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Attempted Telekinesis

Related to: [Compartmentalization in epistemic and instrumental rationality](#); [That other kind of status](#).

Summary: *I'd like to share some techniques that made a large difference for me, and for several other folks I shared them with. They are techniques for reducing stress, social shame, and certain other kinds of "wasted effort". These techniques are less developed and rigorous than the techniques that CFAR teaches in our [workshops](#) - for example, they currently only work for perhaps 1/3rd of the dozen or so people I've shared them with -- but they've made a large enough impact for that 1/3rd that I wanted to share them with the larger group. I'll share them through a sequence of stories and metaphors, because, for now, that is what I have.*

For me, these techniques came out of a stressful time period.

In October 2012, CFAR was very new, and I was very new to being its executive director.

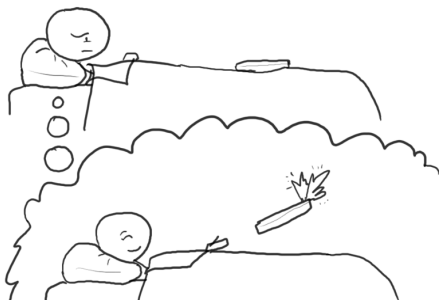
I was faced with a task that I basically didn't know how to do -- filling the first workshop for which we charged "real" money (the \$3900/person that actually let CFAR run), and helping our team create our first decently polished workshop at the same time (which needed curriculum, operations, etc.). But whenever I sat down to try to work, my head would fill up with all the other tasks I "needed" to get done, instead of the particular task I was trying to work on. Or my head would fill with stress and mental static. So, almost *because* of how badly I needed to work, I found myself unable to accomplish much of anything.

The set of stories and metaphors below is somehow what eventually gave me the ability to work with full focus in those conditions (I found them partway through that October), and cured most of my decades-long social shame at the same time.[1] (Though, again, this stuff isn't rigorous yet. It worked for a few folk, but failed a few others; your mileage may vary. Do share your thoughts.)

Attempted telekinesis

One morning, that month, I was lying in bed, half-asleep. And I wanted my laptop. But my laptop was a few feet away, so reaching it sounded hard (because I was half-asleep).

After lying there a while wishing, I finally noticed what my brain was up to. And I noticed that what my brain was doing was visualizing my laptop whooshing toward me. Again and again. (Fix attention on laptop... visualize the woosh. Nope, laptop isn't here yet: repeat!)[2]



I'm going to call this process "Attempted telekinesis".

It seems to me that something like "attempted telekinesis" underlies a large set of stress / shame / worry / etc., and that learning to vanish it has been super-useful for me and several others. I'll start with several examples of what I'll be calling "attempted telekinesis", and then go into some techniques for vanishing it.

The case of the munching noises

Later that day, I was sitting at the office trying to work, and someone next to me was eating. Noisily.

Now, I'm part of the sizable minority of the population that is driven absolutely bonkers by munching noises. Munching noises fill me with rage and make me want to punch someone. But, like, I get that that's petty of me.

So my internal thinking stream goes something like this:

Coworker: [Munch. Munch.]

My system 1/ intuitive brain (*silently, in my head*): Argh! Stop it!

Me: [Type, type.] (While thinking: "I don't want to be petty; best not say anything, nor show annoyance on my face in any way.")

[1 minute later]

Coworker: [Munch. Munch.]

My system 1/ intuitive brain (*silently, in my head*): Didn't you hear me?? Stop it!!

Me: [Type, type.] (... I don't want to be petty; best not say anything, or show it on my face in any way.)

[and another minute later]

Coworker: [Munch. Munch.]

My system 1/ intuitive brain (*silently, in my head*): Argh!! Didn't you hear me?? Stop it!! Why won't it stop!! Clearly I need to use even more emotional force to make it stop!!

Me: [no longer typing] (... Oh, huh, this is that "attempted telekinesis" thing again, isn't it. I'm not doing anything with my face or voice that would cause the eating noises to cease. I'm *intentionally* not doing anything with my face or voice, because I don't want to be petty. And yet my intuitive brain seems to feel like its "be upset" action should've changed something in the world...)

The ad copy writer who doesn't know if she's "good enough"

So, later on that day, I sit down to write some ad copy -- something I can email out to folks who might be interested in the workshop.

And I notice that a bunch of my thoughts aren't about the details of the ad wording at all -- they're about whether I'm good enough at writing to write ad copy, and also about whether the whole workshop is doomed and I'll be cast desolate to the hyenas while my entire tribe mocks me for having ruined CFAR.

So I stop and think through my fears for a moment. And I agree that, indeed, the workshop might not work -- but since it also *might well* work, it'd be pretty damn stupid to stop preparing right then. And in fact, my useful "next actions" from this moment basically involve doing whatever's most likely to make it work, and not [wasting motions](#) on the opposite prospect.

Similarly, I might not be good enough at the writing -- maybe I should be getting someone else to write it for me. But since I might well be able to, and since there's no one good sitting right there to give the task to instead, it seems best to set a 1-hour timer, do the best writing I can for 1 hour without distracting myself trying to evaluate it -- and then, when the timer rings, I can deliberately evaluate whether to write more myself or to look for someone else who can write it.

