



Research Skills and Critical Thinking

A Guide for the Research Skills Academy

Release 0.2.0

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Caution: This web book is a work in progress.

THE ACADEMY

1.1 Introducing the Research Skills Academy

The idea for the Research Skills Academy came from a series of conversations with co-founder and director Mark Galassi and three exceptional students in Santa Fe: Hajer Maaz, Ruben Hernandez O’Kelly, and Valentina Hussey.

In their conversations, they discovered there was a crucial missing link in preparing students to do research. There needed to be a program that would streamline students into higher education and other academic institutions by teaching them both hard and soft skills.

The students and Mark then formulated what a useful collection of skills and background knowledge would be for motivated high school students and ultra-motivated middle school students interested in academic research. This group of skills became the course material for the Research Skills Academy.

We have some goals in mind for what students should pick up in this program: research skills, a habit of critical thinking, exposure to several different career paths, and how research enters into those paths.

The students had final say on the schedule, intentionally designing it to stimulate their age group and not be too exhausting for a high intensity summer program.

1.1.1 The Schedule

Students in the Research Skills Academy commit to about five and a half hours of work, four days a week, for three weeks. The specific durations mentioned below are just an approximation.

Each day starts with a tutorial lecture by a director of the program, Mark Galassi, Karina Higginson, or Albert Kerelis. Starting at 10 AM in our main time zone (US/Mountain time) and lasting about an hour, these lectures cover a wide range of topics, including workshop skills, soft skills, and theoretical discussions. To see a brief overview of the lessons, visit the chapter titled “Sample Syllabuses.”

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Students then have a period of free-form discussion of a long-term research question, or other areas of interest. In this period they are encouraged to invite collaboration from other students on the project they are forming in their mind. This is largely done using chat rooms and document sharing, and is a little over an hour long.

After a 45 minute lunch break, there is a 15 minute “scrum” meeting, guided by the Academy directors Karina Higginson and Albert Kerelis. In these meetings, students discuss and plan tasks with their peers and the senior members present so that their work is guided, efficient, and effective.

After the scrum it’s back to individual, or self-formed small group, work on a topic. This is intended to be focused on producing written results, and goes for about a hour.

The day ends with a career path lecture. Running about an hour and with 15 minutes for questions, scholars and professionals in very diverse areas speak about what careers in their respective field can look like, as well as current questions or issues in their field. The hope is to inspire students to think about potential careers, while also engaging their curiosity in potential research questions. After the final lecture, one more hour or so of independent work. The day will typically end around 3:45 PM.

1.2 What is Research?

For our purposes, research is *not only* scientific research that produces original results, such as experiments or data collections. Research is much more often the *process* of carefully studying a problem or an area of knowledge with the goal of understanding it clearly.

These two uses of the word “research” are linked, one acknowledges the new knowledge obtained while the other acknowledges the process of obtaining it. Original research is often a lengthy endeavor, and in the course of it a scholar will need to research many and varying academic fields that contribute to solving their question or problem.

A classic example of cross-field research is Albert Einstein’s path to formulating the theory of General Relativity. A key component in the theorization of General Relativity was a field of mathematics called differential geometry. Einstein did not know much about it, so, he asked his old friend the mathematician Marcel Grossmann to research whether an appropriate, non-Euclidean, geometry existed. Einstein’s biographer Abraham Pais [Pais1982] reports the story:

[...] he told Grossmann of his problems and asked him to please go to the library and see if there existed an appropriate geometry to handle such questions. The next day Grossmann returned (Einstein told me) and said that there indeed was such a geometry, Riemannian geometry. It is quite plausible that Grossmann needed to consult the literature since, as we have seen, his own field of research was removed from differential geometry.

Grossman and Einstein researched the existing state of mathematics surrounding the geometry of curved spaces. Grossman did traditional *library research*, which taught him of the existence of a

new branch of mathematics. While not Einstein’s original research question, researching new areas of geometry was crucial in enabling Einstein’s original theory on Relativity.

As demonstrated, no research question is limited by it’s field. In any academic project you will need to research a variety of topics, and it is important that you get comfortable doing so with efficiency and precision.

1.3 What Students Should Produce in this Time

The general goal of each day is to produce some written work that demonstrates what a student has learned during their independent research time. What exactly that written product looks like can vary depending on the students inclinations and what makes sense for their project.

A simple goal to strive for could be to pick a topic in the morning, spend most of the afternoon doing research, and then taking the last 30 minutes of the day to write a position paper or research summary on it.

Alternatively, a student could put together a short lecture on their topic, add to a written product that spans multiple days of research, or write an experimental research proposal based on what they’ve learned.

The idea is not to have a rigid rubrick for what a student must complete, but to have each student get in the habit of synthesizing and communicating what they’ve learned in a way that makes sense for them and their project.

1.3.1 The Slant of the Lectures

Below is the simple blurb we send to our lecturers when we ask them to present to the Research Skills Academy.

The purpose of lectures at the Research Skills Academy is to give students an overview of what careers look like in the speaker’s area of scholarship.

We also encourage speakers to include discussion of two aspects of their area: (a) “out of the box” thinking about it, which would demonstrate how it is different from what people imagine, and (b) social justice ramifications and how a student can plan a career that improves their sector of the world.

But in the end it is entirely up to the lecturer – slides, fireside chat, . . . , any format they pick is good.

The lecturers are professionals in their field eager to share their insider knowledge with you. Ranging across many fields, these lectures are meant to inspire and inform not only in content, but also in style of presentation. You’ll have to give your own, so take mental note of what styles of lectures work best for you, and which you might want to emulate.

1.3.2 Computing, Platforms, and Software Freedom

The Institute for Computing in Research is deeply rooted in software freedom and its interns work with free/open-source software (FOSS). The Research Skills Academy uses an entirely FOSS infrastructure, but does not require the use of a complete FOSS platform by students (although we do offer those tools).

While students aren't required to use FOSS, some of the discussion in the Academy revolves around digital citizenship, vendor lock-in, and other areas in which software freedom plays a key role.

For our purposes computers will be used as a tool for communicating, researching, writing, visualizing information, and (quite rarely) examining source code and running it.

The two programs we will use beyond a web browser and office programs will be (a) a plotting program (for when we visualize data), (b) the Python language interpreter (for when we see what a computer program looks like), and (c) version control.

For plotting, there are many tools available, but the one we have prepared some information on is RAWGraphs. For version control, students can expect to learn how to use git.

We have made a list of how to install these kinds of programs for commonly used systems: Linux computers, Chromebooks, Windows PCs, and MacOS PCs. You will find it in the Appendix *Appendix: logistical details*.

CRITICAL THINKING

2.1 Nuance and the Avoidance of Platitudes

Imagine you're looking at a painting. Maybe you're standing at a distance and you have a beautiful perspective of the painting's composition. Maybe you're standing as close as possible and you can see the detail and mastery in the artist's brush strokes and color choices.

While both of these perspectives give you insight into the image and are enjoyable in their own right, neither of them fully encapsulate the painting as a whole. In order to truly understand the painting, you must look from a distance and up close. So too with academic topics.

Part of critical thinking is seeing the nuance in any topic we learn about. Upon initial observation, we only ever see a portion of any picture. In order to be good researchers, and practice good critical thinking, it's crucial that we understand that topics must be closely examined in their individual detail, and also in the context of their field. The difference between academic topics and paintings is that researching the real world never really gives you a nice frame to bound your topic. Our world is so vast and interconnected that we can never zoom out far enough, and at the same time understand with enough detail, that our view of the picture can really be called "complete". Nuance and critical thinking involves looking beyond the surface-level or simple explanations, and knowing that we'll never know everything there is to know. It's about understanding that things are never black or white, but instead are shades of gray.

For example, this comic strip shows a few images that change dramatically as the scope and perspective changes

http://3.bp.blogspot.com/-wblutbx_F0w/UnGTPz1futI/AAAAAAAAAGLs/4VrJMrEmB7E/s1600/zoom.jpg

Notice how the images themselves are not altered, only the perspective of the viewer is.

2.1.1 How To See More of the Painting

The observer at the art museum can walk around the painting in order to gain perspective, but how can we as academic researchers do the same?

The easiest place to start is by recognizing limitations. Understanding nuance involves recognizing that no singular source or study perfectly encapsulates an entire topic or field.

This same reason is why it is so important to have multiple sources, a practice often called triangulation. Triangulation is when multiple research methods are used to validate findings. Just as the more places the art museum goer stands in the room the better their understanding of the painting becomes, the same goes for research findings.

Another wonderful way to address nuance is by discussion. Among peers or professionals, discussing a topic will give you, literally and figuratively, as many perspectives as possible. However, discussion requires other people, and often people will avoid having to discuss nuances or approach disagreements by using platitudes.

Another metaphor we find useful when thinking about gaining multiple perspectives on a topic is the practice of tomography. A famous example of optical tomography is from a researcher from Portugal, Gabriel Martins, who recreated a 3D construction of an embryo by compiling over 1,000 images. You should approach research similarly. In order to gain a fuller understand of a topic as a whole, take many pictures from many angles, and fit them all together.

2.2 Platitudes

A killer of nuance is the habit of using platitudes. Sports journalists, managers in businesses and other administration tasks, trade magazine writers, all fall in to this.

A platitude is an overused statement that might sound deep or meaningful, but often lacks real significance. It's a cliché, it's vague, and it lacks substance.

Platitudes are so detrimental to the understand of nuance because they hinder meaningful discussions by catering to superficiality rather than real depth. They frequently leave out or oversimplify complex issues into tweet-able sound bites.

To explain further, we here reproduce, with permission, a brief essay by Jerry Silver who is a public relations consultant and blogger. It makes this point nicely.

2.2.1 The Platitude Sickness: Taking Out the Trash of Corporate Speak

Author Jerry Silfwer

Source <https://doctorspin.org/creative/storytelling-writing/platitude-sickness/>

I sometimes hate what I do for a living.

A sizeable portion of what I write for clients will pass through numerous of filters before getting published. And the end result is nothing but a dwindling tirade of cringy corporate platitudes.

I'm not alone in feeling this way. We're all exposed to corporate speak. Whether you're in marketing and communications or not, you'll see these platitudes everywhere. And for some reason, platitudes are becoming the go-to format for many branded content strategies.

According to Wikipedia:

“A platitude is a trite, meaningless, or prosaic statement, generally directed at quelling social, emotional, or cognitive unease. The word derives from plat, the French word for “flat.” Platitudes are geared towards presenting a shallow, unifying wisdom over a difficult topic. However, they are too overused and general to be anything more than undirected statements with an ultimately little meaningful contribution towards a solution.”

Corporate platitudes are such a waste of editorial space. Unfortunately, the platitude sickness tends to do quite well in social media.

A text loaded with obvious statements and no real knowledge can still attract quite a lot of social engagement. People often hit that “Like” button (or emoji-button or whatever) without even reading the actual article it refers to.

“It’s important to have a strategy.”

“Always put the customer first.”

“Be proactive and think long-term.”

“Publish epic content.”

Their engagement reflects how they agree with the headline and how it adds to their own personal worldview. It’s probably also a psychological bandwagon-effect at play, a way of signal belonging to important social circles.

So, how can you combat the platitude sickness in your corporate communication?

Make it your personal mission to find platitudes and to destroy them. As this becomes a ritual, you’ll develop an “allergy” to corporate platitudes — and removing them will become second nature.

Welcome to the fight — I'm happy to have you onboard.

2.2.2 Another Rant Against Platitudes

If you need further convincing, [The Speech Dudes](#) have a strongly worded rant about the waste of life that platitudes are. If nothing else, the amount of literature and articles on the nuisances of platitudes should demonstrate to you not only how problematic they are, but also just how prevelant.

They first comment:

More often than not, a platitude simply states the obvious and so would be better off not having been uttered [1]

and footnote [1] is:

[1] With a platitude, not only is there a stating of the obvious but it's also done in such a way as to have the appearance of being profound or wise. Facebook is full of such pre-digested pabulum that, sadly, spreads like linguistic herpes, passed on by well-meaning but ultimately uncritical people who think that quoting something that sounds smart also makes them sound smart. It doesn't. Platitudes also seem to aspire to taking on a moral dimension, presumably to reinforce the semblance of profundity.

After personally insulting much of the population that posts on Facebook, a social media platform popular among middle-aged and elderly people, they go on to mention corporate *mission statement* platitudes:

A mission statement such as “To combine aggressive strategic marketing with quality products and services at competitive prices to provide the best value insurance for consumers” is about as broad as you can get [... this really is the mission statement of a large insurance company]

They finally bring in a criminal organization as an example:

Here's one you might have heard some years ago: Respect, integrity, communication, and excellence. This was from the company called Enron, which was one of the most notorious business scandals in American history and is considered by many historians and economists alike to be the unofficial blueprint for a case study on White Collar Crime. It's also an example of a crime against vocabulary for creating such a miserably loose mission statement.

Clearly the Speech Dudes have an axe to grind here, but I find myself in complete agreement that every example they give is awful.

As an exercise, you could visit [a rather sad site dedicated to mission statements](#), and go to the Fortune 500 Mission Statements page [[Fortune500MissionStatements](#)] and pick out the few cases in which the company's mission statement made you think “aha! this is original, bold, and memorable”. Consider, “what makes this better than the others?” “What are they saying that is unique and meaningful?” “How did they say it in a way that avoided platitudes?”

2.2.3 Mark's Personal Experience

I have worked at Los Alamos National Laboratory for my entire career. Los Alamos started during the second world war, a group of scientists came together to design and build the first atomic bomb.

Later in its history, Los Alamos developed a more corporate atmosphere, with layers of management and an administrative manual with tens of thousands of pages.

As I was writing this section (May 2021) I looked up what our mission statement was, and found:

Los Alamos National Laboratory's mission is to solve national security challenges through scientific excellence.

It surprised me for not being awful – maybe just a bit too long. The mission statement from earlier in my career (1994), formulated by former Los Alamos director Sig Hecker, had been stronger, bolder, and more challenging:

Reduce the Global Nuclear Danger. [[Hecker1994](#)]

Simple, direct, and packing a punch.

READING EFFECTIVELY

3.1 Reading to Understand Vs. Reading to Critique

Whenever we take in information, especially complex information, we undergo a battle between understanding that information on its own terms and reflecting on how we judge and evaluate that information. If you sit down to read an essay, you have to both make sure you understand what the essay is trying to get at, as well as thinking critically about whether you think that essay is right. “Critique” here doesn’t just refer to our usual idea of being critical or saying what we think is wrong (although this is definitely a form of critique), but more broadly refers to how we react to the text. To be good readers and researchers, we need to be able to critique in both senses of the word, and identify when we’re failing to do one because we’re too engrossed in the other.

Even though this section is titled “Reading Effectively,” all of these techniques apply to any kind of research or acquisition of new information. Whether you’re attending a lecture, watching a documentary, or learning experientially out in the field or the lab, applying these ideas will help you gain purchase on your topic of study and turn what you learn from a series of facts into a nuanced understanding.

3.1.1 Understanding with Grace

When we read things that are new to us, it’s important to know that we’re not going to understand it all right away and to reserve judgement for a bit. One concept I use often is to approach what I’m reading with grace, that is, to assume that what I’m reading is written in good faith and is more or less worthwhile. I might reevaluate those ideas later, but it keeps me from getting prematurely frustrated at texts and helps me get the most I can out of them.

When reading W.E.B. Dubois’ *The Souls of Black Folk*, I was really taken aback by the idea of “the talented tenth,” his concept that the top 10% of Black people were fit for education and would lead issues of racial change. To me, this concept seemed elitist and almost had a tinge of eugenics to it. While I still don’t agree with Dubois on the talented tenth, if I had let myself get frustrated by this idea and stopped reading, I would have missed out on ideas of his that are really useful, like Double Consciousness. Even though the talented tenth isn’t something I think is valid, there’s a lot of very

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important ideas in civil rights that were written in response to it. I would have a much harder time approaching those ideas were I not already familiar with the talented tenth.

The takeaway here is that in your research, you need to be able to remove your own opinions and instant reactions and reserve judgement initially to make sure that you're getting everything you can get out of your sources. This is by no means to say your opinions and reactions don't matter, or shouldn't be discussed, but, by placing your initial reactions or modern sensibilities on the sidelines, you broaden the kinds of information and insights you'll be able to gain access to.

3.1.2 Critiquing with Wanton Abandon

It's not enough to make sure you understand a source you come across, you also have to ask yourself how you're going to evaluate that source. Thinking critically means putting the information you've gathered into context with your own thoughts and knowledge. This means asking questions like, "Do I trust this source's author(s)?" "Is their methodology for arriving at their conclusions sound?" or "What are the implications of believing this source?". When we start critiquing our sources, we get an opportunity to put our own brain power towards our research.

Despite the structure of this section, you shouldn't let yourself believe that understand strictly precedes critique or that critique strictly comes afterwards. Often our critical process, where we try to figure out how to put the information we've been given into a broader context, opens up new ideas that help us understand the source better. It's a back and forth process.

3.1.3 Notes Are Your Best Friend

If you're just reading a couple short articles or essays on a topic, you might be able to reasonably hold everything you learn in your head. However, as your list of sources and your sources themselves get bigger, it'll become harder and harder to keep track of it all on your own. Taking good notes is paramount to making sure that you're able to not only retain what you learn, but that you're able to conveniently access it later.

It's hard to give exact advice when it comes to note taking. Note taking strategies are very personal, and you have to find something that works for you. You should always be critically refining your note taking strategies and figuring out where they can better serve you.

First, you should pay attention to what sorts of things you tend to write down, and what sorts of things you tend to reference. Do you find yourself constantly looking back to your notes to find definitions of terms that are important to your research topic? Maybe highlighting definitions in your notes would make them a better resource for you.

One thing that I find helpful is using bullet points in my notes to understand and summarize what I'm reading, and I use asterisks to note where I'm keeping track of my critical thoughts. This practice allows me to have a clear overview of key points made in the text without having to flip through the source. However, other people I know take all of their notes exclusively in the margins

of the source text, highlighting quotes and cross referencing passages. This practice works well if you regularly cite quotes, or enjoy deep analysis of texts.

It's helpful to experiment with different media as you refine your note-taking practice. You might work best with a physical notebook, or maybe you'll find that taking notes on a computer is more natural to you. Maybe you do best taking notes in a minimal, distraction free text editor. Maybe lots of organizational features from a larger piece of note taking software are really useful to you. Maybe you do well with heirarchical outlines, or scattered bulletpoints. Trial and error is the best way to discover what system works for you, and keep in mind that your system might very well vary based on the subject.

3.2 Handling Jargon

We are often held back from feeling confident in our understanding of a topic because of new jargon. Terms we don't recognize can make us throw up our hands and say: "There is no way I can ever understand this."

The situation worsens when we see cocky young people or grizzled older people who rattle off unfamiliar terms from psychology, electronics, chemistry, software, or any other field. We might think; "Other people get this; why don't I?" These hot-shots will happily talk about RAM, DIMMS, and affect (as a noun), and Bayesian priors, and FMRI's, and conditional probability, and Brownian motion, and van der Waals forces, and rear differentials, and carburetors, and op-amps, and TTL versus CMOS, and FETs, and P-N junctions, and Shannon Entropy, and round robin process scheduling, and, and, and ...

Until, eventually, we find ourselves completely lost in a forest of words we don't recognize unable to see the path out.

The truth is that terminology is just a superficial part of a topic. The person who walks in to electronics class and has no trouble talking about resistors, and capacitors, and inductors might know the jargon but probably does not know how to actually *calculate* what happens in that circuit, or how to match it with others.

You and the rest of the class will all be learning that material together, and their head-start will be slight, not overwhelming. Knowing the jargon might give one a language to talk about the subject, but it does not necessarily demonstrate extensive knowledge of the subject.

3.2.1 Suspension of Not-getting-it-ness

In theater, there is a concept called “suspension of disbelief.” This idea dates back to Aristotle, Horace, and Cicero, and the fortunate wording was formulated by Samuel Coleridge.

We willingly suspend our disbelief to enjoy a play at the theater, or a movie, or any work of fiction: we ignore the dissonance and grasp the parts that matter. We don’t see a dramatic fight scene and constantly say: “That’s not real! This is fake!” While we might occasionally think that, especially if it is executed poorly, we typically don’t make a habit of it. For if we were to do so, it would ruin out suspension of disbelief and at some level make the entertainment useless.

Just as you would use “suspension of disbelief” to enjoy the theater, you can use the “suspension of not-getting-it-ness” to avoid getting weighed down by jargon. If I run in to this phrase:

The popularity of the op amp as a building block in analog circuits is due to its versatility. (from the [[WikipediaOpAmp](#)] Wikipedia article on Op Amps)

When it comes to your approach, you have some choices as you read this sentence. Here are three, and there could be others.

