically taken care of.

But the most significant feature of LaTeX, in terms of researchers' perspective, is its citation management combined with BibTeX. A researcher has to know *where* his knowledge comes from and that is the reason why we need to keep it a habit of tracking citation records. The number of citations for a Ph.D. dissertation easily surpasses 100. If you do not keep the record, you will be lost while trying to retrieve your memory.

So how does BibTeX manage your citation records? BibTeX citation file is a simple text file with specific citation field records (See Fig. 1 for an example). You simply need to add entries whenever you come across any good papers. You can write each iterm yourself, but most of online academic paper search engines (such as Google Scholar) provides BibTeX entry as well. You can simply copy-and-paste it.

There are other alternatives such as EndNote. EndNote is popular with Microsoft Office users. I do not have any experience with EndNote, so I skip covering EndNote in this manuscript.

```
@ARTICLE{gode-sunder-1993,
  author = {Gode, Dhananjay K. and Sunder, Shyam},
  title = {Allocative Efficiency of Markets with Zero-Intelligence Traders:
    Market as a Partial Substitute for Individual Rationality},
  journal = {Journal of Political Economy},
  year = {1994},
  volume = {101},
  pages = {119--137},
  number = {1},
  month = feb,
  issn = {0022--3808},
  shorttitle = {Allocative Efficiency of Markets with Zero-Intelligence Traders},
  abstract = {},
  url = {http://www.jstor.org/stable/2138676}
}
```

Figure 1: A BibTeX entry example for a journal paper.

3.1.1 Building and managing your paper collection

[Rewrite. Confusing between importing BibTeX from Zotero or Google Scholar]

Personally, I recommend using the combination of Zotero, BibTeX (and LaTeX of course) for managing your paper collection. Imagine it like managing your MP3 music collections. How do you manage your music collection with, say, iTunes or Google Music? You download or purchase MP3 files of your choice, store them into iTunes folders or Google Music cloud space. Whenever you want to listen to them, you rely on browsing or search features from your iTunes or Google Music.

You can do a similar job for your academic paper collections. Think of Zotero as the iTunes for your paper collection. You search for a paper and download it. Then you save it to Zotero so that Zotero can automatically add the paper to your collections.

Similar to that iTunes can detect the MP3 tags with artist name, song title, album title, etc., Zotero can automatically detect the paper title, author names, published journal or conference name, publication date, and so on. If Zotero fails to autodetect, you can manually enter the information.

But you need to *export* your Zotero collection into a BibTeX format text file in order to include the citations as inline ones for your dissertation. This is a step not needed for MP3 collections. You just pick one MP3 file and listen to it. For paper writing, imagine like you are

writing a MP3 playlist. But the playlist for your paper has to have an intermediary format and BibTeX is the format for the papers being written in LaTeX.

What is the advantage of having a separate format of BibTeX? One handy feature is that academic paper search services such as Google Scholar or Elsvier provide the citation information in BibTeX format. You can export from Zotero. But you do not necessarily do it from Zotero and you are not locked-in the Zotero service only.

[some conclusive remarks?]

Managing paper pdf files This section is my praise for Zotero; when you search for a paper and save the web page to Zotero service, Zotero not only saves the web page but also stores the paper pdf files automatically. This saves you a lot of effort from keeping two separate collections simultaneously: citation database and paper PDF file database.

This feature is very simliar to Evernote's. Whenever you click on the Evernote button from your web browser, the Evernote plugin clips your web page of interest and saves it. Zotero does the same but it automatically recognizes the paper PDF file linked on the web page and save them altogether, generating a catalogue.

3.2 Editors for writing LaTeX manuscripts

There are a bunch of them — basically you can use Windows Notepad as well. But having a LaTeX-aware provides a great boost with your work efficiency. For me, I find syntax highlighting (or coloring), auto indentation, and auto word-completion (citations, links, etc) features helpful. Note that these features are all present for any LaTeX editors.

One thing I would like to recommend to you writers is so-called "distraction-free" feature. A number of editors have this — it creates a full-screen editing environment, without a pull-down menus or icons for other jobs that might distract you into something else. Please have a look at my working environment (Fig. 2):

See? This helps you with not wasting time your away with clicking on here and there on your web browser.