But even after I think that through... my brain keeps on trying to waste these motions. It's like "write... pause... `what if I'm not good enough?"". And I notice that it has the same feel as the laptop and the munching noises. As though something in me hopes that if I just feel upset about things, or if I just visualize that I need the world to be a certain way or worry about how it isn't, this will somehow magic the world into a better state.

A musical artist once said: "You know, how good or bad you are [at making music] is really none of your goddamn business." And I get what he meant, now. My business this hour is to write, not to worry about how I'm not good enough at writing.

But how to do it? How to get my brain to focus on writing, and to drop the attempted telekinesis?[3]

Useful "telekinesis": Separating babies from bathwater

The "attempted telekinesis" examples above are all examples of pointless behaviors -- the kinds of behaviors a person is better off removing. I'd like to take a moment, now, to distinguish pointless cases of "attempted telekinesis" (where a person tries to change the world just by repeatedly stressing out about it) from their useful cousins.

Here's a useful cousin:

The other morning, I was lying in bed, again. Thinking that maybe I should get up. But feeling like bed was warm and getting up would be a little hard.

And then I thought about breakfast. I pictured it: nice, fried eggs; a sliced fresh tomato; a steaming cup of tea. I pictured biting into the eggs, with the runny yolk on my tongue. And suddenly, without any need of prompting from conscious-me, my body was in motion -- up and heading toward the eggs. (Perhaps, from the perspective of the submodule of my brain that did the "wishing for eggs" maneuver, wishing had in fact made it so! It wished, and my body responded: telekinetic success.)

As in the above "pointless" cases, my system 1 brain had a thing that it wanted, and visualized a picture of the desired end-state. But in the breakfast example, that visualization was useful. The imagined flying laptop had just filled my head with repeated wishing. The imagined vanishing munching noises had just filled my head with repeated aggravation. The imagined "being a better writer" state had only distracted me from writing. But the imagined experience of eating breakfast... pulled my system 1 into actually obtaining breakfast.

Similarly, when I imagine Archimedes in the classic bathtub story, I imagine him obsessing a bit about how to measure the crown's density. "How can I measure it? How can I measure it?" his brain might repeat... a little like repeating "Get my laptop to whoosh toward me!". Obsessing on problems at CFAR certainly seems to help me notice potential solutions.

So, what's the take-away? When is it useful to try to wish the world into a different state? What distinguishes the kinds of "attempted telekinesis" that one might like to remove, from the kinds that fetch you breakfast or give you insights into the king's crown?

This matter seems to me to be a bit complicated, but also seems quite important -- if you get it wrong, you either stay unnecessarily distracted and ineffective (like me in the lead-up to CFAR's first workshop), or you end up a sort of parody of pop Buddhism, sitting there being placid about your problems instead of harnessing your drives to solve them.

How to distinguish?

In practice, I tend to distinguish between useful and useless attempted telekinesis based on task type and emotional tone. (Improvements/kibbitzes appreciated.)

Task type:

Type 1: Problems that System 1 can solve by itself:

Examples: Making breakfast; causing someone to know you care about them.

Suggested response: This sort of wishing is healthy, and may prompt actions that make a lot more sense than those system 2 would plan (e.g., your nonverbals as you apologize are likely to be far better if you viscerally care about your interlocutor). Leave system 1 be.

Type 2: Problems that are worth solving, but that need help from System 2:

Examples: "There's nothing good to eat" (situation: you notice that several times, over the last hour, you've gone to the fridge, opened it, stared inside, closed it... and then opened it again a few minutes later -- as though to see if something good has magically materialized into the closed fridge); Feeling 'stuck' at one's job (or in a relationship); Not having enough money. (The distinguishing feature here is that system 1 has been looping on the problem for a while to no effect, and that system 2 has not yet taken a good look at the problem.)

Suggested response: Raise the problem to conscious attention; then, try to figure out what is bothering system 1; finally, decide what to do about it. As you do this, parts of the wishing will naturally shift from the general problem ("Somehow make work less stuck-feeling") to the specific strategy you've chosen ("Figure out how to renegotiate with my manager").[4]

Type 3: "Problems" that should be given up on:

Examples: "Make the munching noises go away" (in a case where you've decided not to); "Make San Franciscans be better drivers"; "Let me vanish into the floor." (The distinguishing feature here is simply that these are "problems" that, on reflection, you do not wish to take action on.)