- a) I do not know the expression “analog circuits”, so I will stop what I am doing until I have learned what analog circuits are.
- b) I don’t understand one or a few of these terms so I am give up on reading the article.
- c) I can tell myself that some circuits are called “analog circuits” (some time in the future I will look that up), and they can be enhanced by using something called an “op amp”, which I’m guessing is a clever piece of electronics.

All three are valid, but option C is most often the best use of your time. As you read further, you might decide you need to learn more about analog circuits, or you might find that the context of the article taught you as much as you needed. It’s also possible that you might discover that the article itself is a side show to a larger topic, or, that the discussion of analog circuits is a side show. Often articles used for research are used by professionals to talk amongst other professionals, so it very well may be that that material is not needed to understand the topic at large, or even just the topic of your research. Option A gets in your way by making you go down a side path on something that might end up being irrelevant. If you keep reading and realize that you’re not going to understand your focus topic until you understand op amps better, then maybe do some research. However, you might be able to save yourself a lot of time by trying option C first. Option B makes you give up prematurely when it’s quite possible that you would have understood the article anyway, or at the very least assured yourself that the article was irrelevant to your research topic.

Your approach to learning terminology should be one of letting the terms wash over you in a relaxed and flexible manner. Picture a sushi conveyor belt, or a baggage carousel at the airport. You can watch as different terms pass by you, observing the ones you don’t recognize, and picking up which ones you want to eat, I mean, investigate further. Some terms might stick quickly, others only when you spend more time on them, but you should never feel that you do not belong. At some point, even the most brilliant of minds were in your shoes. Jargon, like any other skill, comes with time and exposure.

Focus on the essence of what you are looking up, rather than getting stuck when you see a new term. As you read or listen, flag new terms to look up later, and see how far you can keep reading without that term.

3.2.2 The Dream of Full Understanding?

You should not feel guilt, or not feel that you are “copping out”, when you suspend your not-getting-it-ness.

The feeling of copping out might come from the fact that back in an earlier, more innocent, part of your academic career you were able to really understand the underpinnings of everything you learned. Now, as you advance, we say to you: “Abandon that path!”

The last polymath, if polymaths even ever existed, would have lived a very, very, long time ago. It has not been possible to learn and understand everything for a long time now.

The advent of computer software, unlimited storage, the world wide web, and all the accumulated knowledge that has come in its wake, have made the world’s body of knowledge so complex that it is not possible to understand it all.

Just as you admit that you read a book without knowing the chemistry of ink, and you ride in a car without having calculated the heat dissipation from the cylinders yourself, you can also put up with not fully understanding the entire collection of tools that you use. You will want to do the best you can to “get the big picture” of what you’re reading, without getting stuck on jargon and details.

3.3 Building Blocks: Prefixes and Suffixes

Jargon is not without reason. Like all things, terminology is made up of smaller parts. The English language is considered a germanic language, meaning it has been primarily influenced by German grammar and basic vocabulary. However, English also borrows from many other languages, including Latin and Greek.

Throughout Europe in the medieval and renaissance period, Latin was considered “the language of the learned” or “the language of scholarship.” Tracing back to the Roman Empire, Latin was the language of administration, law, literature, and intellectual discourse. As Latin began to leave the vernacular, its roots stuck around in scientific and academic language, so too with Greek. Thus, much of the jargon you’ll encounter will contain latin and greek roots, often in the form of prefixes and suffixes.

If you have a basic understanding of some commonly used greek and latin affixes, you’re ability to make educated guesses about the meanings of different terms will multiple ten fold.

Here are some that are frequently used in scientific terminology:

3.3.1 Latin Prefixes

1. Anti-: meaning against (ie. antibiotic, antifungal)
2. Co-: meaning together (ie. coexist, cooperate)
3. Ex-: meaning out of, former (ie. exclude, ex-president)
4. In-: meaning not, opposite (ie. invisible, incapable)
5. Inter-: meaning between, among (ie. interact, international)
6. Per-: meaning through, completely (ie. permeate, promote)
7. Pro-: meaning before, in favor of (ie. proactive, promote)
8. Re-: meaning again, back (ie. repeat, regain)

3.3.2 Greek Prefixes

1. A-: meaning without, not (ie. amoral, atypical)
2. Bio-: meaning life (ie. biology, biodegradable)
3. Geo-: meaning earth (ie. geology, geography)
4. Hyper-: meaning over, excessive (ie. hyperactive, hypersensitive)
5. Hypo-: meaning under, below normal (ie. hypothermia, hypodermic)
6. Micro-: meaning small (ie. microscope, microorganism)
7. Neo-: meaning new (ie. neologism, neonatal)
8. Poly-: meaning many, multiple (ie. polygon, polygraph)

3.3.3 Latin Suffixes

1. -ology: meaning study or science of (ie. biology, psychology)
2. -tion/-sion: meaning act or state of (ie. reflection, decision)
3. -ism: meaning system, doctrine, condition (ie. capitalism, communism)
4. -ity: meaning state or quality of (ie. integrity, diversity)
5. -ment: meaning result or product of (ie. development, improvement)
6. -able/-ible: meaning capable of (ie. readable, flexible)
7. -ate: meaning to make or cause (ie. activate, educate)

3.3.4 Greek Suffixes

1. -phobia: meaning fear of (ie. arachnophobia, claustrophobia)
2. -itis: meaning inflammation (ie. arthritis, bronchitis)
3. -graphy: meaning writing or recording (ie. photography, biography)
4. -meter: meaning measurement (ie. thermometer, speedometer)
5. -scope: meaning instrument for viewing (ie. microscope, telescope)
6. -cyte: meaning cell (ie. erythrocyte, leukocyte)

3.3.5 Remembering this when *you* are the writer

The goal is *not* to write without jargon: that has its own set of problems. Indeed, the replacement for jargon is often a collection of heavy phrases that get in the way of the reader's flow. Jargon was often introduced for good reasons, so rather than abandoning it we should shepherd it carefully.

One goal should be to either explain the jargon, or to craft your phrasing carefully so that its meaning becomes clear just from the reading of the text. The other goal is to not introduce extra jargon from other fields. This comes up a lot with the use of acronyms and initialisms. Acronyms are almost always specific to a certain field of business or engineering. You are not helping your readers by using them. Often you can just write out the entire expression, and many readers will be grateful.

To give an example: in the United States you could say FBI or CIA, and readers would probably not mind. But unless you are writing for a *very* select audience, you should not drop the expression MOSFET (which stands for "metal-oxide-semiconductor field-effect-transistor") casually. You probably don't want to specify that level of detail at all, but if you do want to drop it into a phrase, you could give the full expansion of the initials.

For example, a phrase could look like "In 1947 researchers at Bell Labs had invented the *field effect transistor* - a small device that allowed an electric field to control the flow of current through a circuit. This made the field effect transistor, abbreviated as FET, capable of being both an amplifier or a switch.

In 1959, again at Bell Labs, this design was improved by the invention of a smaller and cheaper device called the "metal oxide semiconductor field effect transistor". This new device, abbreviated as MOSFET, used sandwiched layers of metal, oxide, is the basis of modern digital (computers, ...) and analog (radio, stereos, ...) electronics.

3.4 An Exercise

I mentioned Aristotle, Horace, Cicero, and Coleridge in section “Suspension of Not-Getting-Itness.” Pretend you have not heard of some, or all, of these writers and try reading this section anyway. Your mind could assimilate it like this:

There were some folk, Aristotle, Horace, and Cicero, who probably lived in ancient times. They came up with a way of thinking about fiction and why we are able to appreciate a story even when we know it is not true to fact.

Then another fellow Coleridge came along and coined the phrase “suspension of disbelief”, which I think I’ve heard before and I like it; I’ll remember it.

Now the author of this book is suggesting that I apply a similar idea to *things I don’t understand* rather than to *things that are not true*. He comes up with an expression that is not nearly as good as Coleridge’s phrase, so I won’t remember it. But I get his point: I need to be flexible as I learn, and not insist on fully understanding everything.

3.5 Building Connections

While sitting in the uncertainty of a new topic or field is important, you often aren’t as lost or far from understanding as you think. Over the course of your life, you’ve undoubtedly learned quite a bit about being a human being, and it would be shocking if you found a source that was entirely disconnected from that experience. The experiences and knowledge you’ve gathered throughout your life will undoubtedly come in handy as you try and approach other people’s scholarship.

For example, when I first read Martin Heidegger’s *Being and Time*, I was incredibly daunted by the text. Heidegger essentially invents his own set of vocabulary to tackle what he saw as problems with existing Western Philosophy, which made it really hard to wrap my head around his writing. However, many of his ideas on Being reminded me more and more of my experiences of building relationships with other people. Heidegger talks about truth as a sort of uncovering, of making clear what was originally obscured. It made more sense to me when I thought about the ways that people’s character becomes clearer to me when I interact with them alone rather than in a crowd of people. I get to see their personality “uncovered,” less inhibited by a need to conform to the expectations of a large gathering. While my analogy there isn’t perfect, it helped me gain leverage in understanding Heidegger’s concept of uncovering in a way that just pouring over the text alone wouldn’t have.

When you connect what you’re reading to your own experiences, don’t think of them as being exactly the same, but think of them as analogous. What between your life and the object of study is similar? Even more importantly, where do your experiences diverge from your object of study? Once you’re able to start identifying those points of divergence, you know that you’re pushing past just your prior experiences and into the topic of study itself!

It’s also helpful to connect your topic to other things you’ve read or learned about. In any field, you

will find overlap and cross applications. You should always be asking yourself if you can leverage anything from fields you already have experience with to give you some sort of new knowledge in the subject you're studying.

In knot theory, mathematicians found that physicists were using some of the same mathematical structures as them to understand quantum fields, so the mathematicians leveraged the techniques the physicists use on quantum fields to understand more about knots.

These connections aren't just a way to develop understandings, they can also serve as a basis for critique. When I make this connection between uncovering and relationships, not only am I learning more about Heidegger, but I'm also creating an opportunity for Heidegger to teach me more about relationships. Physicists in the quantum field research are now using the mathematical techniques developed by knot theorists to better inform their physics.

3.6 Where Is This Source Coming From?

An important thing to always turn a critical eye to is where your sources are coming from. Everyone who is doing research has some set of biases underlying their work. Some of these are benign or difficult to control for. Sometimes, however, we can know that an author might have an incentive to make a certain kind of conclusion. Any time you research a source, ask where the information is coming from and why it is being presented the way that it is.

Sometimes, when you find a connection between a source and who made it, a negative connection is clear. Famously, tobacco companies hire researchers who very conveniently report that tobacco has much lower health risks than researchers not hired by tobacco companies. The researchers have a financial incentive to make their results favorable to the companies, because if they produce research that says otherwise they risk losing funding.

Sometimes the source putting out an article doesn't seem to have much bias, but the sources the article cites do. [This article](#) from CNN reports on hyperloop, a train venture funded by Elon Musk. CNN itself doesn't have any incentive to promote hyperloop, but the only sources they cite are published by the company that produces the train, and the only individuals who comment in the piece are Virgin Hyperloop employees. This isn't a piece of journalism where the journalist is critically asking serious questions of their subject. Despite being on a "news" website, this article is more of a press release from a company; an announcement made by Hyperloop on the CNN platform.

Always pay attention to where an article is getting its information, and who they are citing. Many times a political pundit or an interested party will be framed as an expert source, but they can hardly be trusted to be impartial. Always keep in mind that what might be driving the publication of an article or other source could be more than just a good faith pursuit of truth.

DATA VISUALIZATION

4.1 The Big Picture

The moment there is quantitative information involved in what you study, visualization comes in. Visualization is as much of an art as it is engineering, and practice in making graphs is a key workshop skill.

When we encounter raw numerical data, they can be hard to make sense of at first. Most of us aren't very used to looking at lists or charts of numbers and immediately noticing trends. When we put together a graph to display data, we translate numbers into something that's easier for us to draw meaningful inferences from.

What we get from looking at graphs really are just inferences. Without further scrutiny and statistical testing, just seeing a general correlation on a graph isn't enough to draw a really strong conclusion from, (Statistical tests can give you much stronger, quantitatively driven conclusions. You can read about them at this [wikipedia page](#) if you're really interested) but it can provide a really strong foundation from which to develop an intuitive understanding of relationships between the data you're looking at.

Data visualization is also an invaluable tool when it comes to communicating your findings. A graph can contain a lot of information in an easy to read and understand format. When you present an audience with a graph, they don't have to just take your word for whatever relationships you're trying to point out, they can look at the graph and come to conclusions themselves. By having your audience build their own intuitions about the data you're presenting them with, their understanding will be vastly stronger.

Below, we'll walk through a few example data sets so that you can become familiar both with RAWGraphs and some various data-visualization methods.

4.2 The Data can Lead you Astray

Even though data visualizations represent data, the way they do so is being curated by the person who makes the visualization. When we make decisions about how we represent data, we can make changes to make the relationships we're noticing clearer, but this can lead to somewhat misleading charts. Take the bar chart pictured below.

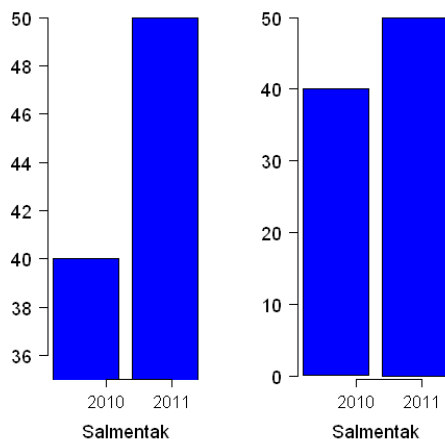


Figure 4.2.1: Image from wikipedia. https://en.wikipedia.org/wiki/File:Misusestatistics_0001.png

In the version of the bar chart on the left, the scale has been truncated. Notice how the scale on the left starts at 36, while the scale on the right starts at 0. When the scale is truncated, it makes the difference between the values seem much larger than in the full-scale graph on the right.

This isn't necessarily a bad thing; sometimes those little differences are really important. However, when we read graphs, we should pay attention to how the graph has been constructed. What are the scales of the axes? How do they affect how you view the data? How is the data labelled? Is one of the labels inflammatory, or designed to provoke emotional reaction? Questions like these are how we critically examine visual data, and we need to keep them handy. Because visual data is so intuitive and easy to absorb, it can be easy to absorb uncritically and have something misleading slip past you.

4.3 Data Visualization Software

There are very many plotting systems, from those that allow quick plots of a data file from the command line (gnuplot), to those that tie in to a language and allow a remarkable microscopic adjustments in the plots (matplotlib), to those that offer a rich feature set even though deployed through the web (RAWGraphs [Mauri:2017RawGraphs]).

For the research skills academy we will work with the RAWGraphs system, since we do not assume that everyone is running an advanced programming/scientific platform. RAWGraphs can

be accessed through a web browser at: <https://app.rawgraphs.io/> and the underlying software is free/open-source which any user can deploy on their own web site as well.

Getting comfortable with RAWGraphs is a pleasant task with no great conceptual difficulty. RAWGraphs has its own set of tutorials at <https://rawgraphs.io/> and they are quite effective. What I show here are some examples of tutorials we will work through together in the research skills academy.

4.4 The !Kung of the Kalahari Desert (Bubble Chart)

Nancy Howell collected data from the !Kung people, sometimes known as the “Bushmen”, a population of hunter-gatherers that live in the western portion of the Kalahari desert, between Namibia, Angola, and Botswana. A summary of Howell’s work is in [Steven Johnson’s twitter sequence](#).

One of Howell’s data sets can be found in the 538 data collection by searching for `Howell11.csv` which should lead to this link:

<https://raw.githubusercontent.com/rmcclreath/rethinking/master/data/Howell11.csv>

and we will look at it using the **bubble chart** feature in RAWGraphs. Their bubble chart is a more featured version of the traditional “scatter plot”.

You should download from this link into a file called `Howell11.csv` at which time you will be ready to upload it into RAWGraphs so that we can analyze it.

You can also go to the “raw” data in github, and then select, copy, and paste into the RAWGraphs input text area.

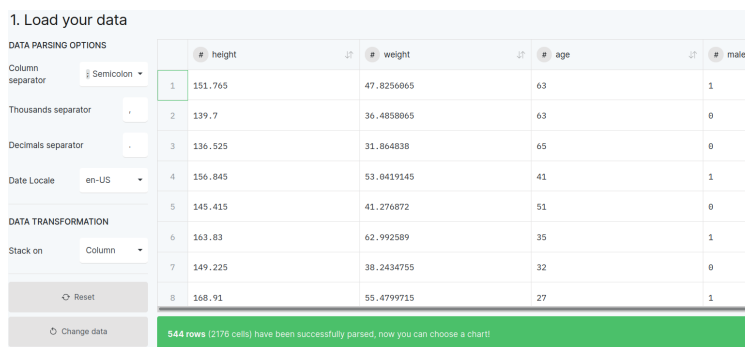


Figure 4.4.1: Loading your own `Howell11.csv` file into RAWGraphs and selecting Semicolon as the column separator.

The most annoying thing to notice about this dataset is that numbers are separated by semicolons instead of commas (commas are more common for simple spreadsheet files). So you have to find the “column separator” widget and select semicolon.

Then, following the figure below, you can select the “age” dimension for the “X axis”, and the “height” dimension for the “Y axis”.

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You can go further and choose to color the points in the plot based on the column called “male”, which in this dataset has 1 for males and 0 for females. The lower part of the next figure shows the color-coded difference.

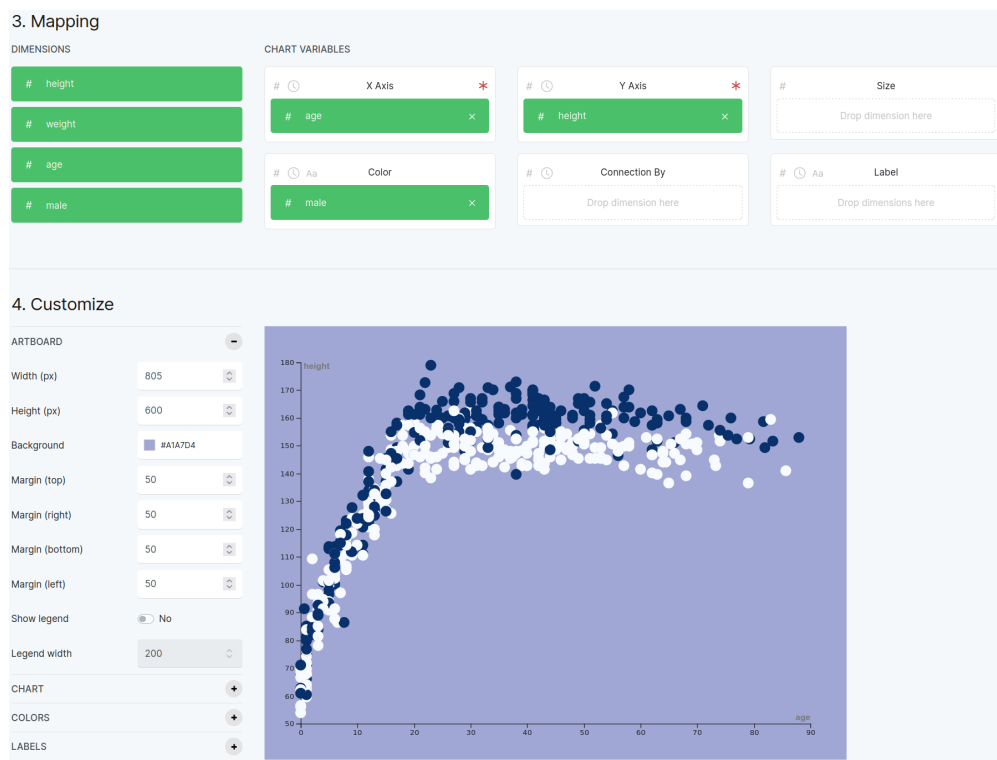


Figure 4.4.2: A result based on the Howell1.csv data set. This shows height versus age, allowing you to distinguish between male and female portions of the dataset.

Another way you could look at the data is height versus weight. The next plot shows how to map height to the X axis, and weight to the Y axis.

You can add further differentiating bits to the bubble chart: color and size of bubbles. Our last example for the Howell1.csv dataset shows how to color-code by sex and make the bubble sizes depend on the age column.

What further insight can we gain here?

4.5 A Fingerprint of a Soccer Player’s Effectiveness (Radar Chart)

Pick the **FIFA Player Statistics** dataset from the **Try our data samples** option in RAWGRaphs.

Then pick the chart type **Radar Chart**.

