

A Researcher's Guide to Managing Knowledge

Jacob S. Zelko

2021-11-10

All Rights Reserved. Copyright ©2021

Contents

1	Why This Book? □	3
1.1	Who Is This Book For?	3
1.2	Who Is This Book Not For?	3
2	Knowledge Building □	5
2.1	Screening Heuristics	5
2.2	The Spacing Effect	6
2.3	Spaced Repetition Systems	6
2.4	Incremental Reading	7
3	Researching Courageously □	9
3.1	What Is “Great?”	9
3.2	Asking Great Questions	9
3.3	Great Ideas	9
3.4	Creating Research Directions	9
4	Funding Your Ideas □	11
4.1	Before Your Funding Search	11
4.2	11
	Appendix	13
	References	15

1 *Why This Book?* □

I did not intend to write this book. Yet, here I am, straddling a log above a brook log listening to the soothing symphony of the running water juxtaposed against the harsh whirl of cars on the main roadway not more than a rocks throw from where I precariously sit. And I suppose, that this description is a very apt analogy for how I found myself writing this book.

Away from the wooded groves and busy streets, for a majority of my life I have found myself not enjoying the vivacious odor of leaves and pines, but musty books and freshly steeped tea. As both a professional student and at-times independent, at-times employed researcher, I have observed an interesting phenomena that can best be characterized as “intellectual waste.” What I mean by this is that I have the great fortune and privilege of being frequently surrounded by brilliant people. Medical doctors, lawyers, company founders - I often interact and even share the occasional coffee or cocoa with stunning minds such as these. Although brilliant, a common observation I have made amongst these professionals from my perch on my proverbial “log” is the lack of intellectual organization.

I vividly remember one conversation with a colleague of mine - a prolific mathematician turned bioninformatician - on the matter of note taking during literature reviews. As a rather novice, though not inexperienced, researcher at the time, I held great respect for this colleague’s thoughts and was eager to hear how he conducted his work. The colleague opened a directory on his personal computer and showed me a plethora of different sub-directories, each containing notes and thoughts on particular papers. It was no shock that it contained so many notes, but I couldn’t help but wonder: “How could they find anything when they needed it?” When I asked about how easy it was to find a particular fact or piece information from this system, the answer was given with a sheepish grin: “Not very.” That question was the catalyst which spurred me to take the question of how to reduce intellectual waste very seriously - especially as I began my own journey as a researcher.

Before you read another word, let me lay out exactly what this book will discuss - and more importantly, what it *won’t*.

1.1 *Who Is This Book For?*

Foo Bar

1.2 *Who Is This Book Not For?*

Foo Baz

2 *Knowledge Building* □

This chapter concerns what I have come across in my educational practices as being of extreme use to me as a researcher and student. The information provided here encapsulates a variety of information and techniques one can make use of in their studies or research. Here are the executive summaries of each section:

2.1 Screening Heuristics - these are some of my own heuristics I use when scanning media. I encourage you to let these inspire you in creating your own heuristics!

2.2 The Spacing Effect - the spacing effect is a useful way to schedule your learning for maximum retention and understanding of material.

2.3 Spaced Repetition Systems - modern tools and suggestions on how to incorporate the spacing effect into your learning.

2.4 Incremental Reading - a paradigm to read multiple pieces of information at once to maximize reading while learning.

These sections expose you to many ideas that can help with you developing your own learning process. Later chapters go more into how to connect all of this together in a more practical manner.

2.1 *Screening Heuristics*

When faced with a piece of media to consume, I apply the following heuristics to determine if it is worth my time:

1. **Do I want to consume this?** Often, I open media after reading the title and sub-heading. If it sounds interesting, I might process it, if not: pass.
2. **Am I motivated to process this?** If I am not motivated to process a piece of media, I either throw it out or save it for processing later. If I keep it and have not processed it after some arbitrary time, I don't bother processing it and throw it out.
3. **Do I find the main thesis of the piece intriguing?** I will jump from the beginning to the end of a piece. If the thesis seems intriguing to me I will investigate the conclusion. If the ending convincingly ties itself back to the thesis, I deem it worth my time. If it fails any of these moments, I throw it out.

To qualify these heuristics, an explanation. I operate under the implicit assumption that time is scarce. Every thing wants your time. Therefore, it is imperative to triage valuable information from noise. I rationalize that the cost of missing something in my screening process is low. If a piece is worth my time, I will be led back to it.