Suggested response: Find a way to let system 1 know that solving this problem isn't worth the cost, or that keeping this problem on your internal "worry/fume about" list is quite unlikely to have positive effects. For example, you might:

- Make a plan for what it would actually take to cause San Franciscans to be better drivers. Estimate the total amount of work involved. Ask your emotional brain if it would, in fact, like you to carry out this plan.
- Visualize a stressed-out/fuming/worrying you getting cut off in traffic. Now visualize a calm you getting cut off in traffic. See if you expect to see anything good happen in the stressed-out case that doesn't happen in the calm case. (Be open to the fact that the answer might be "yes").[5]
- Notice, in detail, what system 1 is upset about. Acknowledge that, yes, you may be late to your work meeting because of the traffic. And that, indeed, your personal driving habits are different from those of the driver who cut you off. And that someday a driver like that may in fact kill you via aggression or carelessness -- it isn't likely, but it's possible, and the lifetime risk of death by traffic accident is distinctly nonzero. Once you've noticed all the painful things, check again to see whether it's worth taking some sort of constructive action on some of them. System 1 may trust your policy decision more now that you've looked at all the downsides (and may be more willing, therefore, to stop trying to will the drivers into a different state).[6]

Type 4: Problems that should be delegated to a particular future-you:

Examples: The problem of locating a workshop venue (during the hour at which I was trying to write the workshops ad, that October); the situation with your roommates and the dishes (while you're at work solving a coding problem).

Suggested response: Designate a particular future-you to do the task. Dialog with your "inner simulator" (your system 1 anticipations) until both system 1 and system 2 are convinced that that specific you will actually do the task, and that there is no additional positive effect to be gained via staying preoccupied now.

Type 5: Problems that System 2 needs "shower-thoughts" help with:

Examples: Archimedes' problem measuring the king's crown; "My relationship with Fred is broken, and I can't figure out what to do about it"; "How the heck can I solve that [math riddle](#)?" (The distinguishing feature here is that both: (1) the problem has already been raised to conscious attention at some point (and system 2 failed to instantly solve it); and (2) the problem is a worthy use of your [shower-thoughts](#) -- either for what it'll accomplish directly, or for the improvement it may give to your pattern of thought.))

Suggested response: This sort of wishing is healthy. Leave system 1 be.

Emotional tone:

Wishes often seem to me to have emotional tones. Some tones are simple desire ("Breakfast... mmm...."). Others have an overlayed hopelessness or bitter resignation about them ("I just always have to put up with how everyone else is incompetent"); others, still, have a tone (at least in me) of hammed-up flailing, self-pity, or desire for outside help -- as though if I just feel helpless enough, somehow a grown-up will come to the rescue ("Make the workshop crisis not be in this state... Make the workshop crisis not be in this state...").

It seems to me that it's worth installing an "alert" that sounds, in your head, whenever it hears either the hopeless/bitter/resigned tone, or the flailing/save-me tone. Both are often signs of buggy "attempted telekinesis" situations that are worth conscious debugging (a la the schema above). And the emotional tones can be easier to automatically flag.

[1] A book called "[Bonds that make us free](#)" played a substantial role in prompting these thoughts and was extremely helpful to me. It's written from a Christian worldview, but if you're up for navigating a foreign expository style and sorting out for yourself which parts to keep, and if in addition you are interested in vanishing social shame or other forms of loopy thoughts, I'd recommend it.

[2] Thanks to Alicorn for making the cartoon.

[3] Other than, you know, to repeatedly visualize my thought patterns whooshing into the new state that I now wished them to be in? ;)

[4] The book "Focusing" by Eugene Gendlin teaches one useful way to do this. If you decide to check it out, I'd strongly recommend the [audiobook](#) over the paper book, as it is abridged and far clearer.

[5] For example, perhaps, if you remain stressed out, perhaps your boss will see how much you suffered in your attempt to be on time to work and will deduce that you care about timeliness. (If you notice some good effect coming from the stress that doesn't come from the calm, you might want to look for an alternative way to cause the effect. For example, you might update your heuristics to decrease the chances of future lateness; plan to explain this to your boss and to offer a 1-sided \$100 bet against this ever happening again; and then drive with your mind free to focus fully on interesting problems.)

[6] More generally, when setting out to convince system 1 that X is true, it is best to be honestly curious as to whether X might in fact be false, and whether system 1 may have some good reason for suspecting this. It is much the same as when attempting to convince another human. Saying "Hey, look, you're wrong and stupid and so your proposed office policy is really bad" is usually not very persuasive; saying "huh; I'm confused; the office policy looks to me as though it'll cost a lot of hours to little effect, but you usually have good reasons for things; maybe you could tell me why you think it's plausible?" is often a better way to persuade; one wishes to do the same thing for system 1.

How to learn soft skills

Acquiring some skills is mostly about deliberate, explicit information transfer. For example, one might explicitly learn the capital of Missouri, or the number of miles one can drive before needing an oil change, or how to use the quadratic formula to solve quadratic equations.

For other skills, practitioners' skill rests largely on semi-conscious, non-explicit patterns of perception and action. I have in mind here such skills as:

- Managing your emotions and energy levels;
- Building strong relationships;
- Making robust plans;
- Finding angles of attack on a mathematical problem;
- Writing persuasively;
- Thinking through charged subjects without bias;

and so on. Experts in these skills will often be unable to accurately and explicitly describe how to do what they do, but they will be skilled nonetheless.

I'd like to share some thoughts on how to learn such "soft skills".

Usefulness of non-true stimuli

If you read a chemistry textbook, it makes sense to ask after each sentence: "Is this true?". If the answer is "no", "no", "no", for a sufficient number of sentences, you should probably abandon that book and look for a better one. Chemistry textbooks are supposed to be made out of statements you can trust -- statements you can add to your file of "trusted explicit claims", in such a fashion as to make you better at chemistry. When a book fails at this property, its main value is lost.