Then pick a mapping of fields as shown in the figure below:

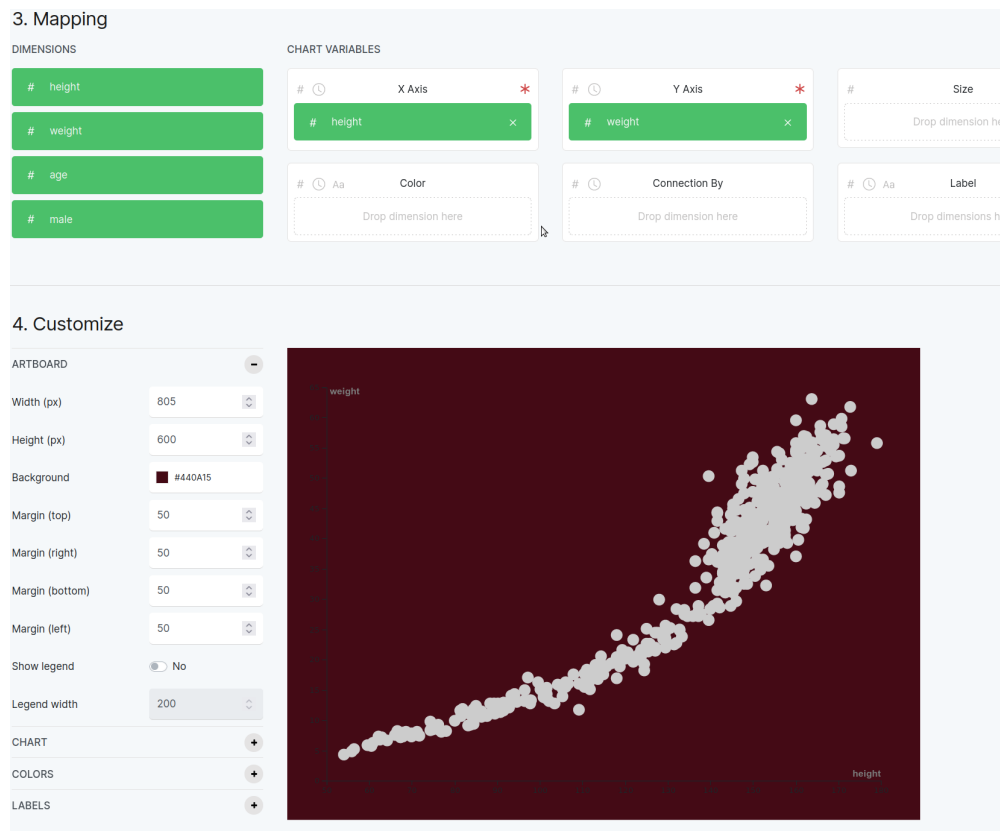


Figure 4.4.3: This plot shows weight versus height.

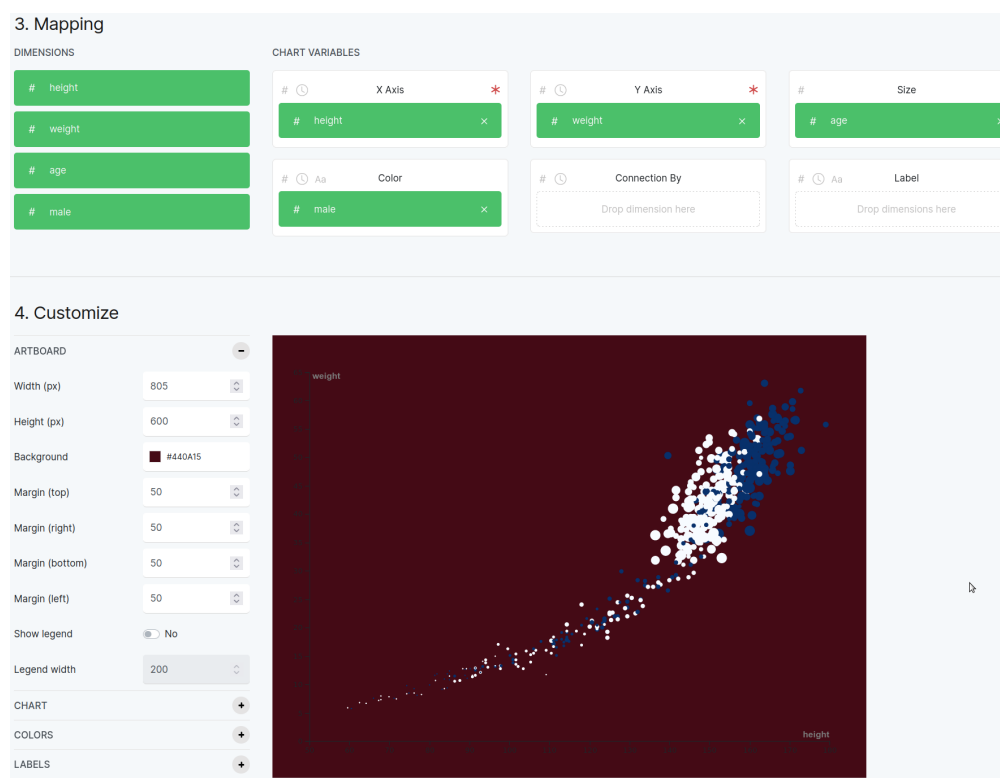


Figure 4.4.4: This plot shows weight versus height, but also colors the bubbles for sex and makes their size depend on the subject's age..

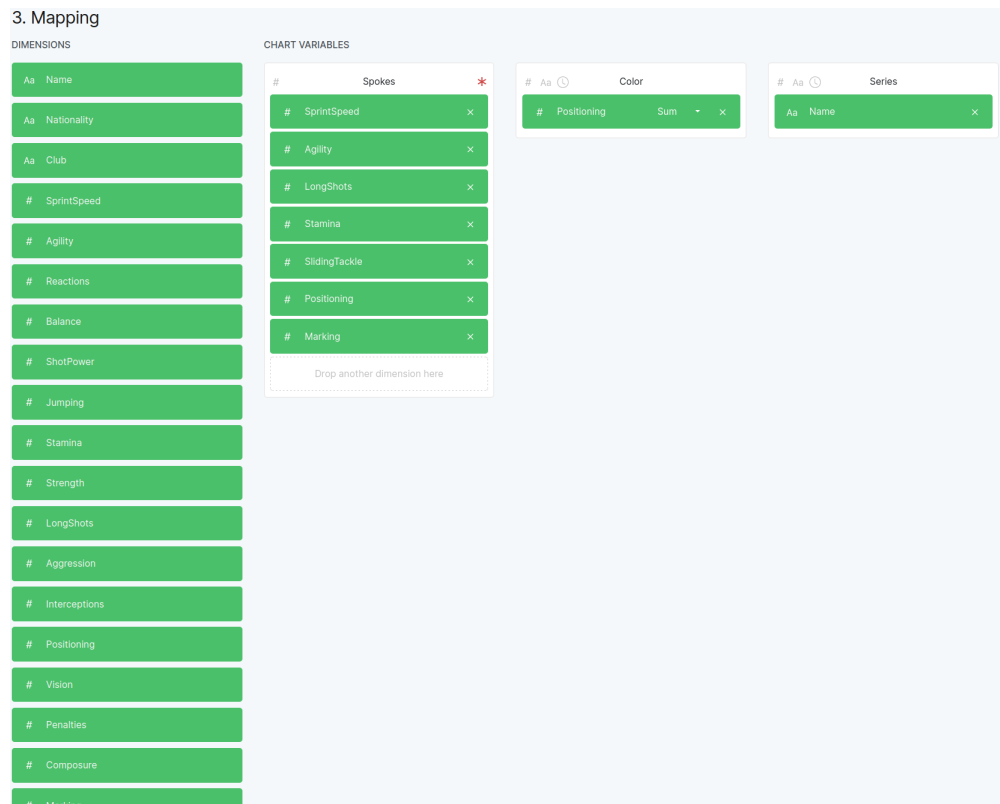


Figure 4.5.1: Mapping various fields in the FIFA data into parts of the plot.

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Which should give you the result shown here:



Figure 4.5.2: The results of the FIFA radar chart.

Now discuss what insights you can get from this. Soccer fans will be able to help the rest of the group discuss which are famous for attacking versus defending skills.

What should emerge from the discussion is this idea of a “fingerprint” or “signature” of a player, which makes the player different.

4.6 Foreigners Living in Milan (Bumpchart)

Pick the “Try our data samples” option in RAWGraphs, then pick the “Foreign residents in Milan” data set.

Make sure you set the “date” column to be a date in DD/MM/YYYY format, so it is interpreted as a date instead of a string.

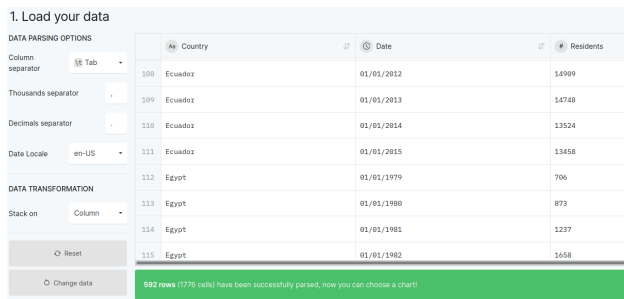


Figure 4.6.1: Note that we have set the “date” column to be a date in DD/MM/YYYY format.

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Now select the Date column for the X axis, the “# residents” column for the Size chart variable, and the Country column for the Streams chart variable. You can see that selection in the next figure, and the plot should look like what you see below.

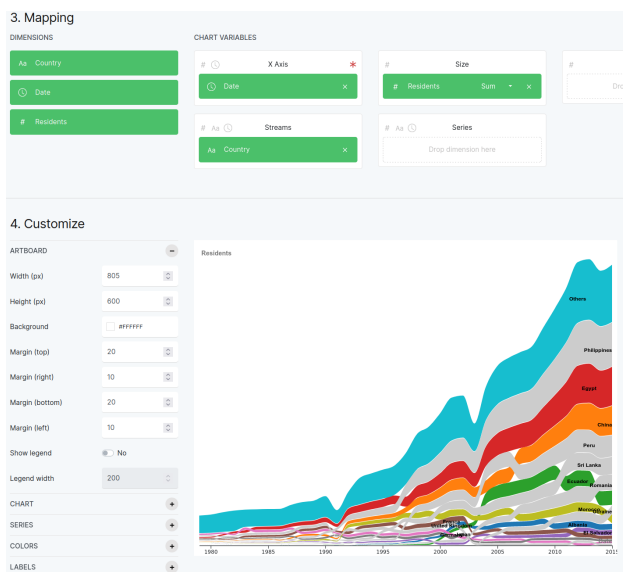


Figure 4.6.2: Customize the plot like this to get the bump chart here.

4.7 A Treemap of Orchestra Hierarchies

Follow the RAWGraphs tutorial on treemaps to get pictures like this one:

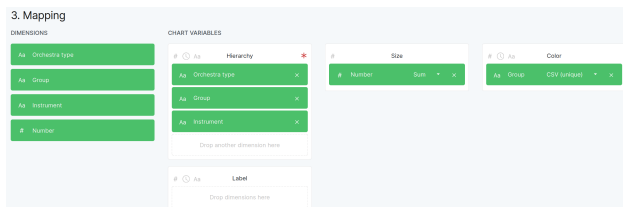


Figure 4.7.1: The mapping of columns to treemap features for the Orchestra structure example.

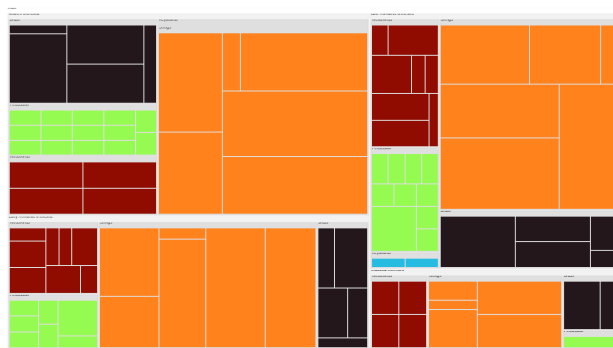


Figure 4.7.2: The result of the RAWGraphs tutorial on making a treemap.

RESEARCH STEP BY STEP

Caution: This section will work best if we have another chapter that lines up with lesson two on finding research and managing a database. That way we can demo all the skills in one fell swoop.

The purpose of this chapter is to model for you what research might look like. We'll ask a research question so that you can see how one might apply the skills from "Reading Effectively" best. Feel free to critique the process as outlined as much as you'd like. The purpose is not to agree with every idea put forth here, but to give you a feel for how the process of reading, understanding, and critiquing works.

5.1 How do we get to our research question?

Usually our questions come from a critical question we ask of something we encounter. These can be from research, or just from our lives: in fact often the two intertwine!!

Let's imagine that one is gathered with their family or friends for a holiday meal and *that* uncle says the phrase "workers should keep their money, not pay it in taxes." A critical mind might be asking what comes next, what questions can we ask that might expand our understanding of this issue, or open up problems? The next question might be "do most workers access public resources funded by tax dollars?" or "if the tax structure were different, would this worker take home more or less money in real terms?"

It's good to think of as many questions about a topic of potential research as possible, but what we really need is something that we can find examples of, data on. This isn't necessarily quantitative data, although that can be rather nice to work with, but it should be a question that we can find examples of and existing literature about. This way we know we'll find some starting places to research an area.

For this example, we'll go with the question "Are there any examples of people with higher and lower tax burden, and what is the outcome?" This question is all about finding an instance that would give us some real traction and data on answering the question. We would get some cases to

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compare against one another, which is often a great way to determine the impact of something like tax burden.

Extra Credit!

Can you come up with any reasons why the Census Bureau might want to skew data? Is there anything the federal government could gain by changing how people report on and conceive of income tax or income data?

Are there any groups or people who you might not trust to reliably produce data on state income taxes or state income?

Can you think of any way these numbers could be skewed?

How would you feel about this data if it was collected by the Majority Committee PAC, a lobbying group associated with Representative Kevin McCarthy, minority house leader. What if it was collected by the American Federation of State, County, and Municipal Employees?

5.2 Finding some early sources

A first series of web searches will take us to a bunch of articles in various online journals and magazines which give information about state tax burdens (and the good ones will not only give state income tax – there are other state-level taxes!), affordability, and quality of life.

Putting “states by tax burden” into a search engine, one result is a wikipedia page called *State Tax Levels in the US* <https://en.wikipedia.org/wiki/State_tax_levels_in_the_United_States>. If I put “states by income” into a search engine, we can find a wikipedia page called *List of U.S. states and territories by income* <https://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_income>. Wikipedia does a really good job of collating lots of information into an accessible format, but we should always take a second to look at where a source is pulling from. Both of the pages say they get their data from the American Census Bureau, so we can reasonably trust that the information is accurate. The Census Bureau is an agency devoted to these exact kinds of statistics and is unlikely to have too much of a reason to skew its data or reporting.

With “State Tax Levels in the US” we can get an idea of how taxes change for residents in different states, and we can use our list of states by income as a very crude approximation for how well people are doing financially in those states.

5.3 Traditional Library Research, Step by Step

Traditional Library Research can look different depending on the library and accessibility, but, following these seven steps will help you be successful conducting your own regardless of which Library you find yourself in.

- 1) **Topic identification:** Clearly defining the research question or topic of interest. Start large and narrow your scope, think about what other fields relate to or inform the field of your main question.
- 2) **Literature review:** Conducting a comprehensive review of existing literature on the chosen topic to gain an understanding of the current knowledge surrounding it. Once you've explored what is already known, information gaps may start to appear or an idea might spark your curiosity, run with it.
- 3) **Source selection:** Identifying appropriate sources and materials that are relevant to the research topic. This step will typically involve using library catalogs, databases, and other resources to locate books, articles, and other relevant documents. Most libraries have staff that are trained in helping you find good sources, don't be afraid to ask for help!
- 4) **Source Evaluation:** Assessing the credibility, reliability, and quality of the selected sources to ensure they are suitable for the research project. Looking to see if the text has been peer-reviewed, meaning it has been evaluated and assessed by experts in the same field or discipline, is a great way to evaluate your source. Using peer-reviewed articles ensures the sources you are using are accurate and valid.
- 5) **Information retrieval:** Accessing the selected sources, either physically or digitally, and extracting relevant information. This step is pretty straight forward. Many libraries have call numbers and maps to help you easily locate texts.
- 6) **Note-taking and organization:** Recording and organizing the collected information. Having a system for noting key information or ideas relevant to your research question will not only help you organize your thoughts, but will also make report writing much more easy.
- 7) **Citation and referencing:** Properly acknowledging the sources used through accurate citation and referencing practices to maintain academic integrity and avoid plagiarism. This is why organizing the information as you collect it is so important. Keeping track of ideas that are your own and those that are someone else's is key to avoiding one of the worst crimes in academia, plagiarism.

As demonstrated, no research question is limited by its field. In any academic project you will need to research a variety of topics, and it is important that you get comfortable doing so with efficiency and precision.

5.4 Noticing Trends

A really good place to start our critique process is to take notice of immediate trends that stick out to us so we can look more into whether there's a useful piece of knowledge behind a correlation. One thing that sticks out is that it seems like states with higher taxes have higher average incomes. We can eyeball this just by looking at the data, but it's important to be critical of immediate judgments like that.

We notice that those exceptions include Alaska and North Dakota. Then a thought comes to the back of our head: "Do I remember something about Alaska giving every resident a check to share oil revenues?" At this point we realize that there is too much nuance. We suspend the "quick bit of research" with this provisional conclusion:

It appears that high state income tax might correlate with high income. This means that higher taxes do not necessarily mean that a worker has less money to spend on what they want. In fact it might go the other way. This would mean that the politician's ten word statement "workers should keep their money, not pay it in taxes" is a pandering phrase aimed at people who do not think critically about those statements.

The Investopedia article "9 States With No Income Tax" <<https://www.investopedia.com/articles/financial-theory/08/standard-of-living-quality-of-life.asp>> seems to cover some ground on accounting for some of these outlier states. They first give quick figures: the state tax burden rank. Putting that article together with the others might give some interesting insights.

We are almost ready to stop the quick dive: this temporary result is an acceptable *interim* conclusion until we have time to do more research. But we don't stop quite yet: we first want to make sure that we list in our mind what are the limitations of the research we just did. Critiquing your own thoughts is important to making sure that when you research, you aren't producing platitudes of your own. A few lingering questions are: (a) that first impression of tax rates correlating with income: is it quantitatively true? (b) does income capture all of quality of life? (c) how about infrastructure? (d) are those numerical rankings good enough or would more be captured by a more complete essay on quality of life in those states?

The idea in the first bits of research is not to suddenly become a genius who knows all there is to know on the implications of tax burdens. Instead the point is to turn give something for your critical brain to play with. To get you to a position where you can ask questions and understand just how much you don't know, and maybe get a sense of where you could start looking to fill in the gaps.

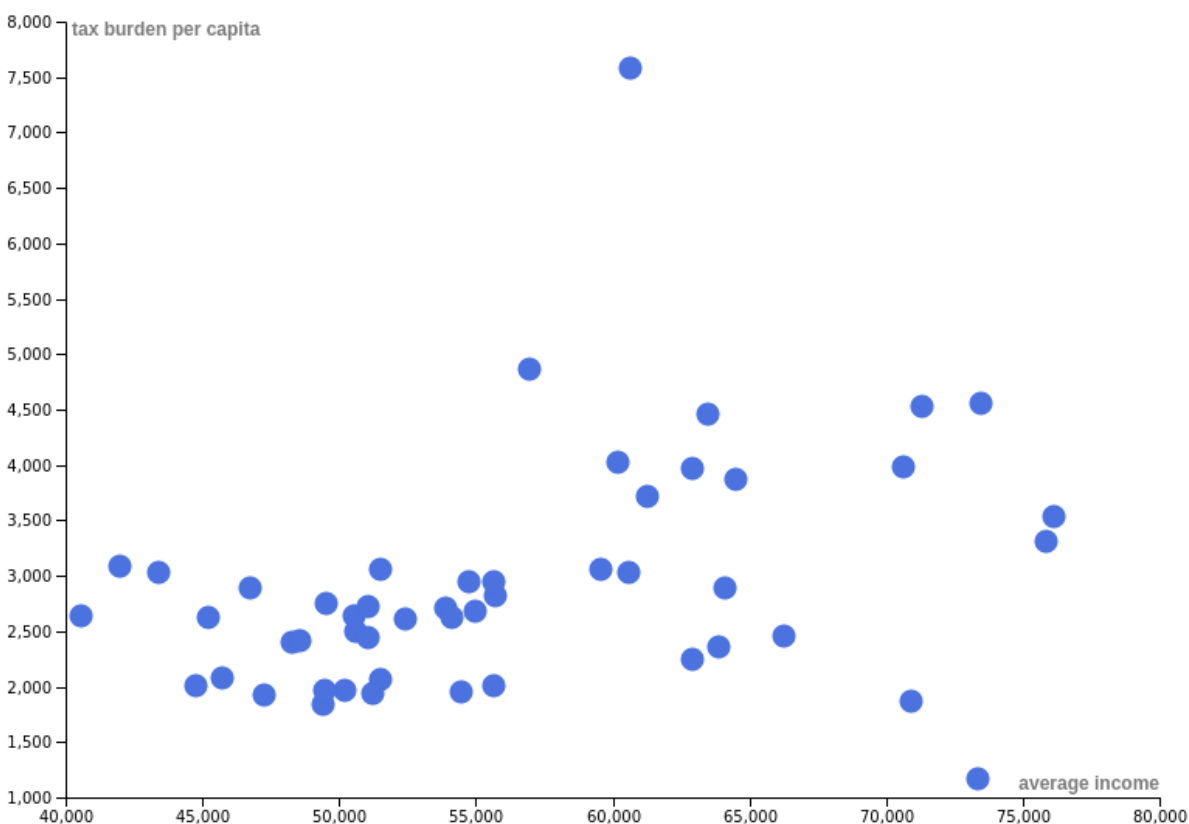
Knowing how to produce this kind of "quick research" to a superficial statement is maybe the most important of our goals: if you learn to get several articles, vet their sources, and reach a deeper conclusion, then you are on the way to being free of misinformation, and free from trusting dangerously shallow reporting.