3.2.1 TeXMaker, TeXShop on Mac, and TeXTronics

If you think you are a beginner, start with TeXMaker. You won't regret it. If you are a Mac enthusiast, consider TeXShop as well. However, note that TeXMaker is cross-platform; it runs on Windows, Mac OS X, and Linux as well.

Some people recommend TeXTronics but I am not so sure about its advantages.

3.2.2 Sublime Text 2 or 3

People are raving on it. Seriously. This is an editor that you might want to purchase.

One drawback is that Sublime Text needs customizations. It is a general-purpose editor, not only for writing LaTeX documents, but also for writing in other programming languages such as C, Java, Python, Ruby, etc. However, once setup, Sublime Text becomes very handy and user-friendly.

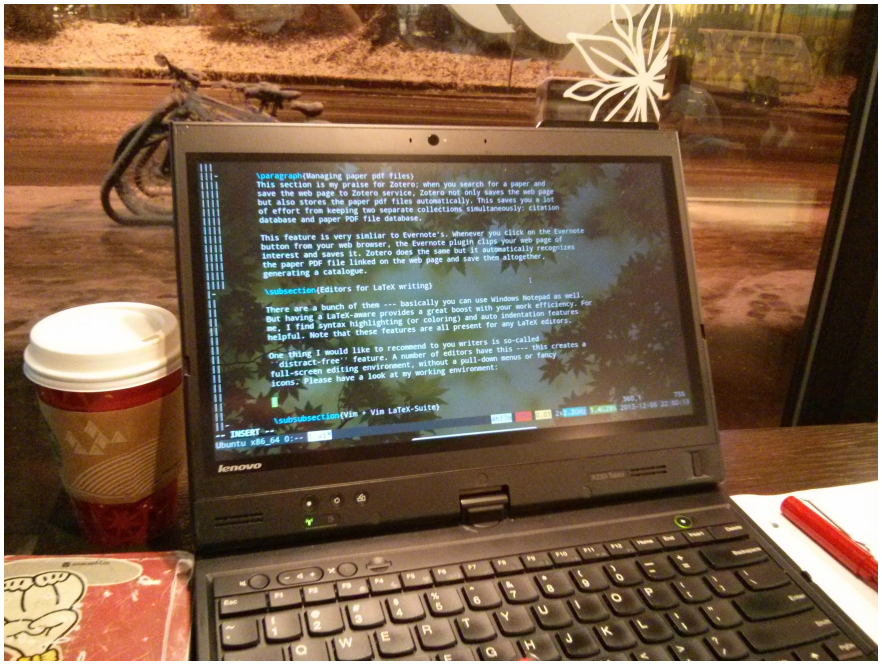

Figure 2: A “distraction-free” editing with `vim` on a Linux terminal

In addition, Sublime Text is highly configurable. Therefore you can customize it at your will: font and paragraph customization, themes, shortcut keys, distraction-free environment, preview mode, 80-column indicator, and so on. Some people say that this is the editor with emacs-level configurability. And there are tons of 3rd-party plug-ins.

Sublime Text is the best editor I would like to recommend, if I have to choose one from this section (and TeXMaker as the second for its ease of use). Be sure to give it a serious try at least once.

3.2.3 Vim + Vim LaTeX-Suite

This is my personal choice but learning `vi` can be a pain when you are not accustomed to Linux or shell environment. In other words, very nice for geeks but not very recommended for other users. (And you probably know by now if you need to skip this section or read further.)

In case you are using `vim`, be sure to have a serious look at Vim LaTeX-Suite. `vim` is good enough, but LaTeX-Suite is a plug-in for `vim` and provides extra features such as paragraph folding and quick search for your BibTeX entries.

Of course, you can use the holy `emacs` instead of `vim`. `emacs` is always rich with great features that human minds can ever imagine.

One clear disadvantage with `vim` is its multi-window support. `vim` is now equipped with multi-window support, but my opinion is that `vi`’s interface is not very much multi-window friendly. For me, I ended up using `byobu`, which is an enhancement on the classic `screen`. Or you can use any terminal emulator with multiple tab-window support.

When you use `byobu`, some shortcut keys conflict with Vim LaTeX-Suite's. A quick tip: press `shift + F12` key to disable them.

3.2.4 Online LaTeX editors:

Templates available. Especially resume or CV's.