Not so, IMO, for soft skills.

You can test ideas in your "inner simulator"

Your "inner simulator" is CFAR's version of the distinction between [profession and anticipation](#). Basically, your "inner simulator" is the part of you that can play movies forward to determine what to anticipate: "Do I have time to turn left before that car reaches me?"; "What will she do, if I approach and say 'hi'?" (that is: what does my inner movie-player show as the next scene, when I play it a movie in which I walk up to her and say 'hi'?).

Your inner simulator is probably more accurate than your explicit models in domains where you have a rich experience base, such as social phenomena, and day-to-day physical phenomena. It is probably worse in areas where you have good book-learning behind you (e.g., you may have an accurate conscious model of the bystander effect, but still mismodel this when you anticipate without conscious adjustment). Your inner simulator is also the place where learning **must** land, if it is

to affect your automatic system 1 responses (such as the perceptual patterns, and the trigger-action habits, that play into many soft skills).

IMO, most “soft skills” books are not trying to add explicit statements to your store of “trusted explicit/verbal statements”. Instead, they are trying to evoke experiments to try out in your inner simulator -- bits that you can then keep, or not, according to whether they feel promising when you imagine trying them out. Later, you can try the promising bits out in the actual world.

Example: Roommate

To see how this can work, imagine you’re in a tricky social situation. Perhaps your roommate, Fred, is easily offended, and also keeps leaving the kitchen in a state of total mess. You’ve brainstormed a number of options for talking to him, but they all seem likely to end badly, and so you find yourself in the self-help section of the bookstore, looking for, well, help.

As you browse, you notice a lot of advice that you’ve heard before -- advice like “imagine what things feel like from Fred’s perspective” and “explain what’s in it for Fred; find a way to appeal to his pride and self-interest”. You could’ve generated a lot of this advice yourself. Nevertheless, much of it is advice you hadn’t actually tried, in Fred’s case. You find yourself moved to actually try it as you read -- the stories in the books pull you to actually want to see things from Fred’s perspective, and you begin spontaneously picturing how he might be feeling. You also find different sentence-stems in your head for how you might start the conversation -- sentence-stems seeded, in part, from the stories you read in the books -- and some of them seem promising.

Some of the books also contain statements that, as far as you can tell, are outright nonsense. One suggests that the only reason you or Fred have any problems is that you weren’t praised enough as children. You try on that perspective as well, but it feels yucky and nothing new clicks into place, and so you move along to the next part.

In this case, the books are acting, not as a source of trusted information, but as spur to your own process of anticipating, perceiving, desiring, and planning -- and, in this way, they are useful.

Example: Reading a good “woo” book

As I read “[Bonds that Make Us Free](#)”, I read many explicit statements I disagreed with (such as statements about a Christian God). I took these in as poetry: I tried to imagine the world the author saw himself in, and to see myself in the same world, so as to have more access to the way he was parsing human phenomena.

The book also contained many stories, all of which “rang true” in my inner simulator (they matched the world as I anticipated it), but which formed new patterns when placed next to each other. I felt my intuitions update as I read -- I felt the stories take patterns I had previously half-seen, and pull them into full conscious awareness.

I left the book with a changed perception of how rationalization patterns affect close relationships, and with an increased ability to separate from my rationalizations and see the people close to me. I left also with some new freedom from social shame.

These changes did not come about via trusting or deferring to the author; they came via trying on his perspective, and finding that pieces of the pattern he was pointing to “clicked”.

Try it!

One way to try this is to read a book. But, since books’ usefulness is not just about their accuracy, it can **also** be surprisingly effective to just write your own book -- or, at least, to write 5 minutes of it. You can think of this as a way of getting system 1 unstuck from its default pattern.[1]

Set a 5-minute timer (I):

Pick a soft skill, X, that you’d like to get better at. Then, set a 5-minute timer (yes, an actual one — thinking for “about 5 minutes” doesn’t work nearly as well). Spend those 5 minutes explaining to yourself, in writing, how to do X. (For example, if you picked “networking at conferences”, you might spend the 5 minutes brainstorming on what the key tricky bits are, and on strategies for navigating them. E.g., “I’m not sure how to start conversations. So, at the conference, I can watch and see what sentence-stems other people use. I can also just start with ‘Hi, my name is Anna’, or with ‘Oh, are you Dr. so-and-so? I loved your paper on such-and-such’. That starter sounds promising, actually; I should try to skim abstracts and Google at least a few papers before the conference....”)

(You might consider giving this a try right now.)

Set a 5-minute timer (II):

This exercise was created by Zak Vance, and is one of my favorites. It’s seriously worth 5 minutes of your life to try this one out. Pick, again, a soft skill, X, that you’d like to get better at (e.g., “networking at conferences”). Now pick a different skill, Y, that you’re already highly skilled at (e.g., “programming” — Y can be a soft skill or any other sort). Now, set a 5-minute timer, and spend 5 minutes explaining (in writing, or aloud to a friend) how skill X is really actually just the same as skill Y, in the sense that anyone who is fluent in skill Y already knows all they need to know to be good at X — they just need to apply their Y-skill to X. (Your goal, as you do this, is to create a very short guide that enables anyone who already knows Y to hit the ground running with X.) You can see my example (taken from the seed “networking at conferences is really just the same skill as programming”) in footnote [2].