5.5 Getting Quantitative

Extra Credit!

Can you find any data that correlates more nicely with state taxes?

While this step is a bit over the top if you're just doing a quick bit of research, I quickly pulled the data from the wikipedia pages and compared the 2015 dollars taxed per capita with the 2015 average earnings from each state and whipped up a scatter plot. The trend we noticed sort of holds, but the correlation isn't crazy tight and there are some wild outliers.



The plot suggests that the trend we noticed had a little something to it, but it was too simple. There's a lot more going on than a simple relationship between taxes and earnings.

And remember that correlation is not the same as causation! Even if we established a nicer, simpler connection between taxes and income, we would still have to show the mechanism by which the two influence each other before we could even get close to saying that this correlation shows a causal relationship.

COGNITIVE ERRORS AND SELECTION EFFECTS

6.1 Cognitive Biases

In the late 1960s and throughout the 1970s, the field of social psychology, which is closely connected with areas of economics, was rocked by the research of Daniel Kahneman and Amos Tversky [[New Yorker Kahneman Tversky](#)]. They carried out a series of experiments that showed that humans do not make decisions in the “rational” manner that economists had assumed. Their research led to Kahneman winning the Nobel Memorial Prize for Economics (which he would have shared with Tversky if the latter had not died young), and made for rapid growth in the field of social psychology and behavioral economics.

Economic theory had often assumed that humans were a “rational actors”, making economic, financial, and other decisions based on an evaluation of the probabilities of events.

Kahneman and Tversky carried out experiments that demonstrated the existence and widespread presence of “availability bias” – roughly, the tendency to think that an event is more frequent or important if you can recall examples of it more readily. Their experiments also revealed several other examples of cognitive biases, and inspired other social scientists to investigate others.

There are many classic examples, and some that you could carry out easily with a group of friends, in classrooms, or at parties. Here are a few:

- **Ask this question in a way that encourages a rapid response:** “Are there more earthquakes every year in California or in the United States?” People who follow US media will often answer “California” because of the frequent mention of earthquakes on the San Andreas fault line. After a bit of time they will say “... Ahhhh, I see, of course not” once they realize the logic of California earthquakes being a subset of US earthquakes.
- **Have everyone in a room write down the last 3 digits of their mobile** phone number. Then ask them to write down their guess of how many nations are “member states” of the United Nations. People’s guesses will mostly be incorrect, and those who have just written down a larger number from their mobile will tend to guess higher, while those with a lower number from their mobile will tend to guess low.
- **Ask people who were children in the 1970s and 1980s if there are** more violent crimes today, or when they were kids. Then compare it to the FBI violent crime statistic plots.

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Daniel Kahneman wrote in his famous book *Thinking Fast and Slow*:

People tend to assess the relative importance of issues by the ease with which they are retrieved from memory – and this is largely determined by the extent of coverage in the media.

This is related to some of the humorously described phenomena, such as the Matthew Effect: if someone's name is repeated often, they are more likely to get the credit for something that was done by others as well.

Cognitive biases are tenacious and very difficult to avoid. Many of Kahneman and Tversky's early experiments were carried out at psychology conferences, so their subjects were highly trained in understanding how minds work. Yet, they were still susceptible to these biases. Nobody should think that their *awareness* of cognitive bias makes them immune from its effect, but awareness does help in designing methods and checks that look for such bias in important decisions.

6.1.1 Selection Effects and the “Hidden Prior”

Experienced researchers pay close attention to the sample, the group of people who participate in an experiment, from which a conclusion is drawn. Disaster lurks in ignoring how the sample was selected.

A classic case study comes from the 1936 US presidential election. A magazine called *Literary Digest* polled 10 million individuals, of whom 2.27 million responded. This is an astonishingly large sample.

The result of the poll was that republican candidate Alfred Landon would win the election by a significant margin. Instead the election was won by a landslide by democratic candidate Franklin Delano Roosevelt.

At the same time, researcher George Gallup used a much smaller sample of 50 thousand people. He predicted a strong victory by Roosevelt.

As a skeptical thinker you should be ready to ask the next question: Who were those 2.3 million people? And who were those 50 thousand people?

It turns out that the 2.3 million people were (a) subscribers to the magazine, (b) registered automobile owners, and (c) telephone users. These key factors could have been easy for the *Literary Digest* magazine to find, but this laziness in selection made for a very biased sample. In the midst of the Great Depression, only wealthy Americans could afford to subscribe to a magazine, let alone to own a car or have a telephone line. The result was a skewed sample of the population that did not resemble the country as a whole.

Gallup's 50 thousand people were carefully chosen to be a representative sample of the entire United States voting population, containing people from different economic and social backgrounds.

So, when you see a report of a study always ask the next question. Often that question will be one that looks out for selection effects.

One of the examples in Chapter *Research examples*, Section *Seychelles Islands vaccine mystery*, is a highly topical one as I write this section (2021-06). While there is no definitive answer for the evolving and unclear situation, you can still apply critical thinking skills to look for selection effects that are not clear from some of the headlines.

Another example is given by a Julia Galef, co-founder of the Center for Applied Rationality, in a thought experiment in which she describes in an online lesson at [[JuliaGalefBayesianThinkingVideo](#)].

She describes how a certain approach to statistics, called Bayesian statistics, can help one understand inferences better. In her example, she imagines a university campus which has only math PhD students and business school students.

She then imagines that you see a student acting shy, and she asks the question: “Would you guess that this is a math PhD student or a business school student?”

The initial guess would be a math student: many people think that mathematicians are more likely to be shy and less socially outgoing than most other students, especially business students.

However, if you are trained in critical thinking you ask the *next question*: “How many math PhD students are there at that university, and how many business school students are there?” Once you model that you might get a very different result. If there are 1,000 business school students, and only 3 math students, the probability of that shy student being a math major gets greatly reduced.

Julia calls this unstated ratio of math to business students a “hidden prior”: information that can strongly influence the accuracy of your inference, and that had not been noted. She also shows some simple useful drawings to illustrate this.

Another classic and simple example comes from astronomy. If you look up at the sky at night, and count all the stars you can see with the naked eye, you might conclude that there are only so many stars in the galaxy as you can see. The reason you might reach this conclusion is a strong selection effect: you are only counting the stars you can see! If a star is far away, then for you to be able to see it, it has to be very bright, so your sample *overcounts* the bright stars.

Astronomers put a lot of effort into modeling and understanding these effects, and the result is the knowledge that there are many more dim stars. They are harder to see, so we have to come up with clever methods to estimate their numbers correctly.

6.1.2 Causation Versus Correlation

An often-discussed cognitive error is that of confusing correlation with causation.

Some classic examples are:

- **Rainfall and the sale of umbrellas often increase and decrease** together. You might conclude that umbrella sales cause rain.
- **Patients go to doctors and demand antibiotics for viral infections.** Some doctors do not fight these demands and just fill out the prescriptions. The patient takes the medicine

and notices that the infections improve, and conclude that the antibiotics caused that improvement (they don't: antibiotics do not affect viral infections). Of course what was at work here was the fact that the infections would have started fading on their own, whether the patient took medicine or not.

- **Another classic phrase: “Every time that rooster crows, the sun comes up.** That rooster must be very powerful and important!”
- **In the past, eclipses of the sun have** been treated as dark omens. The ancient and medieval stories of eclipse coincidences are interesting, but sometimes hard to verify authoritatively. For example, there is a NASA page on solar eclipses in history that claims that the English eclipse of 1133 CE was seen as an omen that the King Henry I, son of William the Conqueror, was about to die. In reality the king died in 1135, so this story has been distorted in various ways. Still, even if Henry I had died the day after the eclipse, his death was caused by eating too many lampreys, not by the solar eclipse. Clearly a case of causation fallacy.

On the other hand, another medieval eclipse legend has it that the son of Charlemagne, emperor Louis the Pious, died due to the terror he felt after witnessing the eclipse in 840 CE. In this case the eclipse would have actually caused his death!

We will discuss the King Henry I solar eclipse further in Chapter *Research examples*, Section *The King Henry I Eclipse*

- **A more subtle example if given in an xkcd comic:** <https://xkcd.com/552/>

This fallacy comes up often enough that the latin expression “*post hoc ergo propter hoc*,” meaning “*after this therefore because of this*,” is sometimes used in English.

6.1.3 Confirmation Biases

Confirmation bias is a tendency of the mind to arrange facts to fit a preconception that we have. One classic, almost caricatured, example is that if we are predisposed to think that a person is a bad person, we will see them rescue a puppy and think that they are doing it with some underlying dark intention. If we look hard enough, and are liberal with our interpretations and facts, we can find details that *seem* to show that bad motives were present.

Confirmation bias comes up frequently in medical care, often responsible for incorrect reporting of treatment success.

Steve Hartman [[Hartman2009IneffectiveTreatmentsSeemHelpful](#)] gives a review of how causation error and several other cognitive fallacies come up in medical treatment, including discussions of causation, confirmation bias, and how it relates to the phenomenon of cognitive dissonance. For each of these he gives a description of the phenomenon, a presentation of how it comes up in medical treatment, and sometimes a discussion of the evolutionary psychology aspects of the distortion.

For our purposes, as we train to be critical thinkers, we obviously need to be aware of cognitive fallacies.

6.2 What kind of mind set avoids these cognitive problems?

In a TED talk [[JuliaGalefTEDxPSU](#)] Julia Galef gives an analysis of the “*Affaire Dreyfus*,” a political scandal that rocked French military and political life from 1894 to 1906. Dreyfus, a French military officer, was convicted to life in a penal colony in South America for passing secrets to German agents.

He was innocent, and his innocence was demonstrated clearly, but the combination of prejudice and biases in examining the case resulted in his serving 5 years of his sentence. Eventually, he was finally exonerated and able to resume his military service.

The *Affaire Dreyfus* is a vast cocktail of poor thinking and poor behaviors (including anti-semitism) by the professionals involved in handling it. It illustrates a remarkable number of cognitive biases and other errors. However, a different character emerges from the affair: colonel Marie-Georges Picquart, who investigated the espionage case and found the true culprit. Picquart was as prejudiced as his contemporaries, but his mind set in the investigation was driven by a desire to find out what had really happened, even if that led to exonerating a man he did not like.

In her TED talk Galef contrasts two mind sets: that of the soldier, driven to force a victory for their cause, and that of the scout, driven to learn the real layout of the situation - a situation where curiosity, rather than loyalty, makes you excel. Picquart is portrayed as an example of the scout mind set.

Galef’s “scout mind set” is her proposal for how to do careful inquiry, escaping from the various cognitive defects and avoiding biases. She points out that *awareness* of bias barely helps with overcoming bias, similar to Kahneman and Tversky’s conclusion. The process of entering a scout mind set is a deep reimagining of one’s identity, what type of person you are and what type of person you want to be. Are you someone who whole-heartedly fight for what you believe at that moment, or are you someone who seeks justice and truth (even if they might disagree with your current opinions).

In an interview on Vox [[GalefMatthewsInterviewVox](#)], Galef points out that choosing to identify as the person who “always has the right answer” is counterproductive. One can, instead, identify as the person who “can admit being wrong” and who distinguishes between different levels of uncertainty in their beliefs.

6.3 Implicit Bias and Underrepresentation

6.3.1 Implicit Bias

If you knowingly reach conclusions about someone based on their membership in a group, that is called an *explicit* stereotype. For example, you might say: “One of the authors of this book has an Italian last name; he probably appreciates good food”.

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All of this might seem benevolent and to be “all good fun”, and certainly in that example nobody is getting hurt.

If the stereotype is “One of the authors of this book has an Italian last name; he is probably not a hard worker”, then damage can occur due to unfair treatment which stems from incorrect conclusions.

These examples of explicit stereotype can be corrected with training and adjustment of mind set.

In 1995, researchers Mahzarin Banaji and Anthony Greenwald identified a type of bias that we experience *before* we start thinking about a situation: implicit bias. Implicit bias is an immediate reaction to a person’s appearance, voice, or other facets that place them in a group. [banaji2016blindspot] They also created the implicit association test [BanajiProjectImplicit] which anyone can take. It uses *timing* information on how long it takes you to answer certain questions, and estimates if you have an implicit bias toward certain groups of people.

Implicit bias is insidious: it has an effect on our hiring of people, selecting students, awarding grants, and other actions that affect people’s lives. As you might have guessed by now, awareness of implicit bias does not help much in overcoming it.

A variety of techniques have been developed to try to reduce implicit bias, with various degrees of success.

For our purposes the main things we need to be aware of are:

- **Any bias based on “belonging to a group” is damaging at many levels.** The biggest aspect of the matter is the social justice concern, but lesser aspects of it are still important. For example, we could exclude a good fraction of good people from positions where they can make important contributions.
- **The cure has not yet been shown to be better than the illness.** At this point in our journey as critical thinkers we are well-trained to be skeptical of breezy corporate personnel initiatives. If a company holds a one-day seminar which attempts to eliminate implicit bias, we will not be surprised to notice that the seminar involves a polished speaker, glossy brochures and hand-outs, and mild phrases that discuss problems without being provocative. These are the types of remedies that have been shown to have no effect.
- **We also know that serious, in-depth, and sometimes intrusive** work can improve a scholar’s mind set, so we do not throw up our hands in frustration and say that nothing can be done – we simply prepare for hard work.

6.3.2 Underrepresented and Underserved Groups

One of the consequences of implicit bias is that it makes it harder to tackle the problem of underrepresentation in the more lucrative and fulfilling professions, such as research and science/engineering careers.

Note that most of the underrepresentation we deal with is based on gender and race, although other aspects do exist. I might occasionally give examples from one type or another, but they often apply to all types.

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A comment by Lorena Barba (video at [\[BarbaFrustrationDiversityEffortsInSTEMVideo\]](#) and slides at [\[BarbaFrustrationDiversityEffortsInSTEMSlides\]](#)) is key here:

Occupational gender segregation is one of the leading factors in the wage gap, and therefore desegregating high-paying, high-demand occupations is a social-justice concern.

(The same goes, of course, for occupational race segregation.)

Most of the attempts at removing bias-based obstacles in the path of underrepresented groups start too late. When you apply to a university, or for a job, there are often careful safeguards in place to make sure that you are not passed over due to bias. Or, there was, but with recent supreme court decisions on Affirmative action, the safeguards become more and more unstable.

Much of this is too late anyways, because of the role of implicit bias in earlier stages of screening for student aptitudes.

An example on the gender side of things: in late elementary school students are often encouraged to start taking computer programming courses. The students sent this way are almost always boys, and the difference starts here. Implicit bias enters the picture from many different angles. One example is that there is a frequent feeling that boys are beginning to spend too much time in video games, and a programming course will give them a better use for their computer. Additionally, girls are seen to be more gifted in the artistic fields and can be told not to bother with the complexity of math and computers.

Other implicit biases have teachers correcting very young boys and girls for different types of failures, with the suggestion that girls are trained to be more risk-adverse, and thus to avoid areas of very high complexity.

A few years later, this body of students has moved on, say from 6th grade to 12th grade, and formal methods are now in place to make sure that young women are given career advice that is as valid as what is given to young men. However, by then the spirit of tinkering has been largely lost. University Engineering faculty have to work to compensate for years of difference in the amount of engineering training.

For our purposes, as critical thinkers, we want to develop a few reactions to this deeply flawed situation of underrepresentation in many exciting careers. We want to feel the social justice aspect of it deeply: all people should have the same *access* to lucrative and fulfilling careers. We also want to question easy statements about solutions to these problems. We need to intervene early on to make sure that all the needed encouragement is given to people from underrepresented groups. Don't worry: the people from entitled groups will still get those opportunities and they will do just fine!

A final note on bias in the work place: I mentioned that once we enter the professional workforce we have professional norms and human resource departments with policies and procedures. And yet, the situation is not rosy even then: there are persistent occurrences of efforts to belittle and even try to eliminate diversity efforts.

A portion of Lorena Barba's talk (mentioned above) is a discussion of the notorious 10-page anti-diversity manifesto circulated by a Google employee in 2017. This shows that even in our day we

still have highly educated and well-employed people who feel the urge to fight against diversity efforts.

6.4 Groupthink and red team exercises

Groupthink is an insidious psychological phenomenon in which a group of people start making irrational or dysfunctional decisions because they are trying to prioritize harmony and getting along with others above all else. It's easy to go with the flow of the people around you and default to agreement, but this is an easy way to fall into beliefs you might not hold if you were to scrutinize them.

The term is inspired by the dystopian political fiction from the mid-20th-century: Orwell's novel 1984. The novel described deliberate brainwashing of the population by the authoritarian leadership. While the psychological phenomena of groupthink is not always deliberate, or forcefully imposed, it still results in a similar conforming of views.

On "Unity"

Not always, but often, people who wish to prioritize "unity" are unknowingly encouraging group think. When you encounter calls for "unity" above other values, ask yourself if this "unity" is really representing a helpful solidarity, or if it is instead trying to quell dissidence without addressing people's concerns.

Research psychologist Irving Janis applied his theory of groupthink to study a whole collection of policy fiascos, including Nazi Germany's decision to invade the Soviet Union, the Bay of Pigs invasion, and the escalation of the war in Vietnam.

Historians and social psychologists have written extensively about this, and debate the role of groupthink in these events. A broad and deep reading of this subject can be thought-provoking and rich in insight.

More recently, groupthink undertones can be found in online communities, specifically in memes. The term "meme" was first coined by the British evolutionary biologist Richard Dawkins in his 1976 book "The Selfish Gene". Though published long before the emergence of internet culture, Dawkins used the term to describe an idea, behavior, or cultural practice that spreads from person to person through imitation. Coming from the Greek word "mimema," "something imitated," the term has been adopted from its original use to refer to rapidly spread or replicated images or jokes. Often, this quick change of information on the massive scale that is the internet can result in the reinforcement of existing biases, echo chambers, and the suppression of dissenting opinions. Is a meme of a cute kitty going to make you part of groupthink? No, of course not. However, darker recesses of the internet may use memes, information that screams "Copy me! Imitate me!" to create groupthink driven environments. When memes venture into the dark and begin to blur fact and satire, danger can arise.

Critical thinkers need to be aware of the possibility of groupthink when they see anything that is the result of a group of people pondering an issue. They should look beyond the surface and make sure that the group was chartered with explicit awareness of this danger.

To avoid the dangers of groupthink the United States Department of Defense created the idea of “red team exercises”. A “red team” plays the role of an opposing side, fully immersed in the opposition’s goals and not influenced by one’s own side. Red teaming is now used in many areas of military and cybersecurity activity, as well as being used in some scientific projects, where a separate team is created to look for problems with a scientific software architecture.

Red teaming is important, but we should always ask what comes next. A breezy statement of “we have red-teamed this . . .” does not mean that we are safe. Management chains will often send the results of a red team to an upper layer of management without emphasizing the problems that were discovered.

Two vivid examples of red team exercises that were ignored are a 1932 simulation of an attack on Pearl Harbor, and some of the results from a review of Boston’s Logan Airport security conducted before the 9/11 terrorist attacks, where two of the hijacked 9/11 airplanes departed from.

The ways in which red teams get ignored is shown in one whistleblower’s testimony to the US Congress during the 9/11 hearings:

The bottom line of FAA’s response to its Red Team findings is that the Red Team was gradually working its way out of a job. The more serious the problems in aviation security we identified, the more FAA tied our hands behind our backs and restricted our activities. All we were doing in their eyes was identifying and “causing” problems that they preferred not to know about. [[DzakovicNineElevenTestimony](#)]

Red Team Exercises can provide a solution to the dreadful groupthink, but, like anything, it can only be effective if executed properly.