3.2.5 Fixed-width fonts

Better fonts than Courier new.

3.3 Learning LaTeX

Math on LaTeX.

StackExchange is awesome.

3.4 Packages

AMSmath and AMSsymb packages: indispensable.

Some font packages: But use Computer Modern for printouts. On screen: CM is not good. Use up-to-date fonts:

fullpage

setspace: onehalfspacing, doublespacing

3.4.1 Tables, Figures, and picture import

start from
includegraphics.

Tables and Figures: Use this template.

Pictures: use png most of time. pdf is actually better in terms of high-resolution printing. Note that MS Office now provides save-as-pdf feature as well.

Look for conferences or journals: they have nice templates as well.

3.4.2 Creating a poster with LaTeX

pros: Scales easily. Flexible textbox support. Math equations

cons: Takes more time for learning than using ppt.

poster tips: 24in by 36in is a US standard. 3-fold poster panel size: 48in by 36in. Most large-format printers support up to 42in.

Cheapest one: use Acrobat reader and color print with the poster option. Letter-sized mosaics. Glue them on the poster panel.

Tips for using Sans Serif fonts:
usepackage. Droid, Dejavu, Bera, Helvet, etc. Sans Serif fonts are good for ppts or presentation materials. Complaints about Arial. Microsoft's C-series fonts are pretty good but limited use under LaTeX environment.

4 Mental support

4.1 Counselling

It might sound strange, but this can be important for your research. Sometimes you can have difficult time making progress as a researcher due to some emotional factors. If this is so, consider talking to a counsellor. Usually the symptoms for any emotional problems for a Ph.D. program student can be roughly referred to "depressions." However, there are numerous reasons when a person experiences depression and it is often hard to identify the specific cause for the depression.

Counsellors are professionals trained to detect this specific cause of the depression and they can give you "prescriptions" depending on your specific type of the depression identified. For example, some people have trouble with fear management. Others might have problems with concentration. These are beyond the scope of your advisor — actually way up beyond their handling capability.

One tip is that you probably have health insurance coverage for counselling. A good(?) news is that the coverage for counselling is usually very nice when your insurance coverage comes from your graduate assistantship work. (TA or RA) So use them if you need — not only for your mental health but also for your research output — and work efficiency including your advisor and your department as a big community.

5 Fun, hobby work

One thing I regret is that I have not had any hobby (or fun) work during my long Ph.D. program period — note that I use the word "hobby work" instead of "hobby" or just "fun." Do it. Do it regularly like a work — or do it like a regular exercise or training depending on your personal taste.

The main reason is that (again!) your brain does need breaks. Having a break from your research work is hard since it is a mental process. As long as you are awake, some thoughts on your research work will always pop up. Well, sometimes you will see them in your dream as well.

So you have to figure out a way to *enforce* some regular break to your brain. The easiest way is to make your brain concentrate on a totally different thing other than research. What different thing will be good then? Your hobbies are naturally the easiest choice.

Those can be anything. Physical sports activities are the actually the best since they not only gives your brain a significant break but also heals up your body. In terms of brain activity, you will have more blood flow in your brain after your sports activity. And do not forget: healthy body eventually leads to healthy spirit as well.

I would like to recommend art activity as a second. (Unfortunately I am not a sportsman type person and I do not have enough experience with physical sports activity myself.) Personally I listen to jazz and classics. But that is not sufficient since you need a practice-like activity — even with music appreciation. So I started practicing piano playing a few months ago.

From my experience, the benefits of this piano-playing practice are like these: first, as I

said before, your brain can have a true break while practicing piano-playing by focusing on something different from your research.

Second, you can explicitly observe your progress as time goes on. It is often hard to see progress from your research since this is a mental activity. But these trainings, or practicing things actually generate the observable evidence that you are making progress. And this can become a big emotional support for your lonely journey of the Ph.D. program.

And finally, your life deserves something valuable other than the Ph.D. degree. And the Ph.D. process takes a long time. Of course, your Ph.D. is invaluable to your life but . . .

6 Conclusions

References

[1] Varian, Hal R., *How to Build an Economic Model in Your Spare Time*, `http://people.ischool.berkeley.edu/~hal/Papers/how.pdf`, University of California at Berkeley, 1994.