It’s important, of course, not to believe everything you generate in such an exercise — after all, it was secretly written by a **beginner** in Skill X. But, again, you can use it to brainstorm ideas to try out, and to thereby get your system 1 intuitive search pattern out of any local optima you may be caught in.

Some good “soft skills” books to try reading:

[*Bonds that Make Us Free*](#), by Terry Warner

[*An Open Heart*](#), by the Dalai Lama

[*Feeling Good Together*](#), by David Burns

[*Eat That Frog*](#), by Brian Tracy

[*How to Win Friends and Influence People*](#), by Dale Carnegie

[Self-therapy](#), by Jay Earley

[Focusing](#), by Eugene Gendlin (the audiobook is much better than the paper, IMO)

[The Core LW Sequences](#), by Eliezer.

You might also just try going to the bookstore and locating a new “soft skills” book, by scanning through a few and seeing if any “speak to you”. Books of the relevant sort can be found in the business, self-help, continental philosophy, and spirituality sections, as well as in sections focused on particular soft skills such as writing or problem-solving.

As you read:

As you read a soft skills book (or the results of your own 5-minute timers), you may wish to ask about each paragraph:

- Is it true? Can I use it to update my explicit model of Skill X? (Yes, explicit models are still useful!)
- Even if it's false -- is there something near it that is true?
- If I free associate from here, do any of my past experiences click into a new focus?
- What feels fruitful/interesting about this idea? About ideas I can free associate to from here? Does this improve my implicit space of hypotheses?
- As I read this, can I visualize myself carrying out soft skill X in a usefully different way? Do I find my intuitions changing?
- How can I climb as thoroughly as possible into the frame, feeling, groove, or worldview that generated this book? And once I do that, does anything new click into focus?

Do consider adding your favorite books, or book-reading strategies, in the comments!

[1] System 1 stuckness of this sort seems to be almost ubiquitous. For example, I type and drive quite a bit, but my typing and driving skill are pretty similar to what they were several years ago; my conversational skills improve more, but they seem to have some of this same "trying the [same things](#) again and again" flavor. In this context, even random noise seems helpful to jumpstart learning.

("Learned blankness" seems related here as well; one somehow gets stuck in an ontology; the goal of soft skills books is often to help a person jumpstart out of it.)

[2] The example I generated from this seed, in 90 seconds:

Networking at conferences is really just the same skill as programming. The three programmers' virtues of Laziness, Impatience, and Hubris will take you all the way there, as will basic principles such as analytic thinking and code reuse.

Re: Laziness: Many folks who set out to network at conferences work hard, and push themselves to talk to lots of people. But in fact, some conversations are predictably much higher value than others. Be Lazy: plan a bit during your plane-ride to the conference (or during a boring talk!), so that you know *who* you're hoping to have *what kind* of conversations with, and can position yourself accordingly.

Also, when you approach a new person, see it as an opportunity to **practice** and **debug** your greeting, as a re-usable code module, instead of treating it as a one-off task to separately sweat about and make throw-away code for. And, afterward, review it briefly in your mind — and see if you can create a way to refine it.

You might also look for “test cases”, much as you would when debugging — you might approach people who you already know by reputation, or who a friend of yours has secretly already approached, and see if your interaction pattern is similar to what you’ve heard. You can use “test cases” of this sort to find out how your results compare to others, and to gain valuable info for debugging your own routines.

Note that, to show a real example, the text above is the first thing I generated when I gave myself 90 seconds to type from that seed -- it is a typical case, not a selected case -- and certainly not a vetted guide to networking. Nevertheless, you can perhaps see how this sort of rationalization(!) process might be helpful to seed learning.

The Truth About Mathematical Ability

There's widespread confusion about the nature of mathematical ability, for a variety of reasons:

- Most people don't know what math is.
- Most people don't know enough statistics to analyze the question properly.
- Most mathematicians are not very metacognitive.
- Very few people have more than a casual interest in the subject.

If the nature of mathematical ability were exclusively an object of intellectual interest, this would be relatively inconsequential. For example, many people are confused about Einstein's theory of relativity, but this doesn't have much of an impact on their lives. But in practice, people's misconceptions about the nature of mathematical ability seriously interfere with their own ability to learn and do math, something that hurts them both professionally and emotionally.

I have a long standing interest in the subject, and I've found myself in the unusual position of being an expert. My experiences include:

- Completing a PhD in pure math at University of Illinois.
- Four years of teaching math at the high school and college levels (precalculus, calculus, multivariable calculus and linear algebra)
- Personal encounters with some of the best mathematicians in the world, and a study of great mathematicians' biographies.
- A long history of working with mathematically gifted children: as a counselor at [MathPath](#) for three summers, through one-on-one tutoring, and as an instructor at [Art of Problem Solving](#).
- Studying the literature on IQ and papers from the [Study of Exceptional Talent](#) as a part of my work for [Cognito Mentoring](#).
- Training as a full-stack web developer at [App Academy](#).
- Doing a large scale data science [project](#) where I applied statistics and machine learning to make new discoveries in social psychology.