WORKSHOP SKILLS

7.1 The Ballad of Jack Thompson

In the mid 1980s I met a remarkable scholar and artisan. Jack Thompson ran the Thompson Conservation Lab in Portland, Oregon [[LienhardAConservationLab](#)]. He developed techniques for the conservation of anything related to books, with a particular interest in medieval bookbinding technology.

Jack's achievements were significant: he was the expert cited in all aspects of medieval book technology, from identifying types of ink, to how paper was made, to making sewing needles from hog bristles [[ThompsonNeedles](#)], and how to identify parchment [[Thompson2002](#)]. He also had designed and built the environmental system used to preserve the Lincoln Cathedral exemplar of the Magna Carta [[Thompson1987](#)], and taught an annual full-immersion workshop on "The Technology of the Medieval Book" in a remote off-the-grid mountain area in Idaho [[Thompson1994](#)].

I asked how he had reached his level of proficiency in both theory and practice, and he replied with a warm and gentle voice "For me it all started with workshop skills. I had always spent time in carpentry workshops [...]"

Jack had then gone on to add a broad and deep knowledge of chemistry to his workshop skills. This combination of skills allowed him to carry out his wonderful conservation program.

This encounter was early in my career, and in my entire career I have noticed that:

Every area of endeavor includes a combination of *theoretical knowledge* and *workshop skills*.

Your achievement will be enhanced more by your workshop skills than by your knowledge of subject matter. You should spend your entire career perfecting and updating your workshop skills.

If you are a writer and a very slow typist, then you will not be able to get your idea down for revision and dissemination.

If you are a programmer then you spend a great amount of time moving chunks of text around within a file or between files. If you detach your fingers from the keyboard to use a mouse every time then you will be much less productive than someone who has mastered their programming editor.

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If you are a cabinet maker and you have designed a wonderful piece of furniture, but you are not fast and precise with your table saw, then you will take a very long time to produce it, and you will not have a chance to implement your next design idea.

We will now look at various examples of workshop skills that are needed in most areas of scholarship.

7.2 Keeping Research Tidy

Research is a process of accumulating many sources and perspectives on a subject. For this accumulation of information to really serve you, you need to be able to easily organize and access all of your sources. Any time you come across a new piece of information, regardless of how good you really think it is, you might want to see it again later. You need to develop some way of quickly keeping track of what you come across. This can be something as simple as a document with citations in it, or a library created with database management software.

7.2.1 Citations

A citation is a short piece of text that contains information about where a source can be found. It'll have information like the source's title, its author(s), and its publication date. Storing citations for what sources you use helps you find those sources again later, and adding citations to the products you create lets people know who research and knowledge should be attributed to. Read more about the importance of citing sources in products in *What is Plagiarism?*

It can be daunting when you see the massive list of traits a citation needs, but you don't always have to fill in every piece of information. Fill in all the information you have access to, but if you don't have the publisher location, your citation will be okay without it.

Italics vs Quotation Marks

When a source is short or is part of a larger container (a short story, a chapter in a book, an article in a journal, etc.) the title should have quotation marks around it. The title of a long source or container (a book, a journal that publishes many articles, a TV series with many episodes, etc.) it should be italicized.

Different teachers, professors, and fields will use different citation styles, here's a very brief overview of the commonly used styles with their respective field.

- Modern Language Association (MLA): often used in the humanities.

Author Last, First MI. "Source Title." Container Title, Other contributors, Version, Number, Publisher, Publication date, Location.

- American Psychological Association (APA): often used in the social sciences.

Author Last, FI. (Publication Date). Source Title. Publisher

- Chicago Manual of Style (CMS): used in both the humanities and the sciences, depending on the variation, the notes and bibliography system or the author-date system.

Chicago uses two main citation styles, long note:

Author full name, Book Title: Subtitle, edition. (Place of publication: Publisher, Year), page numbers, URL.

And short note:

Author last name, Shortened Book Title, page number(s).

- Institute of Electrical and Electronics Engineers (IEEE): often used in engineering and computer science.

Author initials. Last name, Book Title. City (and state if in US), Country: Publisher, Year.

- American Medical Association (AMA): often used in medicine and biological sciences.

Author last name Initials. Source title. Container. Year;Volume(Issue):Page range. DOI or URL.

- Council of Science Editors (CSE): often used in the natural and physical sciences.

Author(s). Title. Edition. Place of publication: publisher; date. Extent. Notes.

7.2.2 Source Management Software

There are many pieces of software for managing your sources, and the one we'll be talking about here is called Zotero. It's free, open source, and cross-platform, but other solutions do exist. Below we'll be walking through some of Zotero's features and how to integrate it into your workflow.

To install Zotero, you'll want to go to their [download page](#). You'll want to download both the desktop application for your operating system as well as the "connector" extension for your browser.

7.2.3 Adding Sources

Automatically With the Connector

First make sure that the Zotero desktop application is running. In your browser, navigate to the source you are using. This can be a news article, social media post, academic journal. The Zotero connector is really quite robust. In the toolbar of your browser, find the Zotero connector icon and click it. You should find a matching entry has been made in your desktop application's library. If there is an associated pdf like with an academic journal, Zotero will automatically download it for you so you always have access to it.

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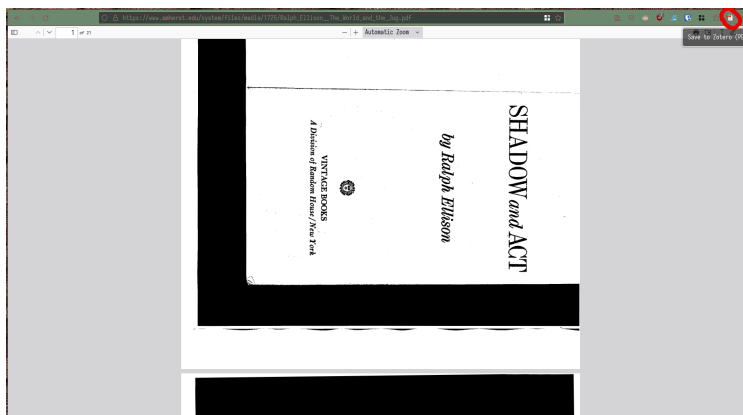
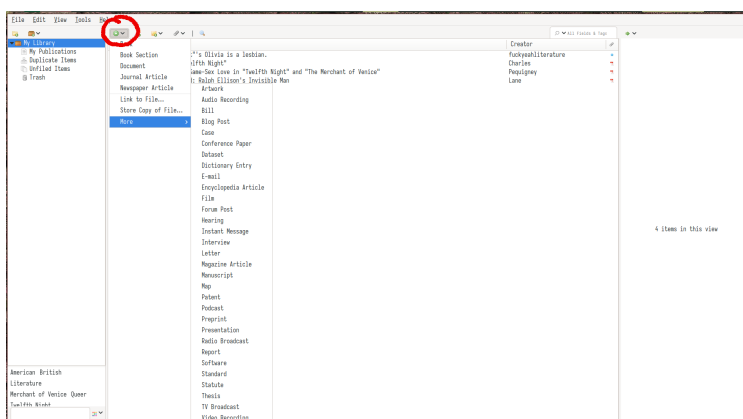


Figure 7.2.3.1: The Zotero connector extension might not always be in the same place depending on your browser, but it's most likely in the top right hand corner.

Manually in the Desktop Application

If for some reason the connector isn't working, or if you're working with a source not in your internet browser, you can add sources manually as well. In the top left is an icon that has a green circle with a white cross.



Clicking this will open a dropdown menu that lets you select the type of source you're storing. Then a sidebar will let you input all of the fields that you have access to.

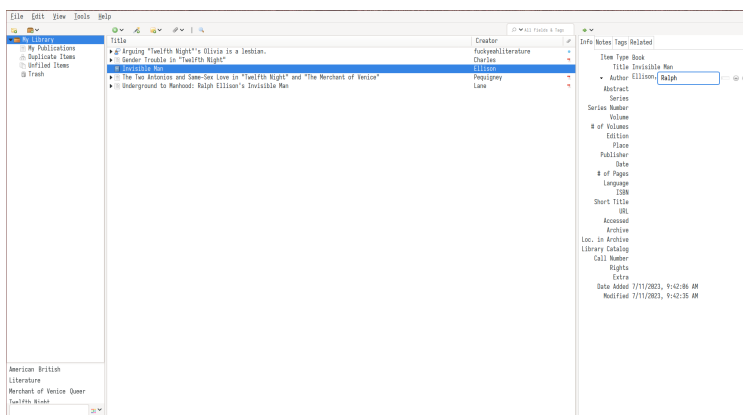
7.2.4 Annotating Sources

At the top of the sidebar where you manual add information about your source, there are a few extra tabs. Two important ones are "Notes" and "Tags"

Notes lets you add small pieces of formatted text to your entry for that source. These can be a great place to store information about what you thought about your source, what you might use it for. You can even use this as your primary note taking tool so that all of the information you have for your research is managed in the same place.

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Tags let you organize your library so that it's easier to find what you're looking for later. If you have a bunch of sources on astrophysics and a handful of them are on pulsars, you could tag all of them with “pulsars” so that when you decide that you want to reference those sources again for a write up or presentation, you can see all of your pulsar related sources by clicking the “pulsars” tag that was created in the bottom left hand corner.

7.3 Time management

When balancing many due dates and topics, time management is a skill you must develop, and the sooner the better. Like most things, there is no one right way to time manage, but taking the time to find what works best for you can be easy, and will be worth it. Here are a few techniques I like to use when managing my time.

7.3.1 Planners

There are a multitude of types of planners on the market. There are daily views, weekly views, and monthly views. I suggest finding one with all three. There are some really fancy ones and some more bare bones ones on the market. Some programs available.

These three views are helpful for different reasons. The monthly view is useful when keeping track of upcoming deadlines, for example, a paper due or a test coming up. Something that you know about in advance and need to do some prep work for.

Weekly views are helpful for keeping track of short term deadlines, things like quizzes or meetings. Having these short term appointments visible when your planning your week will help you more accurately gauge what you can realistically accomplish each day and week.

Daily views are great for day to day tasks. Making to do lists here will help you keep track of what you'd like to do each day, and over the long term will give you a good idea of how much you realistically accomplish each day. Plus, it's always fun to cross things off your to do list.

7.3.2 Knowing Your Work Style

Are you someone who can sit down and work for four hours straight? Or are you someone who works in short bursts. There is no perfect work flow, and trying to force yourself to work a certain kind of way will most likely be unsuccessful. This is why it's important to work *with* your brain, rather than against it.

If you find yourself losing focus, try the Pomodoro method (working for 25 minutes, then a 5 minute break and repeat). Maybe some days will be better than others. If you feel stuck, try walking around the room or saying what the issue is out loud.

The environment you work in can greatly impact your flow. Are you someone who needs total silence, or are you someone who needs background noise. Do you like working around or with others? Or are you more of a solo worker?

Finding what style works best for you is a matter of trial and error, and it might even differ subject to subject, task to task. Finding your work style is important for time management because it allows you to be as efficient as possible.

7.4 Communication and Collaboration

7.4.1 Collaboration with peers

Clear Communication

Clearly communicating is an essential skill in all aspects of life, but especially useful when collaborating. When working with peers, clear communication looks like providing constructive feedback and being open to suggestions. The whole point of collaborating is the free exchange of ideas. If your peer has a suggestion for your work, or vice versa, keeping an open mind and friendly disposition will encourage a mutual exchange, and will result in a better end product than you might have been able to create on your own.

Set Shared Goals

Part of your communication skill is the ability to define and set goals. These could be lofty goals of the project as a whole, and smaller picture goals of accomplishing tasks. When collaborating, you want to make sure everyone is on the same page with what is expected of them. Setting realistic timelines and expectations for the amount of work each person does will ensure you are able to successfully produce something of quality.

Assign and Delegate

Once the shared goal has been set, you can assign and delegate tasks. There is power in numbers, the more eyes on a project the more insight will be provided and the team will be more efficient. Build off skills and strengths of your team members. Is one person very organized? Is someone else well versed in tech? Not only will this allow each member to shine as individuals, but it will make it a smoother and well rounded process.

Respect and Trust

Respect diverse perspectives, foster trust and mutual respect, and be flexible. Doing these three things help create a supportive and positive environment. Teams where people feel unwelcomed or ostracized rarely do good work.

Resolving Conflict

Be ready to compromise, not everyone will agree all the time. It's a cliché, but there really is no "I" in team. That being said, make sure you are advocating for yourself when appropriate. The best way to resolve conflict is an open discussion with the parties involved as well as other members of the team. Having a mediator present allows you to find a solution that satisfies all parties.

7.4.2 Collaboration with mentors

Communicate

Your mentor is there to help you, seek guidance and feedback. However, you don't want to only talk to them when you have a problem. Even though they are there to help you, they are people too. Establishing regular communication, expressing gratitude, and staying connected will help you form a rewarding and long term relationship with incredibly interesting people! Just as you would when collaborating with peers, be receptive to guidance. That's what they're best at after all.

Respect

Your mentor has worked hard to get to their level of expertise in their field. It's of the utmost importance that you show them respect. The easiest way to do this is by being respectful of their time. Not all mentors are the same, some will love to chat and be available anytime, others might not. Show them respect by maintaining confidentiality and trust, they are sharing their vast knowledge and forming a relationship with you, so it's important to show appreciation for that.

Take the Wheel

Your mentors are more than likely very busy working on exciting new projects or lecturing other students. The best thing you can do is not make them do all the work for you. Establish clear goals and expectations, be proactive and prepared, take ownership of your growth. They are there to guide you, but if you don't man the ship, nothing will come of it.

7.4.3 Effective use of email

Here is an example of an exchange between a student and one of his mentors.

The backdrop is that Dan had interned with Felix the previous summer, and had also been mentored by Jake in the past. Dan is a very good mathematician and programmer, but is still working on improving his written communication skills.

Now (spring 2021) Dan has called Jake to ask about summer job strategies, and that kicks off this sequence of emails.

Happy ending spoiler: after this exchange Dan got a summer job working for Felix.

Note: The people mentioned here are not called Dan Chesterton and Jake Clovelli and Felix O'Sullivan, but apart from changing their names, the exchange is reported here exactly as it happened.

First request by student

```
From: Dan Chesterton <dchesterton@example.com>
To: Jake Clovelli <jakeascoli@example.com>
Subject: email consulting
```

```
Hey, this is Dan Chesterton, last night on the phone you said that
you would review an email to Felix O'Sullivan and give me tips.
```

```
Here is what I have at the moment
```

```
" Hello, this is Dan Chesterton, you were my mentor last summer for
↳the
Computing in Research program. I was wondering if there was any work
↳that I
could do for you this summer, or if you knew of a place where I
↳could do
some computer-related work over the summer. "
```

First response-by mentor

From: Jake Clovelli <jakeascoli@example.com>
To: Dan Chesterton <dchesterton@example.com>
Subject: Re: email consulting

Dear Dan,

Here is a lesson in "soft skills".

First of all, you use standard politeness tips. So for example, when you write to me you do not put it as a demand that I fulfill my promise, but rather as a "thank you". That means that this phrase:

```
> Hey, this is Dan Chesterton, last night on the phone you said that.
↳you
> would review an email to Felix O'Sullivan and give me tips.
```

would have sounded much better to me if it had been:

```
""""Dear Jake, thank you again for offering to help review my email.
↳to Felix.
```

```
Here is a draft -- do you think it could do with improvements?""""
```

```
Do you see the difference? The wording I propose is introduced in a
↳polite
format which is standard for business correspondence. It goes on to
↳show
appreciation, and then asks for the favor within that spirit of
↳thankfulness.
```

As for the letter to Felix, here are some things to think about:

1. He certainly remembers you, so that beginning is awkward.
2. You need to show appreciation for what he did for you last summer. I don't know if you have written since then to say "thank you", but in any case you need to begin this letter in that way.
3. You do not mention how much you like systems programming and low level work. Your enthusiasm is what will make him happy and motivate him to look for something for you. Your phrasing sounds like "I need to make some money; can you help me do

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that". Instead it should be bursting with this kind of message: "last summer you showed me a fascinating path, through free and open-source software, to do technically really cool things. I would like to do more Linux work. Might you, or any people you know, be looking for summer interns to do IT or systems work?"

4. You do not mention what you've done since. He volunteered his time to work with you last summer. You owe him to keep him posted. (Side-note: you also owe it to Ms. Vilnius -- she did a lot of work to get you the job last summer.)

If you understand those points, you could write me another draft. Then we can get into specifics.

Next iteration from student

From: Dan Chesterton <dchesterton@example.com>

To: Jake Clovelli <jakeascoli@example.com>

Subject: Re: email consulting

alright, thanks for the advice, communicating with people can be a
↳ little
difficult for me.

here is what I have with your suggestions

"

Hello, I want to thank you again for helping me out with my project.
↳ last
summer. Since then I got accepted into NMT where I will double major.
↳ in
both Math and Computer Science, I have also been studying Java and
↳ abstract
Math in preparation.

Last summer you showed me the tip of what can be done with open-
↳ source
software and the cool systems that you can make with it. I would.
↳ like to
continue to see the things that are being done with Linux and
↳ OpenWrt. I
was wondering if you, or if you know of anyone, that is currently
↳ looking
for interns to do IT or other related work.

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"

Final tip from mentor

From: Jake Clovelli <jakeascoli@example.com>
To: Dan Chesterton <dchesterton@example.com>
Subject: Re: email consulting

> alright, thanks for the advice, communicating with people can be a
↳ little
> difficult for me.

Nah: once you make it a goal then it's a skill like any other, and
↳ your
rewrite of the email is very good, so clearly it's just a matter of
↳ wanting to
do it :-)

The only thing I would suggest is that you add the two words "this
↳ summer" at
the very end of the message, and then send it off.

Closing of the exchange from student

From: Dan Chesterton <dchesterton@example.com>
To: Jake Clovelli <jakeascoli@example.com>
Subject: Re: email consulting

and the email is sent,

thank you so much Jake!

7.4.4 A good start is not enough

Two years later there was a sad afternote to the story:

Jake recently met Felix and found out that in the end the student Dan had interned but never did any work. He just spent all his time scrolling things on his phone instead of taking initiative.

Conclusion? The better use of email worked well for Dan, but he still had to develop a more mature work ethic.

PRODUCTS

8.1 The Written

Here I will just put it very concisely: you need to be ready to write a lot.

Don't let your perceptions of traditional scientific writing influence you too much because:

Almost all scientific and technical writing is lousy.

8.1.1 Backing Up Your Claims

Whenever you state a fact in your paper, you need to back it up. Of course, some facts are common knowledge, you don't need to prove that the sky is blue, for example. However, anything beyond common sense needs to have an explanation or a source.

This is important because it validates your thesis. Too often when I'm editing I'll make the note "How do you know this?", "So what?", and "Expand". Don't assume your audience knows the nuance of your topic, explain it to them.

8.1.2 Proper Scope

Since you need to back up each of your claims, it's important to limit your scope. In a typical 12 page paper, you won't have room to address huge topics or make massive statements about incredibly complex questions. Limiting your scope to something manageable will keep your writing clear, concise, and valid.

8.1.3 Appropriate Language

Different audiences require different tones. However, you don't want to use words just to sound smart. If you're going to use a word, make sure you know what it means. When writing academic papers, avoid slang. At the same time, using colloquial terms or phrases can be an effective way to ground your readers in something they understand and relate to.

8.1.4 Practical Advice

Here are some practice tips to keep in mind when writing.

- 1) Avoid platitudes. In the chapter Critical Thinking, we covered why platitudes are problematic when engaging with critical thinking, those same sentiments are applied to your writing. You want to say something worth saying, and a platitude is not that.
- 2) Do not generalize. In the same vein as avoiding platitudes, you want to be careful not to make huge claims that you can not fully back up.
- 3) It's better to understate than to exaggerate. Just as you want to avoid generalizing, it's better to be reserved in your claims than to be too liberal.
- 4) Avoid Repetition. You should assume that your readers are intelligent. Unless you're repeating in a way that clarifies or adds new information, you don't want to say the same thing over and over again. You want to avoid repetition. Do not repeat.
- 5) Make sure your subjects and verbs agree. Here's a helpful example: The list of items is on the desk. The items are on the desk.
- 6) Avoid double negatives. Double negatives are a fun aspect of the English language, but should not be used in your writing. It is not not confusing.
- 7) Avoid sentence fragments. That in itself is a sentence fragment. When doing academic writing, make sure each sentence has at least a subject and a verb.
- 8) Don't over use exclamation marks!! Over using exclamation marks are fine when texting your friend, but not when writing a paper. It sounds informal and makes you seem anxious.
- 9) Don't discount your points. Too often I'll see someone discount their claim before even making it. An example of this would be saying: "Other scholars might disagree but I think..." If other scholars disagree, bring them up after your claim.
- 10) Avoid adjectives and adverbs. While useful in fiction writing and world building, adjectives and adverbs don't do much for academic writing. If you feel like you have to use an adverb to get your point across, you should pick a different verb.
- 11) Use spelling and grammar checking tools. I am awful at spelling, these tools have caught things I haven't many times.
- 12) ALWAYS proof read and edit. You will never write something perfectly the first time round. Proofing your writing will help you avoid embarrassing or silly mistakes.