Furthermore, I am a selfish in my consumption of media. I choose to consume that which I wish to consume. While processing a piece of media, I may skip around in it until I find something interesting.

2.2 The Spacing Effect

The spacing effect accounts for the fact that learning is improved when studying is spread out over time. It was first discovered and described by Hermann Ebbinghaus during 1880 - 1885. ([Ebbinghaus, 1885](#)) His findings were later accurately reproduced and documented by *Murre & Dros*. ([Murre & Dros, 2015](#)) (Click for results of that study here)¹

¹ 0528202017
s.md

The spacing effect has not been very well utilized in US-based education institutes despite its multitudinous benefits. ([Dempster, 1988](#)) Cepeda et al. determined that in a memory based challenge, spaced based learning outperformed massed learning ~96% of the time. ([Cepeda et al., 2006](#)) This coincides with the deficient processing view posited by Hintzman that stated how massed repetition leads to a lack of attention in later reviews. ([Hintzman, 1974](#))

According to *Pyc and Rawson*, labored but correct recall while practicing improves memory. Spacing items of recall produce greater effort during retrieval and enables thorough conversion of the item to memory.² ([Pyc & Rawson, 2009](#)) Semantic processing of information during repetitions assists in making that information more anti-fragile, to borrow from Nassim Taleb,³ during reviews. This causes performance in later memory testing to be unaffected by changes in such things like the type of font used when presented information.⁴ ([Mammarella et al., 2002](#))

² Testing

³ 0317202003

⁴ Testing

A confounding factor in the idea of the spacing effect is the encoding variability theory. This theory states that one's performance on a memory test is related to overlaps amongst current contextualized material both during testing and while encoding. According to this view, spaced repetition typically entails some variability in presentation contexts. Yet, this results in a positive outcome being that there are then more retrieval cues associated with that material. ([Cormier, 2014](#))

However, there are concerns about the spacing effect that have impeded its overall adoption into educational formats. *Dempster* made a case examining potential rationales for the lack of adoption in a review of the current state of the spacing effect (though the study is old over 30 years old, it still remains that education systems do not incorporate the spacing effect). ([Dempster, 1988](#)) His biggest point of concern was the lack of studies that showed effective classroom utilization of the method.

2.3 Spaced Repetition Systems

Despite such misgivings, it is still a phenomenon that have given rise to many benefits and potential applications for at least personal education. Principle of which is in the form of spaced repetition systems.⁵ These systems have determined the best spacing algorithms for a learner to use the spacing effect to assist in learning diverse educational material.

⁵ 0525202018
tems.md

There are multiple algorithms available used for effectively implementing the spacing effect. The earliest algorithm comes from the original discoverer of the spacing effect, Hermann Ebbinghaus. The algorithm has been replicated⁶ and scrutinized examined multiple times. ([Bjork et al., 2011](#); [Ebbinghaus, 1885](#); [Murre & Dros, 2015](#)) Spaced repetition systems are based around proper implementations of such algorithms.

⁶ 0528202017
s.md

Before the advent of computers, it was very difficult to implement such a system. The best system to take advantage of this effect was the Leitner System which used paper note cards⁷ to assist with remembering information. ([Sebastian Leitner, 1972](#)) However, this was still a somewhat fragile system and difficult to manage.

⁷ 0510202022

With computers, there have been several pieces of software made to automate and keep track of repetitions *for a learner*. A majority of these systems directly adapted the Leitner System from the analog to the digital world. Each software generally has proprietary algorithms that supposedly maximize the spacing effect but are directly inspired by the original work done by Ebbinghaus.

Whether analog or digital, key features of these systems are as follows:

1. Uses an algorithm implementation of the spacing effect for a user.
2. Each piece of information is spaced automatically per a user's perceived difficulty in either remembering or processing that piece of information on a repetition.
3. Pieces of information are generally presented in a "flashcard" format and are stored in "decks."