I've thought about writing about the nature of mathematical ability for a long time, but there was a missing element: I myself had never done genuinely original and high quality mathematical research. After completing much of my data science project, I realized that this had changed. The experience sharpened my understanding of the issues.

This is the first of a sequence of posts where I try to clarify the situation. My main point in this post is:

There are several different dimensions to mathematical ability. Common measures rarely assess all of these dimensions, and can paint a very incomplete picture of what somebody is capable of.

What is up with Grothendieck?

I was saddened to learn of the [death of Alexander Grothendieck](#) several months ago. He's the mathematician who I identify with the most on a personal level, and I had

hoped to have the chance to meet him. I hesitated as I wrote the last sentence, because some readers who are mathematicians will roll their eyes as they read this, owing to the connotation (even if very slight) that the quality of my research might overlap with his. The material below makes it clear why:

"His technical superiority was crushing," Thom wrote. "His seminar attracted the whole of Parisian mathematics, whereas I had nothing new to offer. — **Rene Thom, 1958 Fields Medalist**

"When I was in Paris as a student, I would go to Grothendieck's seminar at IHES... I enjoyed the atmosphere around him very much ... we did not care much about priority because Grothendieck had the ideas that we were working on and priority would have meant nothing. — **Pierre Deligne, 1978 Fields Medalist**

"[The IHES] is a remarkable place.. I knew about it before I came there; it was a legendary place because of Grothendieck. He was kind of a god in mathematics." — **Mikhail Gromov, 2010 Abel Prize Winner**

"On arriving at the IHES, we ordinary mathematicians share the same feeling that Muslims experience on a pilgrimage to Mecca. Here is the place where, for a dozen or so years, Grothendieck relentlessly explained the holy word to his apostles. Of that saga, only the apocrypha reached us in the form of big, yellow, boring-looking books edited by Springer. These dozens of volumes...are still our most precious working companion." — **Ngo Bau Chau, 2010 Fields Medalist**

Based on these remarks alone, it seems hard to imagine how I could be anything like Grothendieck. But when I read Grothendieck's own description of himself, it's hauntingly familiar. He writes:

"I've had the chance...to meet quite a number of people, both among my "elders" and among young people in my general age group, who were much more brilliant, much more "gifted" than I was. I admired the facility with which they picked up, as if at play, new ideas, juggling them as if familiar with them from the cradle - while for myself I felt clumsy. even oafish, wandering painfully up a arduous track, like a dumb ox faced with an amorphous mountain of things that I had to learn (so I was assured), things I felt incapable of understanding the essentials or following through to the end. Indeed, there was little about me that identified the kind of bright student who wins at prestigious competitions or assimilates, almost by sleight of hand, the most forbidding subjects."

When I mentioned this to professor at a top math department who had taken a class with Grothendieck, he scoffed and said that he didn't believe it, apparently thinking that Grothendieck was putting on airs in the above quotation - engaging in a sort of bragging, along the lines of "I'm so awesome that even though I'm not smart I was still one of the greatest mathematicians ever." It is hard to reconcile Grothendieck's self-description with how his colleagues describe him. But I was stunned by the professor's willingness to dismiss the remarks of somebody so great out of hand.

In fairness to the professor, I myself am much better situated to understand how Grothendieck's remarks could be sincere and faithful than most mathematicians are, because of my own unusual situation.

What is up with me?

I went to Lowell High School in San Francisco, an academic magnet school with ~650 students per year, who averaged ~630 on the math SAT (81st percentile relative to all college bound students). The math department was very stringent with respect to allowing students to take AP calculus, apparently out of a self-interested wish to keep their average AP scores as high as possible. So despite the strength of the school's students, Lowell only allowed 10% of students to take AP Calculus BC. I was one of them. The teachers made the exams unusually difficult for an AP Calculus BC course, so that students would be greatly over prepared for the AP exam. The result was that a large majority of students got 5's on the AP exam. By the end of the year, I had the 2nd highest cumulative average out of all students enrolled in AP Calculus BC. It would have been the highest if the average had determined exclusively by tests, rather than homework that I didn't do because I already knew how to do everything.

From this, people understandably inferred that I'm unusually brilliant, and thought of me as one of the select few who was a natural mathematician, having ability perhaps present in only 1 in 1000 people. When I pointed out that things had not always been this way, and that I had in fact failed geometry my freshman year and had to retake the course, their reactions tended to be along the lines of [Qiaochu's response](#) to my post [How my math skills improved dramatically](#):

I find this post slightly disingenuous. My experience has been that mathematics is heavily g-loaded: it's just not feasible to progress beyond a certain point if you don't have the working memory or information processing capacity or whatever g factor actually is to do so. The main conclusion I draw from the fact that you eventually completed a Ph.D. is that you always had the g for math; given that, what's mysterious isn't how you eventually performed well but why you started out performing poorly.

It's not at all mysterious *to me* why I started out performing poorly. In fact, if Qiaochu had known only a little bit more, he would be less incredulous.