8.2 The Presented

You should repeat this mantra frequently:

Note: Almost all presentations are lousy.

That means that your advice and examples should come from people who are aware of this and are trying an approach to give non-lousy presentations.

8.2.1 Problems to Overcome

Here are some frequent issues with presentations, and our attempt at guidance in overcoming them.

Mechanical (i.e. slides)

Slides that are bullet lists, or have large chunks of text, are usually awful.

Content

The talk is not that interesting because the content is not good. The speaker does not motivate the subject matter.

Confusion

The lack of a clear plan, so it later feels like it was a jumble of information, with no take-home points.

Dynamics

The speaker's tone doesn't work. Not all speakers are lively, but that's OK: A deadpan speaker can deliver very compelling talks. So the problem is a nuanced one, usually boiling down to the fact that the speaker has not yet found a good synthesis of their speaking style and the way they organize the material.

Another problem that comes up quite frequently, especially in younger presenters, is that of speaking too quickly.

8.2.2 The Solution - a reasonable baseline

Mechanical

The TED organizers have thought about this matter carefully and have come up with good guidelines on preparing slides.

<https://www.ted.com/participate/organize-a-local-tedx-event/tedx-organizer-guide/speakers-program/prepare-your-speaker/create-prepare-slides>

Following their guidelines on images and text-heaviness will solve most of the mechanical problems. My brief summary of those points is that *you* tell the story with *your voice*; the slides just provide visual aids and props. You *never* read off slides.

Solving these mechanical problems with slides will have a cascade effect that will help solve some other shortcomings as well.

Some more advice from the TED people is at:

<https://ideas.ted.com/6-dos-and-donts-for-next-level-slides-from-a-ted-presentation-expert/>

In this post they show (item #4) a specific example of going from a first pass with busy graphs to a final graph that is much easier on the audience.

You also get a significant improvement with almost no work by simply shifting your slide aspect ratio from 4x3 to 16x9. Make this setting the default, and you will find it hard to go back.

Content, Confusion, and Dynamics

The talk is not that interesting because the content is not good. The speaker does not motivate the subject matter.

Confusion is generally caused by the lack of a clear plan. Not having a plan makes your presentation feel like it was a jumble of information, with no take-home points.

Issues with dynamics arise when speaker's tone doesn't work. Not all speakers are lively, but that's OK: A deadpan speaker can deliver very compelling talks. So the problem is a nuanced one, usually boiling down to the fact that the speaker has not yet found a good synthesis of their speaking style and the way they organize the material.

Another problem that comes up quite frequently, especially in younger presenters, is that of speaking too quickly.

8.2.3 The Solution - our proposals

Sorry: I have no simple solutions here. This is part of having done good careful work before you prepare a lecture.

But there are things you can do if you “speak too quickly”: get in the habit of pacing the floor back and forth in front of your projected slide (or in front of your blackboard). As you do so, gesticulate toward parts of your slide, emphasizing that in your voice. Then put pauses after you tell the audience something you want them to think about. This kind of lecture, with pacing around and dynamic behavior on your part, tends to work quite well.

Keeping Your Audience Engaged

Now for the next step toward really gripping your audience. I will give you some prescriptions. You should not take them as gospel (they are my style, after all, not necessarily yours), but rather see how they mix with your own style, and if they are useful.

For some of these I have links to some talks, or articles about talks.

Cognitive Basics: Don't Tire Your Listeners

Listening to long winded stories, or reading certain materials, forces the listener or reader to do a lot of work to understand how it comes together.

Don't do that to them.

Your lecture shouldn't feel like watching the Matrix Movie for the first time; confusing until a brief moment of clarity at the end.

Attitude: The Grizzled Veteran

Here's a tip I give people when they give talks: talk like you're a grizzled old-timer in that field. Have fun telling stories and presenting the “insider” view.

This also applies when people are 16 years old: they have experiences and they can present them like veterans.

For example, let's say you are talking about the C programming language, developed between 1972 and 1973 by Dennis Ritchie at Bell Labs.

You could simply present the facts and say

“C was developed by Dennis Ritchie at Bell Labs between 1972 and 1973”.

Or you could add color as if you were in the room when it happened, and add:

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“At the time FORTRAN was the most widely used programming language, but it was only effective for scientific computation and not for systems programming. Back then systems programming was almost entirely done in assembly language, a very detailed language which maps directly [and here you are using hand gestures to drive your point home] to the machine codes. Few people are happy writing big programs in assembly. Ritchie’s genius was to design a language that was good for both *low level* programming (you really know what’s happening in the hardware when your C program runs) and high level programming (you have high level features like structures). C adoption spread rapidly and Ken Thompson and Dennis Ritchie re-wrote the early UNIX operating system in C.”

As you tell the story you chuckle and express the fun that an old-timer would have remembering those days when C came onto the scene.

You could then continue by saying that in the 1980s and 1990s C became the choice language for high performance numerical computing, gradually overtaking FORTRAN (although FORTRAN still retains an enduring market share).

And of course that’s all your story-telling: it’s not on the slides. You have been pacing the room and using hand gestures to tell this story.

As an example, those familiar with old Rock and Roll music might remember the song “Sympathy for the Devil”, by the Rolling Stones. The character narrating that song in first person is the ultimate grizzled veteran.

So why would you do all this? Audiences want to feel that they are listening to a key person in the field, someone who was part of the story they are telling (even if only because they studied it). Giving them that feeling makes them enjoy the talk more, be less fatigued, and learn better.

Having said all this, there are valid criticisms to the attitude of the grizzled veteran. One is:

- It is frivolous and wastes time. A solution: make sure that after every one of those anecdotes you return to a serious part of your project that drives the science forward. Ramble a bit, but then show that you are a no-nonsense researcher pushing forward, not someone trapped in nostalgia.

For the sake of rigor, and to keep up our habit of being hard-nosed and brutally honest in our reporting, I will add some crucial requirements for the speaker who wants to come across like a grizzled veteran:

- You must have really studied the material so well that you can tell the stories authoritatively. Audiences spot that feeling of depth and they understand when you have assimilated the story, rather than memorized the words in the story.
- You must be accurate.
- You must calculate carefully that the stories will give new *insight* to your audience - otherwise they are indeed a waste of time. The story of Dennis Ritchie shows how this remarkable innovation came out of a crisis that needed a solution, and also paints the picture of a thriving dynamic team at Bell Labs in that period.

Another example: your discussion touches upon Dante. You could say:

“[...] Dante, the medieval Italian poet and writer, [...]”

Or, if you intuit that your audience barely knows who Dante was, you could take the opportunity to add:

“Here’s how to visualize the intellectual landscape in Italy in the late 1200s: people had started moving from farmhouses and villages into cities again, reversing a trend that had started with the fall of the Roman Empire. This means that there was a new intellectual pole: earlier the only scholars were monks in monasteries – names you might have heard are Abelard and St. Thomas Aquinas. Now, in the late 1200s you have city-dwelling intellectuals, often drawn from minor nobility or even the bourgeoisie. Dante grew up in this environment in Florence, and he became a poet - by many accounts the greatest poet in the Western canon.”

Motivation: Personal and Global

Always remember that **motivation is everything**. Repeat this to yourself again and again. You start out by giving the motivation for the work you are presenting.

I suggest offering motivation separated out into two categories:

1. Your personal motivation - this is where you tell them why you are fascinated by something, what drove you in to this. Keep it brief, but do bring it up: it is part of how you charm an audience into following you more closely.
2. The “deep in the bones of the world” motivation: this is where you reassure the audience that you and your colleagues understand the nature of the world, and how your research subject fits into it. If you are talking about a narrow result, you still connect it to one of the great themes that drive history.

The second type relates back to the “attitude of the grizzled veteran” suggestion above. Audiences like it when you project that you speak from that depth. The psychological factor is huge: when our up-and-coming generation of young researchers (like you) project a smooth calm competence, audiences really get a lot out of the talk. (Of course part of this is due to the fact that your big-talk subconsciously justifies the time they devote to your talk - but “take the win”: it means they will pay attention and remember more.)

Humor: An Effective Crutch, but is it Useful?

There are debates on how you should use humor in talks, or any discussion. There are convincing reasons to do so (keep the audience engaged), and convincing criticism (it is a crutch - you could work harder and hook your audience without the distractions of jokes).

In addition, humor has to be used carefully since the same joke is perceived differently by different cultures, sub-cultures, and individuals. Some solve this problem by having the humor come out in subtle ways, like carefully pointing out an amusing irony in a situation.

In general I enjoy humorous talks, and remember their points better, so *I personally* encourage humor in talks – but remember what I said above about the “old-timer storytelling” attitude, when I pointed out the “it is frivolous and wastes time” criticism. A solution is to make sure that after you take a humorous flight, you quickly return to the serious discussion of the work. This rapid return to serious work creates a subliminal perception of momentum in the audience, and they leave with a feeling that good and important things are happening.

Here are a few lectures I have enjoyed, which highlight different ways in which humor is used or not:

Tim Urban’s “Inside the mind of a master procrastinator” <https://www.youtube.com/watch?v=arj7oStGLkU> Tim Urban’s talk is almost entirely humorous, and while his take-away points are valid, the results are also to be seen in a humorous vein.

Paul Bloom’s TED talk on the value of art <https://www.youtube.com/watch?v=RPicL1AWrs8> Paul Bloom’s talk is a serious discussion of how the mind assigns value to things, but all the examples he gives are quite funny.

Julia Galef’s discussion of the “hidden prior” https://www.youtube.com/watch?v=BrK7X_XIGB8&t=207s Julia Galef mentions a joke in passing, but mostly to make a point about people’s perception of mathematicians. For the rest her talk is serious and to-the-point. I like it as much as others because she discusses an important point carefully.

Not Taking Yourself Too Seriously

Related to the discussion of humor, here are some examples of very carefully prepared *parodies* of the talks given by thought leaders:

Thought Leader https://www.youtube.com/watch?v=_ZBKX-6Gz6A

John Oliver’s “Todd Talks” (Before choosing to watch this, remember that John Oliver uses some language intended for mature audiences.) <https://www.youtube.com/watch?v=vvtp-dKfbco> This is part of a longer segment: <https://www.youtube.com/watch?v=0Rnq1NpHdmw&t=43s>

Use these talks to remember that, even though you want to present yourself as a “thought leader”, you should not take yourself too seriously.

A Couple of Pitfalls for the Younger Crowd

Younger researchers will often put “**I would like to thank** my mentor AAA BBB, and my teacher CCC DDD [and sometimes even a parent]”. I recommend against putting it that way: you are not the center of this story - the science is.

There are a few ways in which professional researchers give credit to their collaborators. It’s usually toward the start of the talk, or at an appropriate moment during the talk. It is phrased as “... this work was done in collaboration with ...”, or “... the foundational work for this was done ...”

I recommend thinking of the two or three direct influences you have had, and mentioning their *specific role* in the acknowledgments. This might or might not be your mentor. I’m sure you can find another way to thank your mentor.

Another problem with presentations by young researchers is that they **recite verbatim**, sometimes even **reading from a script**.

It is hard to imagine how anyone might have thought this is a good idea: I have been to talks where people did that and I felt “why are they wasting my time?” But apparently it has been taught in some schools as a valid way of giving a presentation. I have even seen people read a presentation from their phone.

Avoiding this requires a bit of work: you have to really learn your material! Of course if you’re giving a talk on something, let us hope that you know it cold. But make that knowledge even more intimate: spend time in your mind visualizing all the things you will discuss, and probe all the possible related issues with your mind, and do a bit of extra reading on those related issues.

Young researchers also **often speak very quickly** and finish their talk after no time at all. There are techniques for spacing it out.

For example, if you have a slide with a cool picture or quote or plot (as you should), stop for a while, pace back and forth in front of it (or have a sip of water if you are presenting in videocon) - you can either mention what’s cool and how you like looking at those graphs and how to think about the axes, or you can just pause and let the audience look at it.

Or you can dive into the background for something, as we mentioned when discussing the “grizzled veteran” approach; you can also stop to give motivation, possibly with a personal anecdote.

And **what if you are terrified?** Stage fright is a problem, but most of the time you will find yourself getting over it by starting to talk about your subject - do it right away.

Physicist extraordinaire Richard Feynman tells this story from when he was in his early 20s, a graduate student at Princeton University. His advisor John Wheeler had him give a talk, and invited Wolfgang Pauli, John von Neumann, and Albert Einstein to listen. Feynman was quite nervous, as he recounts in his memoir *Surely You’re Joking, Mr. Feynman*:

Then the time came to give the talk, and here are these monster minds in front of me, waiting! My first technical talk – and I have this audience! I mean they would put me through the wringer! I remember very clearly seeing my hands shaking as they were pulling out my notes from a brown envelope. But then a miracle occurred, as it has

occurred again and again in my life, and it's very lucky for me: the moment I start to think about the physics, and have to concentrate on what I'm explaining, nothing else occupies my mind—I'm completely immune to being nervous. So after I started to go, I just didn't know who was in the room. I was only explaining this idea, that's all.

ACADEMIC AWARENESS

Caution: This section is a work in progress.

9.1 What is an academic field

9.2 A tour of academic fields

https://en.wikipedia.org/wiki/List_of_academic_fields

9.3 Well-informed career choices

RELEVANT ETHICS

10.1 The Big Picture of What We Do

The Research Skills Academy was created to fill gaps in knowledge about how to properly conduct research. The Academy's goal is a bit more nuanced than that though, naturally.

On [our website](#), you can find our goals. A quote from that section reads: “almost all the prestigious research opportunities for youth go to students from privileged families who have connections to laboratories and universities.”

The road to diversity is long and winding. We live in a world in which diversity or inclusion has only recently become a part of the conversation, and, in a lot of ways, we're playing catch up.

Our goal at the Research Skills Academy has many components, but is ultimately dedicated to making valuable opportunities available to as many people as possible. This explains our relatively low barrier to entry, our promotion of the public library, and the remote nature of the program.

10.2 Respect and Codes of Conduct

At the Institute for Computing in Research, we adapted our code of conduct from the [Contributor Covenant](#). You can read our full code of conduct [here](#).

10.2.1 Workplace Behavior

When working in a team on a project or for a company, your personal ethics are not the end all be all. For example, if you agree to be part of a project, you are agreeing to *their* rules (often, via a signed document or contract). Therefore, you must follow them, even if you don't agree with all of them. Keep in mind, this is not to say you should abandon your own ethics for a job or project, rather, be aware of what kind of environment you are agreeing to be a part of. Once you've made that agreement, honor it.

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If you find yourself in a situation where you believe your peers, superiors, or the company at large are participating in unethical practices, there will often be systems that can give you an opportunity to speak up (for example, Human Resources). However, you can also report externally, to regulatory bodies, unions or law enforcement, depending on the severity of the issue and the company's response to concerns. Whether you raise concerns internally or externally, it is important to remember that while you have to follow rules you agreed to, you always have the ability to speak up if something seems unethical to you. *Your voice and opinion matters!*

Extra Credit

Think of a time you really enjoyed working with someone, perhaps a group project or partner work in class. What did you enjoy about their work attitude? What about it meshed well with yours?

Alternatively, think about a time in which you *didn't* enjoy working with someone. What about their attitude did you not enjoy? How did it effect the quality of the work produced?

Who are some mentors or teachers in your life that you look up to? What approach do they take? How might you be able to replicate it?

Be kind. Treat others how *they* want to be treated. No one wants to work with someone unpleasant, rude, or disrespectful. Often, media presents us with a picture of the successful entrepreneur: a blunt, cocky, and slightly cold white man in an expensive suit, drinking whiskey in an office overlooking a cityscape. The people in these positions of power are praised for being “hard,” a “boss,” or even “ruthless”. However, this model is only one example of a type of attitude in the workplace. While occasionally effective for wealthy white guys, this style often does not produce the same results when executed by a person in a minority group. For example, a woman who might behave similarly to her head-strong male co-worker might be labelled “difficult to work with”, “moody”, or “mean”. While there might be no one right way to be successful, it's important to make sure you are showing up in a way, in and outside of your workplace, that is true to your values and compassionate to the people around you. Sometimes the most effective leaders do so by kindness, flexibility, and empathy.

10.3 Plagiarism: Don't Do It.

One thing you will hear consistently from middle school all the way to graduate programs is to never plagiarize. You might already have an understanding of what it is, and how to avoid it, but it is one of those things that's worth repeating.

10.3.1 What is Plagiarism?

Plagiarism is the act of using someone else's ideas, words, or work without giving them proper credit. Of course, ideas naturally build on each other. However, something becomes plagiarism rather than the natural evolution of ideas when the original idea is not properly cited. The point of citations is not cause you headaches, but to make sure that people who work to create and write down ideas are recognized for their work.

Here are a few examples of plagiarism:

1. Copying and pasting from a source without citing it.
2. Paraphrasing someone else's ideas or concepts without giving credit.
3. Using images, graphics, or illustrations without proper attribution.

Before you go to publish or share any piece of work you do, ask yourself if all of the ideas you wrote down were really you're own. If you feel like you're indebted to any particular sources, cite them! The authors of those sources helped you learn and grow. The least you can do is give them credit where it's due.

To avoid plagiarizing, it is of utmost importance that you learn proper citations. There are many free online resources that will do the citations for you, or at least get you started. These generators can be incredibly helpful and a good place to start, but often they miss a few things or mistake different versions of the same texts. So, it's also important you learn to do it for yourself, if for no other reason than to be free from the machine.

You can find more discussion of citations in *Citations*

10.3.2 Putting Yourself in Their Shoes

Picture this: You've just graduated with a masters in your field. You are excited, passionate, and eager to begin your own research project (not unlike the position you find yourself in at the Research Skills Academy). You finally have the freedom to explore the nooks and crannies of your beloved subject. You research and write, and research and write, and research some more, until you have finally produced your masterpiece. Full of original ideas and new findings, your article sludges through the grueling peer-review process and by some miracle gets published and verified.

All this disappears when you plagiarize. Not only are you being dishonest with yourself and others, but you are actively discounting someone else's, someone who you probably actually have a deep respect for, countless hours of work. If you wouldn't like it to be done to you, don't do it to someone else.

10.3.3 Scary Campfire Stories

The German politician and defense minister Karl-Theodor zu Guttenberg was found guilty of plagiarizing large portions of his doctoral thesis. After it had gotten wide spread acclaim, an internet user noticed extensive plagiarism. He had copied sentences, paragraphs, and even whole pages with no citations. Gaining national and international media attention and being extensively reviewed by academic institutions and organizations, he was found guilty in March 2011. This caused his University to *take back his doctoral degree* and a *forced resignation* from his position as German Defense Minister.

His reputation, career, and what he had been working towards for six years were all taken away from him. Scary? It should be! Do. Not. Plagiarize.

10.3.4 The Beauty of Citations: Sharing is Caring

It's a little kitsch, but true. Properly citing your sources makes you part of a larger academic conversation. The author of the text you're citing gets to delight in seeing how others expand on their findings, the readers of your research have resources to fuel their curiosity, and your claims are legitimized as well-informed.

Research, and academia in general, is at its core a collaborative endeavor, and its beauty is in that collaboration!

10.4 Established Ethical Guidelines in Certain Fields

Different fields have different ethical guidelines, naturally. They all generally revolve around protecting the subject, patient, and consumer. In order to learn the ethical guidelines of your respective field, there's a few places you can look.

The best place to start is Professional Association websites. Most fields have an organization or association, such as the American Psychological Association (APA), or the American Medical Association (AMA). These organizations are made up of professionals in their respective fields who come together to decide on standards for the practices. Some other association websites you might find helpful are the Association for Computing Machinery (ACM) and the National Society of Professional Engineers (NSPE).

If you have no luck there, you might try government agencies and regulatory bodies. For example, the World Health Organization (WHO) provides guidelines for medical research and drug development.

THE RESEARCH PROJECT CEMETARY

THOUGHT-PROVOKING BOOKS AND MEDIA

Caution: This section is mostly finished.

Here I propose a list of some books which might inspire thinking beyond their specific subject matter.

This “thinking beyond...” can be due to (a) an approach to the subject matter that brings several disparate fields together, or (b) a way of finding angles of analysis of a topic that expand our way of thinking about any subject.

Some words about the choice of books:

The list is clearly arbitrary: I have put down books I am familiar with and which I found thought-provoking. The most obvious “selection effect” is my personal preference in reading.