2.4 Incremental Reading

Piotr Woźniak, a Polish learning researcher, is thought to be the originator of the term and process of "incremental reading." Incremental reading is a methodology that enables one to process multiple written pieces concurrently over several days while promoting learning. The methodology follows this general format:

1. Identify written pieces of interest.
2. Prioritize the pieces according to personal urgency. Adjust while reading.
3. Allocate a comfortable reading time duration per piece with a timed, short break in-between.⁸
4. While reading each piece, annotate material that is of interest or difficult to process.
5. Transfer annotations from each piece to an index card representation (actual or digital).
6. Pause reading and review collected annotations using a spaced repetition system.
7. Once annotations have been thoroughly revised and reviewed, repeat from step 2 until finished with pieces over the next several days.

⁸ Testing

Incremental reading aids attention and encourages better retention via intermittent breaks and mixing of reading materials, respectively.⁹ (Ariga & Lleras, 2011; Bjork et al., 2011; Shea & Morgan, 1979) Ingesting raw annotations into a spaced repetition system makes processing them manageable as the cards they are written appear at spaced intervals. On each appearance of a card, one can rewrite or modify that card; further cementing it in memory.¹⁰ (Bjork et al., 2011) After finishing revisions and reviews, this general process is repeated until done with reading the pieces.

⁹ Testing

¹⁰ Testing

3 *Researching Courageously* □

Once you get your courage up and believe that you can do important problems, then you can. - Richard Hamming, "You and Your Research"

3.1 *What Is "Great?"*

Based off the talk by Richard Hamming, *"You and Your Research"*.

3.2 *Asking Great Questions*

The art of making great research.

3.3 *Great Ideas*

3.4 *Creating Research Directions*

The distinguishing feature between research directions and research ideas is a matter of pinning. Generally, up until now, the ideation is fantastic. It is playful, it is creative, and it is unfettered by any barrier.

A research direction however, requires one to define what it is they want to pursue. An idea is only an idea, until it is succinctly communicated. That communication, too early, can be a negative barrier to creativity as one may not have had enough time to play with the thoughts. It is a balancing act of determining at what phase an idea is ready to be communicated.

My personal rule of thumb for this is as follows:

1. Have an idea and explore it thoroughly through whatever means suitable.
2. Work towards having a mental sketch of what this idea could lead to.
3. When you start feeling like you want to share the idea with someone, share it.

4 *Funding Your Ideas* □

Grants. For some, the word brings excitement. Others: terror.

4.1 *Before Your Funding Search*

4.2

Appendix

Foo bar

References

- Ariga, A., & Lleras, A. (2011). Brief and rare mental “breaks” keep you focused: Deactivation and reactivation of task goals preempt vigilance decrements. *Cognition*, 118(3), 439–443. <https://doi.org/10.1016/j.cognition.2010.12.007>
- Bjork, E. L., Bjork, R. A., & others. (2011). Making things hard on yourself, but in a good way: Creating desirable difficulties to enhance learning. *Psychol. Real World Essays Illus. Fundam. Contrib. Soc.*, 2(59-68).
- Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychol. Bull.*, 132(3), 354.
- Cormier, S. M. (2014). *Basic processes of learning, cognition, and motivation*. Psychology Press.
- Dempster, F. N. (1988). A Case Study in the Failure to Apply the Results of Psychological Research. *Am. Psychol.*, 8.
- Ebbinghaus, H. (1885). *Ueber das gedächtnis*.
- Hintzman, D. L. (1974). *Theoretical implications of the spacing effect*.
- Mammarella, N., Russo, R., & Avons, S. (2002). Spacing effects in cued-memory tasks for unfamiliar faces and nonwords. *Mem. Cognit.*, 30(8), 1238–1251.
- Murre, J. M. J., & Dros, J. (2015). Replication and Analysis of Ebbinghaus’ Forgetting Curve. *PLoS ONE*, 10(7), e0120644. <https://doi.org/10.1371/journal.pone.0120644>
- Pyc, M. A., & Rawson, K. A. (2009). Testing the retrieval effort hypothesis: Does greater difficulty correctly recalling information lead to higher levels of memory? *J. Mem. Lang.*, 60(4), 437–447.
- Sebastian Leitner. (1972). *So lernt man lernen: Aangewandte Lernpsychologie - ein Weg zum Erfolg*. Verlag Herder.
- Shea, J. B., & Morgan, R. L. (1979). Contextual interference effects on the acquisition, retention, and transfer of a motor skill. *J. Exp. Psychol. [Hum. Learn.]*, 5(2), 179.