Aside from taking AP Calculus BC during my senior year, I also took the SAT, and scored 720 on the math section (96th percentile relative to the pool of college bound students). While there are many people who would be happy with this score, there were perhaps ~60 students at my high school who scored higher than me (including many of my classmates who were in awe of me). Just looking at my math SAT score, people would think very unlikely that I would come close to being the strongest calculus student in my year.

As far removed my mathematical ability is from Grothendieck's, we have at least one thing in common: our respective performances on some commonly used measures of mathematical ability are much lower than what most people would expect based on our mathematical accomplishments.

Hopefully these examples suffice to make clear that whatever mathematical ability is, it's not "what the math SAT measures." What the math SAT measures is highly relevant, but still not the *most* relevant thing.

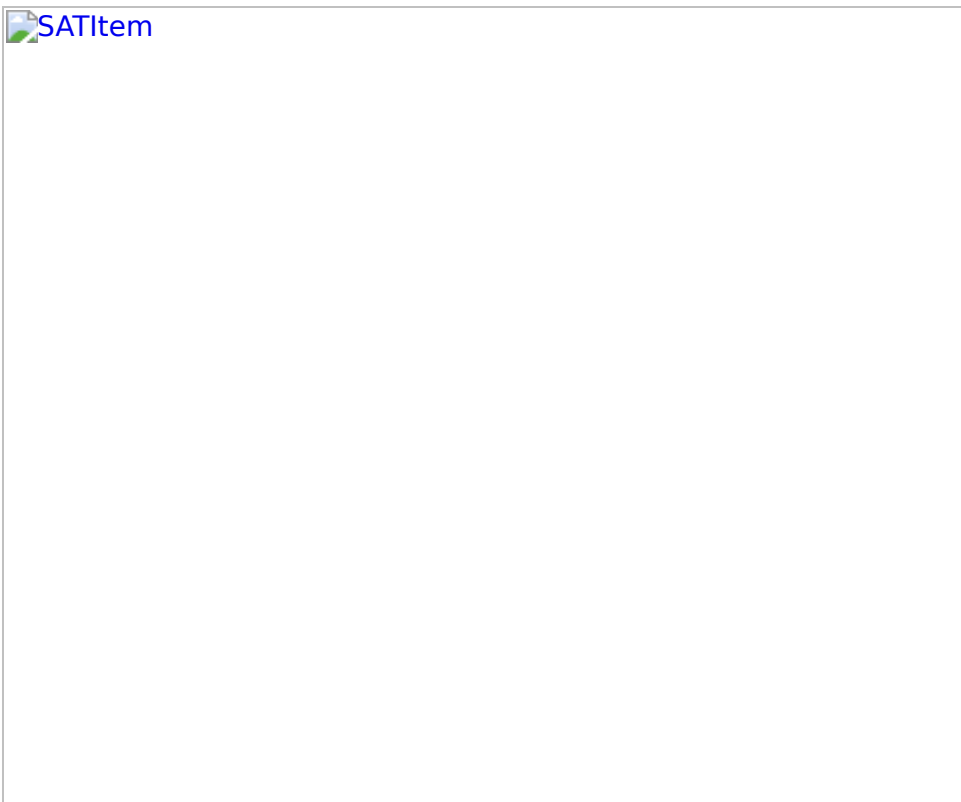
What *does* the math SAT measure?

Just for fun, let's first look at what the College Board has to say on the subject. According to [The Official SAT Study Guide](#)

The SAT does not test logic abilities or IQ. It tests your skills in reading, writing and mathematics – the same subjects you're learning in school. [...] If you take rigorous challenging courses in high school, you'll be ready for the test.

Some of you may be shocked by the College Board's disingenuousness without any further comment. How would they respond to my own situation? Most hypothetical responses are absurd: They could say "Unfortunately, you were underprivileged in having to go to the high school ranked 50th in the country, where you didn't have access to sufficiently rigorous challenging courses" or "While you did take AP Calculus BC, you didn't take AP US History, and that would have further developed your mathematical reasoning skills" or "Our tests are really badly calibrated – we haven't been able to get them to the point where somebody with 99.9 percentile level subject matter knowledge reliably scores at the 97th percentile or higher."

Their strongest response would be to say that the test has been revised since I took it in 2002 to make it more closely aligned with the academic curriculum. This is true. But a careful examination of the current version of the test makes it clear that it's *still* not designed to test what's learned in school. For example, consider questions 16-18 in Section 2 of the [sample test](#):



The grid above represents equally spaced streets in a town that has no one-way streets. F marks the corner where a firehouse is located. Points W, X, Y, and Z represent the locations of some other buildings. The fire company defines a building's m-distance as the minimum number of blocks that a fire truck must travel from the firehouse to reach the building. For example, the building at X is an m-distance of 2, and the building at Y is an m-distance of $\frac{1}{2}$ from the firehouse

1. What is the m-distance of the building at W from the firehouse?

2. What is the total number of different routes that a fire truck can travel the m-distance from F to Z ?
3. All of the buildings in the town that are an m-distance of 3 from the firehouse must lie on a...