I don’t agree with everything that is said in all of them, and sometimes I don’t even agree with the book’s overall thesis, or the way the author has chosen to argue it, or even the tone. Still, they can be thought-provoking, and reading them can be a part of your own dialectic in how you think about a subject.

For example, “The Dawn of Everything” seems to use what I sometimes characterize as a “I have a big chip on my shoulder” approach: the authors are proposing a different view of prehistoric civilizations from a mainstream narrative, and they feel the need to frequently point out how wrong the proponents of other narratives are. When I read these passages I found them awkward: they impede the flow, and leave me less convinced than I might be otherwise. It is also “clannish”: it limits the efficacy of that discussion to those who have read the books they are criticizing. Still, I think it is important to be aware of their point of view, and I would recommend reading the book if you want to do a full tomography of early civilization.

Sometimes the book shows how the author has put careful thought into how to present the material. In the introduction to “The Story of Art”, for example, Gombrich writes:

“[...] I have tried, in writing this book, to follow a number of more specific self-imposed rules, all of which have made my own life as its author more difficult, but may make that of the reader a little easier.”

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Other times I have found that a book is “intellectually not lazy”. For example, although one might argue with some specifics, Jared Diamond’s book “Collapse” is a *tour-de-force* that does not skimp on explaining methodology and sources.

How to read these resources

There are many articles and books on how to read books. In this vast space of opinions there is really no need for mine, but I will put my oar in just a little bit, and express some opinions while I am at it.

An article I have found to be **good** (and also brief!) is Paul Edwards’s “How to Read a Book” (I read it at version 5.0). You can find it [here](#)¹ It points out the fundamental difference between reading fiction (where you have to read in order, since it is building up suspense) and nonfiction where you can and should dart around.

Edwards puts it really well (and concisely!) with gems like:

So unless you’re stuck in prison with nothing else to do, NEVER read a non-fiction book or article from beginning to end.

Instead, when you’re reading for information, you should ALWAYS jump ahead, skip around, and use every available strategy to discover, then to understand, and finally to remember what the writer has to say. This is how you’ll get the most out of a book in the smallest amount of time...

Almost all the books and articles I’m proposing here are non-fiction, so please attack them with the optimization goal that Edwards proposes.

I also recommend skipping the awful book by Adler and Van Doren “How to Read a Book”. This is one of several awful books that has acquired the status of being a “classic” and gets recommended out of group-think.

Sections inside this page

- *Books: non-fiction*
- *Articles, article collections, blogs*
- *Audio/visual*
- *... And what about fiction?*

¹ In case the published copy moves away I also offer a copy for download here: [PaulEdwards-HowToReadABook_v5.0.pdf](#) I can do this because the author did the awesome thing of offering it under a creative commons BY-SA license.

12.1 Books: non-fiction

12.1.1 History

Tamin Ansary *The Invention of Yesterday: A 50,000-Year History of Human Culture, Conflict, and Connection*

Barbara Tuchman *A Distant Mirror: The Calamitous 14th Century*

The march of folly: from Troy to Vietnam

David Fromkin *The Way of the World: From the Dawn of Civilizations to the Eve of the Twenty-first Century*

Margaret MacMillan *War: How Conflict Shaped Us*

Dangerous Games: The Uses and Abuses of History

Yuval Noah Harari *Sapiens: A Brief History of Humankind*

Mary Beard *S.P.Q.R. A History of Ancient Rome*

Jared Diamond *Collapse*

David Graeber and David Wengrow *The Dawn of Everything: A New History of Humanity*

Steven Pinker *The Better Angels of Our Nature*

Leonard Mlodinow *The Upright Thinker*

Kai Bird and Martin J. Sherwin *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer*

12.1.2 Politics

Ibram X. Kendi *How to Be an Antiracist*

Francis Fukuyama *The Origins of Political Order: From prehuman times to the French Revolution*

Michael Lewis *The Fifth Risk*

Jae Gutterman *Her Neighbor's Wife*

12.1.3 Art

E. H. Gombrich

The Story of Art

(There is an edition of this book for younger readers.)

Art and Illusion: A Study in the Psychology of Pictorial Representation

12.1.4 Miscellaneous

Hanif Abdurraqib They can't kill us until they kill us: essays

Garry Kasparov How Life Imitates Chess

12.1.5 Computer science, AI, math

Melanie Mitchell Artificial Intelligence for Thinking Humans

Complexity: A Guided Tour

Douglas Hofstadter: Godel, Escher, Bach: An Eternal Golden Braid - A metaphorical fugue on minds and machines in the spirit of Lewis Carroll

Julia Galef The Scout Mindset: Why Some People See Things Clearly and Others Don't

Steven Pinker Enlightenment Now: The Case for Reason, Science, Humanism, and Progress

Rationality: What It Is, Why It Seems Scarce, Why It Matters

Leonard Mlodinow The Drunkard's Walk

Richard Hamming The Art of Doing Science and Engineering: Learning to Learn

Nate Silver The Signal and the Noise

Brian Christian and Tom Griffiths Algorithms to Live By: The Computer Science of Human Decisions

12.1.6 Psychology

Michael Lewis The Undoing Project

Jim Davies Riveted: The Science of Why Jokes Make Us Laugh, Movies Make Us Cry, and Religion Makes Us Feel One With the Universe

Being The Person Your Dog Thinks You Are: The Science of a Better You

Charles Duhigg The Power of Habit: Why We Do What We Do in Life and Business

David McRaney You are Not so Smart

Marcel Mauss The Gift

12.1.7 Writing and literary criticism

Harold Bloom The Western Canon: The Books and School of the Ages (<https://www.kirkusreviews.com/book-reviews/harold-bloom/the-western-canon/>)

How to Read and Why

Sandra M. Gilbert and Susan Gubar The madwoman in the attic : the woman writer and the nineteenth-century literary imagination

Steven Pinker The Sense of Style: The Thinking Person's Guide to Writing in the 21st Century

12.1.8 Philosophy

Anthony Gottlieb The Dream of Reason: A History of Philosophy from the Greeks to the Renaissance

The Dream of Enlightenment: The Rise of Modern Philosophy

Bertrand Russell A history of Western Philosophy

Alasdair MacIntyre After Virtue: A Study in Moral Theory

Jonathan Glover Humanity: A Moral History of the Twentieth Century

Carlo Rovelli Reality Is Not What It Seems: The Journey to Quantum Gravity

Brian Christian The Most Human Human: What Artificial Intelligence Teaches Us About Being Alive

The Alignment Problem: Machine Learning and Human Values

Thomas Moore Utopia

12.1.9 Medicine and epidemiology

Laurie Garrett The Coming Plague

Richard Preston The Demon in the Freezer

Richard Rhodes Deadly Feasts

Jeremy N. Smith Epic Measures: One Doctor. Seven Billion Patients.

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Tracy Kidder *Mountains Beyond Mountains: The Quest of Dr. Paul Farmer, a Man Who Would Cure The World*

Mountains Beyond Mountains (Adapted for Young People)

How to *frame* these resources

Read critically: for each book or article you read, look for articles with contrasting points of view. Always make sure you are convinced that you understand the context ... make sure you have always asked the next question (refer to our other chapters) ... does it teach us how to write about subjects? ... FIXME: unfinished

12.2 Articles, article collections, blogs

Paul N. Edwards *How to Read a Book* (version 5.0 on 2022-05-29) - <https://pne.people.si.umich.edu/PDF/howtoread.pdf> archived at: <https://web.archive.org/web/20230526182410/https://pne.people.si.umich.edu/PDF/howtoread.pdf>

A articles related to the New York Times “1619 Project”

- <https://www.nytimes.com/interactive/2019/08/14/magazine/black-history-american-democracy.html>
- <https://www.nytimes.com/2019/12/20/magazine/we-respond-to-the-historians-who-critiqued-the-1619-project.html>
- <https://www.theatlantic.com/ideas/archive/2019/12/historians-clash-1619-project/604093/>
- <https://www.theatlantic.com/ideas/archive/2020/01/inclusive-case-1776-not-1619/604435/>

Collection of articles on world history <https://www.worldhistory.org/>

The Manhattan Project: an interactive history <https://www.osti.gov/opennet/manhattan-project-history/index.htm>

Voices of the Manhattan Project <https://www.manhattanprojectvoices.org/>

Sridhar Mahadevan Quora response on art and AI - <https://www.quora.com/Do-you-believe-human-art-and-design-is-about-to-crumble-because-of-the-introduction-of-artificial-intelligence-answer/Sridhar-Mahadevan-6?share=1>

Taylor Branch *The Shame of College Sports* - <https://www.theatlantic.com/magazine/archive/2011/10/the-shame-of-college-sports/308643/>

Blas Moros’s The Rabbit Hole blog and more - <https://blas.com/>

You are Not so Smart blog - <https://youarenotsosmart.com/>

12.3 Audio/visual

This section is necessarily less permanent. The links I give here might not work: some material might have disappeared from the web, or might have been moved to a different location. Still, it should be possible to find almost all this material with some effort.

12.3.1 Lectures

Richard Feynman Los Alamos From Below - <https://www.youtube.com/watch?v=uY-u1qyRM5w>

Richard Rhodes Twilight of the Bombs - <https://www.youtube.com/watch?v=IRN2g8uoQkg>

Stuart Firestein The Pursuite of Ignorance - TED talk - <http://historyofliterature.com/>

Ignorance, Failure, Uncertainty, and the Optimism of Science - Santa Fe Institute public lecture - <https://www.youtube.com/watch?v=YIah2JtqlZk>

Melanie Mitchell Artificial Intelligence: A Guide for Thinking Humans - <https://www.youtube.com/watch?v=NMUqvhuDZtQ&t=228s>

Brian Arthur Complexity Economics - <https://www.youtube.com/watch?v=P8IzaECeQOk>

Paul Bloom How Pleasure Works - <https://www.youtube.com/watch?v=lWOfP-Lubuw>

Can prejudice ever be a good thing? - <https://www.youtube.com/watch?v=KDBcoRLkut8>

Amanda Palmer The Art of Asking - https://www.youtube.com/watch?v=xMj_P_6H69g

Brian Christian The Most Human Human: What Artificial Intelligence Teaches Us About Being Alive - <https://www.youtube.com/watch?v=8Zs-GQ-ECLs>

Quentin Skinner Machiavelli: A Very Short Introduction - Talks at Google - <https://www.youtube.com/watch?v=CKGuzJ6GwHM>

Richard Hamming You and Your Research - <https://www.youtube.com/watch?v=a1zDuOPkMSw>

Hans Rosling Global population growth, box by box - <https://www.youtube.com/watch?v=fTznEIZRkLg>

DON'T PANIC - Hans Rosling showing the facts about population - <https://www.youtube.com/watch?v=FACK2knC08E>

200 years in 4 minutes - <https://www.youtube.com/watch?v=Z8t4k0Q8e8Y>

12.3.2 Podcasts

History of Literature <http://historyofliterature.com/>

Freakonomics <https://freakonomics.com/podcast/>

Alex and Books <https://alexandbooks.com/podcast>

Malcolm Gladwell's Revisionist History <https://www.pushkin.fm/podcasts/revisionist-history>

Hari Kunzru's Into the Zone <https://www.pushkin.fm/podcasts/into-the-zone>

The BBC's Start the Week <https://www.bbc.co.uk/programmes/b006r9xr/episodes/downloads>

Melvyn Bragg's In Our Time <https://www.bbc.co.uk/programmes/b006qykl>

Roman Mars Roman Mars Can Learn About Con Law - <https://learnconlaw.com/>

99% invisible - <https://99percentinvisible.org/>

Strong Songs <https://strongsongsodcast.com>

12.4 ... And what about fiction?

Fiction might have greater influence on us than non-fiction: reading fiction alters our mood more, which can predispose us to assimilate new ways of experiencing subject matter. This can lead to provoking new thoughts that then stay with us. Fiction, as well as art and music, can also make us realize that the words and art media are pliable and can be formed into remarkable new works. That frame of mind would be a precious one for a researcher.

But is there a reason to put a list here? I thought about it at length: it is tempting to mention the books that have had great effect on me, or that I know have had the effect on others. But it would not put *you* along a path to get the same out of it.

I do not know how to work in with the indirectness with which fiction affects us, which ... in the end I came up with science fiction books, but they seemed appropriate from a different point of view. The extreme “world building” in science fiction gives it a sliver of non-fiction-ness.

So I am looking for suggestions on how to think about a section on fiction, or on reasons to remove this stub altogether. Meanwhile I have two suggestions:

- Follow reading lists from books of literary criticism, or the light-weight version which are blogs and podcasts about books. Now your reading of fiction will be accompanied by an analysis of the books, and you will have a greater self-awareness of the effect it has had on you.
- Read treatises that discuss a genre of fiction on a large-scale, such as Aristotle's “Poetics”, Auerbach's “Mimesis”, Nietzsche's “The Birth of Tragedy”, ...

notes on future additions

Zora Neale Hurston - maybe “Fannie Hurst”

Richard Dawkins (books and TED talk)

Steven Jay Gould

RESEARCH EXAMPLES

Caution: This section is a work in progress.

13.1 Things to have handy before you do research

https://upload.wikimedia.org/wikipedia/commons/0/07/Media-Bias-Chart_4.0.1_WikiMedia_Commons_Copy.jpg

13.2 Worked examples

13.2.1 Taxation, disposable income, quality of life

See the discussion in *How do we get to our research question?* for this interesting research topic. At this time we give you some reference links below.

Here is an example of how you could carry out some research on that statement to get a more nuanced understanding of taxation and an individual's quality of life and purchasing power.

[FIXME: unwritten below here]

<https://www.cbo.gov/>

<https://www.cbo.gov/publication/57170>

<https://www.jct.gov/publications/>

tax revenue:

<https://www.thebalance.com/current-u-s-federal-government-tax-revenue-3305762>

<https://www.cbo.gov/about/products/budget-economic-data#2>

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https://www.brookings.edu/wp-content/uploads/2016/06/09_effects_income_tax_changes_economic_growth_gale_samwick.pdf

detailed study:

<https://eml.berkeley.edu/~dromer/papers/RomerandRomerAERJune2010.pdf>

popular article but quite complete:

https://www.investopedia.com/articles/07/tax_cuts.asp

quality of life and infrastructure:

<https://www.usatoday.com/story/money/2020/04/19/taxes-2020-states-with-the-highest-and-lowest-taxes/111555224/>

<https://www.epi.org/publication/ib338-fiscal-cliff-obstacle-course/>

<https://taxfoundation.org/which-states-have-most-progressive-income-taxes-0/>

https://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_income

<https://www.investopedia.com/financial-edge/0210/7-states-with-no-income-tax.aspx>

13.2.2 The King Henry I Eclipse

There is a reddit thread called “Bad NASA Eclipse History, or How Henry I of England did not die twice” at [RedditKingHenryEclipse]

This is a nice worked example of a puzzle that shows sloppy reporting that has made its way into numerous articles as if it were fact.

13.2.3 The fivethirtyeight data sets and examples

The fivethirtyeight team of data journalists make their data sets available, together with the articles they write about what they glean from the data.

The data for their worked examples can be found at:

<https://data.fivethirtyeight.com/>

13.2.4 President Biden’s comment on the Marijuana suspension of Richardson

Backdrop: shortly before the Tokyo “2020” olympics (which are to take place in the summer of 2021) US sprinter Sha’Carri Richardson, one of the fastest 100 meter athletes in the world, tested positive for THC, the active ingredient in marijuana. Repercussions of this test led to a 30 day suspension from racing, which would keep her out of most of the olympic races, including the 100 meters.

President Biden was asked what he thought of Richardson’s suspension. Part of his reply (where he said “the rules are the rules”) was posted to twitter by someone, and that reply was then “re-tweeted” by highly regarded statistician Nate Silver, who added a negative comment.

The comment by Nate Silver is at <https://twitter.com/NateSilver538/status/1411418022237990912> and I show it here:

Nate Silver

@NateSilver538

Kinda surprised by this **from Biden**, I'd imagine her suspension is quite **↪ unpopular**.

Jennifer Jacobs

@JenniferJJacobs

Jul 3, 2021

"The rules are the rules," Biden says **in** Michigan when asked about Sha' Carri Richardson's one-month suspension **for** marijuana use. @itskerrii will miss the **100m** race during the Olympic games **in** Tokyo.

I list this in this “worked examples” section because the thread on twitter has a discussion that touches upon many of the questions we might think to ask, and has reflections and conclusions.

Examining the thread brings out several important discussion points and a collection of facts and opinions about the situation, Richardson, Biden, and Silver.

Some points to think about in this exchange are:

- Some comment on how she knew the framework she works in.
- Some people comment on the appropriateness of THC bans.
- Some comment on how the IOC (International Olympic Committee) does not follow US law, but rather its own regulations. In addition they point out that THC can be a “masking agent”, so it might stay banned even if the US lifts its ban.

Note that all these points need to be looked at carefully, but maybe the most important point is made further down in the thread:

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- Someone points out that Biden’s comment was much more detailed and nuanced than “the rules are the rules”.

The full statement was:

Everybody knows of the rules going in. Whether they should remain the rules is a different issue, but the rules are the rules.

I was really proud of the way she responded.

One can also find video clips of this, which confirm the more complete statement by president Biden.

Below I give some of the raw text from the twitter thread. My goal is to get you to think of which comments provide insight.

But it is also to make you think critically of where those comments end, and what they might be missing, and how they might be grossly incorrect.

Remember how in Chapter *Where Is This Source Coming From?* we lambasted lazy journalists for not asking the next question. We would be as lazy as them if we did not ask the next question about this statement:

Why would it move the ioc? [IOC is the International Olympic Committee] Many legal things are banned by the ioc because they are considered masking agents. The ioc doesn't care about the federal law in the us.

Jeff C Red circleBlack circleRed circle
@JMC9787

.

Jul 3

Replying to

@NateSilver538

I personally don't understand all the outrage. Should marijuana be allowed at this point? Sure. But she knew the rules and knew it wasn't allowed and did it anyway. Zero personal accountability. She made her own bed.

Sean Jones

@sprov4

.

Jul 3

Why punish people for not following a pointless rule?

Jedi, Interrupted Rainbow flagYellow heart

@JediCounselor

.

(continues on next page)

(continued from previous page)

22h

Replying to
@NateSilver538
FULL QUOTE:

“Everybody knows of the rules going in. Whether they should remain the rules is a different issue, but the rules are the rules.”

“I was really proud of the way she responded,” he adds.

Did you pop off without bothering to get the context again, Nate?

Dr. Berenger
@Frenchesque

.

20h

Thank you for this. Silver’s tweet makes it sound like Biden suspended her himself.
It’s irresponsible.

Mike Malloy
@MikeTuesday2

.

Jul 3

Replying to
@NateSilver538

That forbidden “rule” would seamlessly go away with federal drug reform of THC. Gee Joe, perhaps you should do something about that already.

Jaime Robledo
@RobledoReturns

.

23h

Literally the next sentence is him questioning whether those laws should stand. Why a polling aggregator is offering opinions on Olympics drug policy anyway is beyond me.

Ron Wechsler
@RonWechsler

(continues on next page)

(continued from previous page)

.

Jul 3

Replying to

@NateSilver538

Suspect this isn't the full quote.

Jedi, Interrupted Rainbow flagYellow heart

@JediCounselor

.

22h

Replying to

@NateSilver538

FULL QUOTE:

"Everybody knows of the rules going in. Whether they should remain the rules is a different issue, but the rules are the rules."

"I was really proud of the way she responded," he adds.

Did you pop off without bothering to get the context again, Nate?

Dr. Berenger

@Frenchesque

.

20h

Thank you for this. Silver's tweet makes it sound like Biden suspended her himself.

It's irresponsible.

Dave Total Landscaping

@Save_the_Daves

.

23h

Replying to

@NateSilver538

He's not wrong. You can think the rule is dumb while still acknowledging she was wrong for knowingly violating it. She shouldn't have to stay home for smoking marijuana. She absolutely should stay home for violating a drug policy she knew full well would get her DQ'd.

Matthew

@acadianrunner

.

22h

(continues on next page)

(continued from previous page)

Ya. Keep her home based on a rule that is archaic and based on racism.↵

↪Great look America

Dr. Berenger

@Frenchesque

.

20h

Marijuana usage isn't racially determined and the Olympics isn't American.

I do hope they change the rules.

Dave Total Landscaping

@Save_the_Daves

.

19h

Agree with all of this

ConanTheCnidarian

@CCnidarian

.

Jul 3

Replying to

@NateSilver538

I mean, what is he supposed to say? It's unfortunate that the rules are the way they are, but he has a lot more to worry about than whether marijuana disqualifies you from international track meets... is Biden supposed to lead the movement to change the track marijuana rules?

Jamie McCurdy

@ackbar7

.

Jul 3

He should lead a movement to change those rules and laws in our country
josh valentine

@jjv124

.

Jul 3

He said the rules are the rules but whether they should remain that way.↵

↪is a different thing

Jamie McCurdy

@ackbar7

.

Jul 3

Sure, but if he doesn't like them why isn't he doing more to change the laws here in the US? The question was what was he supposed to do, and the US legalizing marijuana would probably do a lot to move the IOC in that direction as well.

(continues on next page)

(continued from previous page)

josh valentine

@jjv124

.

Jul 3

Why would it move the ioc? Many legal things are banned by the ioc because they are considered masking agents. The ioc doesn't care about the federal law in the us

You can use display-thread flag to display replies.

13.3 Unworked examples

13.3.1 Instant messaging and privacy

Article that asks real questions and goes in to detail:

<https://www.bloomberg.com/news/articles/2021-05-28/signal-app-is-surgin-in-popularity-and-hitting-growing>

13.3.2 Texas mask mandate mystery

<https://www.theatlantic.com/ideas/archive/2021/05/texas-mask-mandate-no-effect/618942/>

13.3.3 Seychelles Islands vaccine mystery

In May 2021 the Seychelles had succeeded in vaccinating more of their population for the COVID-19 virus than any other country on earth. And yet at the same time they had a great increase in COVID-19 cases.

Read the news articles, and possibly scholarly articles, and apply your understanding of selection effects, described in Chapter *Cognitive Errors and Selection Effects*, Section *Selection Effects and the “Hidden Prior”*. Prepare a few paragraphs on what might be going on.

This exercise might not give a definitive result in the spring of 2021, since it is a new phenomenon, but you could turn that into a strength for this exercise: get used to having a partial and provisional understanding of a topic, that can adapt gracefully as new information comes in.

13.3.4 Julia Galef's hidden prior experiment

Chapter *Cognitive Errors and Selection Effects*, Section *Selection Effects and the "Hidden Prior"*

Take the “mathematics grad student or business school student” thought experiment that Julia Galef gives at [[JuliaGalefBayesianThinkingVideo](#)]. Research the actual ratio of math graduate students and business school students at a few US universities.

Be careful to choose representative samples of academic programs – some universities might be skewed for or against pure mathematics or business.

And maybe you can even research the actual ratio of shy mathematics students to shy business students.

With this real data in hand, see if you can confirm or disprove Galfe's thought experiment.

SAMPLE SYLLABUSES

In this chapter we present an aid for an instructor in Research Skills: example syllabuses.

There are many effective ways in which one could teach the material as a set of tutorials. In the Research Skills Academy we have tried several approaches, and we have imagined others.

Each section in this chapter shows an example of a syllabus based on 12 tutorials, of about an hour and a half each.

14.1 Higginson and Kerelis 2023

Karina Higginson and Albert Kerelis ran the Research Skills Academy in 2023 and used this syllabus as a blueprint.

14.1.1 Lesson 1: The History of Critical Thinking

Why teach this: Having an understanding of where ideas and practices come from gives a more holistic understanding of a topic, which is great, but also gives examples of how the skill that the students are actively learning has been used to change the world.

Main lesson: If you can master critical thinking and want to make a positive change in the way the world operates today, history is on your side. Our generation is hyper-aware of political and social strife due to over exposure and saturation of media, seeing historic examples of people using a skill from their tool belt inspires the ability to see and eventually actualize change.

Pt. 1: Historic roots of critical thinking as a philosophical practice. Moad, Omar Edward. “Comparing phases of skepticism in al-Ghazali and Descartes: some First Meditations on Deliverance from Error.” *Philosophy East and West*, vol. 59, no. 1, Jan. 2009, pp. 88+. Compares two early philosophers from different areas of the globe and their ideas that revolutionized how we think about thinking. While these philosophies have an undeniable religious element, this article does a good job focusing on the ideas of skepticism above all else. This is admittedly a difficult text, but I think our advanced high schoolers will enjoy the challenge as it is definitely still comprehensible.

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Potentially could focus on sections two and three, but the earlier does provide good context

Why has it been important historically? Challenging the Church

Andersen, Kurt. *Fantasyland : How America Went Haywire : a 500-Year History*. First edition. New York: Random House, 2017, pp.16-17. Offers a brief example of how Martin Luther inspired reformed protestantism, a direct result of critical thinking and skepticism of the churches current practices at the time. . . AND a religion that encouraged (some) critical thinking in it's followers. NOTE: the language in this book can come across somewhat extreme, maybe find a different source

Pt.2 Modern Critical thinking and systemic change How critical thinking is/has been/can be used to destabilize institutionalized power

Hooks, bell. *Teaching Critical Thinking : Practical Wisdom*. New York: Routledge, 2010.

“Decolonization” Pg. 23-28, highlights how questioning one binary or power structure often leads to questioning other ways that same structure oppresses other groups. Critical thinking about one issue can lead to the liberation of others.

“Feminist Revolution” Pg. 91-94 highlights the role of lower and high education, how biases affect it, how it can change, and how it has changed

14.1.2 Lesson 2: Keeping Research Tidy

In this lesson students will learn how to find and manage information on their research topic. Research is only as good as the sources we access, and we can only make use of those sources when we can manage them effectively. By learning how to query academic databases, students will gain access to a wider array of quality sources of information and be able to use them effectively.

Students will also learn to use Zotero, a free and open source library and citation management tool, to track and organize their sources and generate bibliographies. By using a citation manager, students won't waste time trying to find sources they forgot to write down, and will be able to better parse a long list of sources by using tags and notes.

Note taking is another critical skill in conducting library research, and by learning to experiment with their note taking strategies students will be able to find a note taking strategy that works for them. Good notes not only help us understand our material as we read, but also help us reference our findings quickly and accurately. They are a key tool in making as much of the information we've gathered from our research available to us as seamlessly and conveniently as possible.

14.1.3 Lesson 3: Good Writing: What it is, How to recognize it, and How to do it

Why teach this: Being able to effectively and clearly communicate your thoughts is a tool needed for any field, but also for life.

Pt.1: What makes good writing good Samberg, Joel. “Bad Writing Inc.” *BusinessWest* 32, no. 27 (2016): 14–.

Pt. 2: How to recognize good and bad writing What it means, when referring to writing integrity, to do something in good or bad faith

Journalism in the age of the internet - Clicks over integrity - Rage baiting

Pt. 3: How to do good writing Good writing in narrative

Abell, Stig. “Get to the Point: Irina Dumitrescu and Sam Leith on How to Write Well.” *TLS. Times Literary Supplement* (1969), no. 6101 (2020): 1–.

Finding your voice, make bad habits charming (while still grammatically correct)

Exercise: Writing your writers manifesto

Williams, Paul. “A Writer’s Manifesto: Articulating Ways of Learning to Write Well.” *New Writing* (Clevedon, England) 17, no. 1 (2020): 71–79. <https://doi.org/10.1080/14790726.2019.1566366>.

14.1.4 Lesson 4: Progress

Relevance: Much of our economic system today is propelled by an idea of progress. That the more we create and invent, the better our lives will necessarily be. However, this idea that more technological innovation is necessarily a good idea has led to the creation of a wildly unjust and violent economic system. Without taking time to step back and understand the impacts of the systems we participate in, we risk complacency with mass violence.

- Max Weber saw industrialization and the movement of people into factories not just as something which increased production, but also turned peasants into laborers.
 - While industrialization made it possible for one laborer to make far more of a product that was possible before, they didn’t spend less but more time working!
 - Manufactured goods were cheaper to acquire, but the quality of life for those making them decreased.
- In *One Dimensional man*, Herbert Marcuse takes note of how technical progress had diverged from its original stated aim - the amelioration of human life.
 - For Marcuse, technology is no longer primarily something which we produce to make our lives better, but is something which creates necessities for us.

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- Climate change is a great example of the massive unintended consequences of our technological advances
- The silicon valley motto “move fast and break things” is great when what you’re breaking is some new video game or entertainment system, but when what you’re breaking is the social fabric of myanmar because your social media platform doesn’t have a system of moderation and is allowing for hate speech to spur a genocide, you have to question whether the ends of technological progress unilaterally justify its means.
- But obviously some technology is good - how do we progress responsibly?
 - Ecological sustainability - by forefronting questions of how sustainably a technology can grow, we can avoid destroying our planet.
 - Afrofuturism - science-fiction has always spurred forward technological progress from the submarine to the metaverse. Afrofuturism has provided a way for Black writers to envision what technological progress that is inclusive of marginalized people could look like.

14.1.5 Lesson 5: Measurement, Method, and Parsimony

Relevance: How we evaluate truth claims is central to our idea of research. To some extent, science simplifies Truth for us: $p < 0.05$. While the rigors of the scientific method allow us to make truth claims about our world really effectively, they can sometimes obfuscate mistakes from us if we’re not careful about it. By looking into how science measures and interprets data, we can better understand what studies are really looking at.

- prediction and parsimony
 - “A key feature of scientific ideas, as opposed to other types of ideas, is not whether they are right or wrong but whether they are logically coherent and make unambiguous, observable, and generally quantitative predictions. They tell us what to look for and predict what we will find if we look at or measure it.” CLUE - Chap 1
 - * Scientists look for the simplest possible explanation that predicts accurately - parsimony
 - Analogous to okham’s razor
 1. In evolutionary biology, we can build trees of relation between species, locating which ones had more recent common ancestors, by cataloging traits of each of the species and building that tree of descent which requires the fewest mutations.
 2. Have people download mesquite and do a parsimony simulation?
- *Pseudoreplication* <<https://faculty.washington.edu/skalski/classes/QERM597/papers/Hurlbert.pdf>>
 - This landmark ecology paper critiqued how ecologists had historically worked on experimental design.

- It raises really great questions about how we structure trials that allow for deep investigation into what a modern data driven scientific approach to understanding looks like and where it might go wrong.
- Leads us to a question about what we are actually measuring when we collect data
- Operationalism!
 - Here’s a piece I wrote for the Quest a long time ago that goes into some fun detail on how scientific measurements work.
 - * <https://reedquest.org/2021/04/02/albertoperationalism/>
 - Basically, science can only ever observe interactions between its subject and its measuring device.
 - Scientific data exists primarily in the in-between, not in the thing itself

14.1.6 Lesson 6: Cultivating Curiosity

Why teach this: As future researchers and academics, curiosity is a fundamental attribute the students should be cultivating.

The five dimensions of curiosity and their motivators Jones, Dan. “How to Be Curious.” *New Scientist* (1971) 256, no. 3408 (2022): 38–43. [https://doi.org/10.1016/S0262-4079\(22\)01862-0](https://doi.org/10.1016/S0262-4079(22)01862-0).

The benefits of curiosity

- Creativity and curiosity often go hand in hand
- Reduced anxiety with a curiosity based reframing
- How to avoid judgment (the killer of curiosity)
- What might be limiting our curiosity? Often, it can be biases, conscious and unconscious, that create fully formed and unmovable opinions on something without due diligence

What are biases

- How are they created
- How can we recognize our own and others?
- How can we challenge our own and others?
- Why curiosity makes some people uncomfortable

Requires them to think critically and sometimes independently This often comes with a lack of validation from others

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Beliefs have kept them safe Whether perceived or actualized danger, some belief systems are held so strongly by people because it currently or at some point has provided safety or security for them

Disagreement It's possible to disagree but respect why people may be hanging on to their beliefs, after all, it's about your journey not theirs.

14.1.7 Lesson 7: Epistemology, Hermeneutics, and Pragmatism

Understanding how and why we evaluate truth claims is central to well, existing in the world. However qualitative humanistic data requires different methods than science has to offer. Hermeneutics and Pragmatism offer two sorts of reckoning that expand past quantitative measurement and into the examination of human art and culture.

In this lesson, students will learn about three concepts that can help us parse information and make sense of the world around us.

Henri Bergson's intuitive approach asks that we first approach problems from the level of the question they are trying to answer. Often we take questions to be a neutral starting point for inquiry, but Bergson tells us that questions can carry with them assumptions and contradictions that can easily find their way into our work if we're not careful.

The hermeneutic circle is a concept that takes many forms for many thinkers, but its basic premise is that better understandings are always generated from partial misunderstandings. Our knowledge of a subject never comes to us *ex nihilo*, and we must both be confident enough to proceed with incomplete knowledge, as well as humble enough to recognize it as such. The hermeneutic circle tells us that understanding is not a final destination of perfect knowledge, but is constituted by a continued striving for better understanding.

Pragmatism gives us a simple yet powerful evaluative framework for our ideas. It sees knowledge, ideas, and truth, as tools. Pragmatists evaluate claims based on how well those claims let us achieve our goals and attain more useful worldviews. This leaves us with an immense responsibility in how we define our goals. We need to have an idea of who we want to be, what kind of things we want to achieve, before we can be good pragmatists. But once we are able to attune ourselves to a sense of that, pragmatism lends a powerful tool in parsing information and making sure our knowledge and truth align with our values.

14.1.8 Lesson 8: Introduction to Absurdism

Why teach this: Entering early adulthood, you're told to start searching for your purpose, "what are you here to do?" Absurdism offers an alternative to narrowly defining your existence to a purpose, and to only one of them.

All based off works by Albert Camus, especially *The Myth of Sisyphus*

Pt. 1: God is dead the scientific revolution brought about nihilism, the philosophical idea that according to science, there seems to be no God. Since before then, all moral and ethical questions, as well as lifestyle, had been answered according to religion. For people of science though, this no longer seemed like the correct solution. Man discovered life has no prescribed meaning.

As a reaction to nihilism, two schools of thought formed, existentialism and absurdism, existentialism (Existentialism is Humanism by Jean-Paul Satre) believe our actions create life's meaning and our purpose.

Pt. 2: Absurdism (I find when teaching philosophy, it works well to lean into quotes so the students have something visual to parse and understand rather than just talking abstractly. Parsing quotes give philosophy a place to ground itself. Ideally these quotes would be from Satre and Camus.)

Absurdism does not try to find meaning or purpose, but rather enjoys the freedom of a meaningless existence

Trying to find meaning is philosophical suicide

The only "purpose" of life is to live it, to do whatever it is that prevents you from killing yourself

AAA I LOVE ABSURDISM!!

Pt. 3: Puzzles (this would work best as a round table discussion, as there are no defined answers to these huge questions!)

How do we grapple ethics?

How do we operate in a very un-absurdist social structure?

What are the places absurdism falls short?

14.1.9 Lesson 9: Energy and Thermodynamics!!

Relevance: Some basic understandings of Energy are super important for building models of how scientific systems work. The principle of minimum energy is one of these big central ideas that gets used across scientific disciplines. While it's simple to state, the minutiae of the second law of thermodynamics can give us a more rigorous understanding of what energy is and how we apply these concepts.

- Understand energy graphs - Show in chemistry - fusion, bonding - But also in physics - potential energy in gravitational systems
- Activation energy! - Definitely a chemistry concept but applicable to so many fields
- Entropy - Second law of thermodynamics - $S = k \log(W)$ - Micro-states and macro-states
- Relate to other systems

- Ecology!
 - * Biodiversity = stability
 - On a big picture scale, we can understand this from an entropy lens
 - Those ecosystem macrostates which have the most possible configurations or microstates will be more likely to arise.
 - * Alternative stable states
 - When ecosystems degrade, they are often put into states that are hard to get out of, even if they are not the most stable, because they would have to transition through unstable states!
 - * Disturbance regimes - Many ecosystems tolerate and in fact depend on occasional disturbances as long as those don't pull them entirely out of their stable state
- Economics - Corporations and other economic entities often work to minimize costs, which are kind of like energy in an economic sphere.
- These concepts can also be used in coarse non-quantitative ways.
- Minimum energy can also be thought of as following the path of least resistance - People tend to follow the path of least resistance! We do what's easiest for us. - This is a super useful rule of thumb for everything from navigating your relationship with others to good game design.

14.1.10 Lesson 10: Poetry and the space between life and death

Why teach this: What better way to study the power of words than to see it's potential to move the reader into a metaphorical realm that exists outside of time and space!***I'm using an essay I wrote about this topic, so there's much more detail and sources to add here, just wanted to get the general outline.

Pt. 1: "Here," "There," and everywhere Location descriptors act metaphorically to create a location, the location of the poem, that exists outside of time and space. It refers to the here of the reader, the here of the word on the page, and the here of the speaker

Pt. 2: The Lyrical Present Locates the reader in the poetic realm, where they are participating in the action with the speaker. "I walk" as opposed to "I walked."

Pt. 3: Immortality through words The poets version of themselves, the speaker, can exist as long as there are people reading their poems in that poetic realm. You can put that version of yourself, the reader, into that poetic realm that exists outside of time and space, and walk with the speaker and by extension the poet.

14.1.11 Lesson 11: The Surrealist Art Movement and Imagination

Why teach this: The Surrealist Art movement prioritized creativity and imagination, which as we know from earlier, goes hand in hand with curiosity. Art for the sake of art, and learning for the sake of learning. **I'm using an essay I wrote about this topic, so there's much more detail and sources to add here, just wanted to get the general outline.**

Pt. 1: The history and philosophy Started in the 1930s France

About allowing the unconscious mind to explore, emphasis of creativity and imagination
Leaning into the impossible

Pt. 2: key works (show key pieces, and artists and a brief progression of their works over time)

How did this artist embody or shape the surrealist art movement

Pt. 3: the value of imagination in an industrial world Surrealists valued creativity for purely its own sake

A rebellion against commodification, artists who had the skills to capture accurate portraits or realistic landscapes (and could have gotten paid to do so) instead chose to make art that was just for enjoyment

14.1.12 Lesson 12: Gender and Queer Theory Primer=

Relevance: Taking a critical eye to gender is important both personally and socially. By understanding how gender both gratifies and constrains us, we can develop sounder and healthier relationships with ourselves and expectations of us. By understanding how gender has been historically constructed, we are better situated to intervene in instances where ideas of gender are not serving us or our communities.

I have a whole presentation I gave to a philosophy club at my highschool a couple years ago ready to go, replete with resources for further study. <https://drive.google.com/drive/folders/11a5dCgxDn7xPGfBVXwa80srXa8APQRTa?usp=sharing>

Here are some rough outlines for lessons. I tried to include the main talking points and some extra sources, as well as different methods of teaching that might work best.

APPENDIX: LOGISTICAL DETAILS

Caution: This section is a work in progress.

There are some tools a student should always have handy to use in the ordinary course of their studies. These include a plotting program, the Python interpreter, and the `git` version control program.

RAWGraphs is a free and open source webapp that can be found at <https://app.rawgraphs.io>.

There are others that are useful for specific courses, tasks, or jobs.

15.1 Linux

15.1.1 Arch Linux

```
$ sudo pacman -S git python
```

15.1.2 Debian

```
$ sudo apt-get update $ sudo apt-get install git python3
```

15.1.3 Fedora

```
$ sudo dnf install git python3
```

FIXME: unfinished, but the outline is to show how to install each of these programs on Linux, Chromebook, Windows, and MacOS.

APPENDIX: LIST OF ARTICLES FOR DISCUSSION

Caution: This appendix is a work in progress.

16.1 Media bias diagram

https://upload.wikimedia.org/wikipedia/commons/0/07/Media-Bias-Chart_4.0.1_WikiMedia_Commons_Copy.jpg

<https://mediabiasfactcheck.com/>

<https://mediabiasfactcheck.com/the-balance/>

League of women voterse discussion of media bias charts:

<https://my.lwv.org/california/torrance-area/article/how-reliable-your-news-source-understanding-media-bias-2021>

16.2 Pushing at an open door

Report from the CDC, a trusted organization:

<https://www.whitehouse.gov/briefing-room/press-briefings/2021/04/27/press-briefing-by-white-house-covid-19-response-team-and-public-health-officials-32/>

Critical look at the CDC report:

<https://www.nytimes.com/2021/05/11/briefing/outdoor-covid-transmission-cdc-number.html>

<https://statmodeling.stat.columbia.edu/2021/05/11/if-a-value-is-less-than-10-you-can-bet-its-not-0-1-usually/>

16.3 Selection effects

<https://www.cnn.com/2021/05/13/seychelles-most-vaccinated-nation-on-earth-but-covid-19-has-surged.html>

16.4 Taxation policy

<https://www.usatoday.com/story/money/2020/04/19/taxes-2020-states-with-the-highest-and-lowest-taxes/111555224/>

<https://www.epi.org/publication/ib338-fiscal-cliff-obstacle-course/>

<https://taxfoundation.org/which-states-have-most-progressive-income-taxes-0/>

https://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_income

<https://www.investopedia.com/financial-edge/0210/7-states-with-no-income-tax.aspx>

16.5 Renaissance Capital

<http://lib.21h.io/library/P4IH7WWY/download/UDUBAIW5/Zuckerman%20-%202019%20-%20The%20man%20who%20solved%20the%20market.pdf>

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BIBLIOGRAPHY

INDICES AND TABLES

- genindex
- modindex
- search

BIBLIOGRAPHY

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