I don't think that rigorous, academic challenging courses build skills that enable high school students to solve these questions. They have *some* connection with what people learn in school – in particular, they involve numbers and distances. But the connection is very tenuous – they're extremely far removed from being the *best* test of what students learn in school. They can be solved by a very smart 5th grader who hasn't studied algebra or geometry.

The [SAT Subject Tests](#) are much more closely connected with what students (are supposed to) learn in school. And they're not merely tests of what students have memorized: some of the questions require deep conceptual understanding and ability to apply the material in novel concepts. If the College Board wanted to make the SAT math section a test of what students are supposed to learn in school, they would do better to just swap it with the Mathematics Level 1 SAT Subject Test.

If the SAT math section measures something other than the math skills that students are supposed to learn in school, what *does* it measure? The situation is exactly what the College Board explicitly disclaims it to be: the SAT is an IQ test. This accounts for the inclusion of questions like the ones above, that a very smart 5th grader with no knowledge of algebra or geometry could answer easily, and that the average high school student who has taken algebra and geometry might struggle with.

The SAT was originally designed as a test of aptitude: not knowledge or learned skills. Though I haven't seen an authoritative source, the consensus seems to be that the original purpose of the test was to help smart students from underprivileged backgrounds have a chance to attend a high quality college – students who might not have had access to the educational resources to do well on tests of what students are supposed to learn in school. Frey and Detterman [found](#) that as of 1979, the correlations between SAT scores and IQ test scores were very high (0.7 to 0.85). The correlations have probably dropped since then, as there have in fact been changes to make the SAT less like an IQ test, but to the extent that the SAT differs from the SAT subject tests, the difference corresponds to the SAT being more of a test of IQ.

The SAT may have served its intended purpose at the time, but since then there's been mounting evidence that the SAT has become a harmful force in society. By 2007, things had reached a point that Charles Murray wrote [an article](#) advocating that the SAT be abolished in favor of using SAT subject tests exclusively. This will have significance to those of you who know Charles Murray as the widely hated author [The Bell Curve](#), which emphasizes the importance of IQ.

Twice exceptional gifted children

Let's return to the question of reconciling my very strong calculus performance with my relatively low math SAT score. The difference comes in substantial part from my having a much greater love of learning than is typical of people of similar intelligence. I think that the same was true of Grothendieck.

I could have responded to Qiaochu's suggestion that I had always had very high intelligence and that that's why I was able to learn math well by saying "No, you're

wrong, my SAT score shows that I don't have very high intelligence, the reason that I was able to learn math well is that I really love the subject." But that would oversimplify things. In particular, it leaves two questions open:

- A large part of why I failed geometry my freshman year of high school is that I wasn't interested in the subject at the time. I only got interested in math after getting interested in chemistry my sophomore year. But almost nobody at my high school was interested in geometry, and almost everybody passed geometry. What made me different?
- Can a love of learning really boost one's percentile from 1 in 30 to 1 in 1000? The gap seems awfully large to be accounted for exclusively by love of learning. And what of Grothendieck, for whom the gap may have been far larger?

Partial answers to these questions come from the literature on so-called "[Twice Exceptional](#)" (2e) children. The label is used broadly, to refer to children who are intellectually gifted and also have some sort of disability.

The central finding of the IQ literature is that people who are good at one cognitive task tend to be good at any another cognitive task. For example, people who have better reaction time tend to also be better at arithmetic, better at solving logic puzzles, better able to give coherent explanations of real world concepts, and better able to recall a string of numbers that are read to them. When I was a small child, my teachers noticed that I was an exception to the rule: I had a very easy time learning some things and also found it very difficult to learn others. They referred me to a school psychologist, who found that I had exceptionally high reasoning abilities, but only average short term memory and processing speed: a 3 standard deviation difference.

There's a sense in which my situation is actually not so unusual. The finding that people who are good at one cognitive task tend to be good at another is based on the study of people of average intelligence. It becomes less and less true as you look at people of progressively higher intelligence. Twice exceptional children are not very rare amongst intellectually gifted children. Linda Silverman [writes](#)

Gifted children may have hidden learning disabilities. Approximately one-sixth of the gifted children who come to the Center for testing have some type of learning disability—often undetected before the assessment—such as central auditory processing disorder (CAPD), difficulties with visual processing, sensory processing disorder, spatial disorientation, dyslexia, and attention deficits. Giftedness masks disabilities and disabilities depress IQ scores. Higher abstract reasoning enables children to compensate to some extent for these weaknesses, making them harder to detect.

This starts to explain why I failed geometry during my freshman year of high school. The material was boring and I wasn't very focused on grades. But I also genuinely found it difficult to an extent that my classmates didn't. Learning the material the way in which the course was taught required a lot of memorization – something that I was markedly worse at than my classmates at Lowell, who had been selected for having high standardized test scores.

It also explains why I didn't score higher than 720 on the math section of the SAT. It wasn't because I couldn't answer questions like the ones that I pasted above. It was because some of the math SAT questions are engineered to trip up students who forget exactly what a problem asked for, or who are prone to arithmetic errors. Often a

multiple choice question will have one wrong answer for every such mistake that a student might make. I used to think that this was a design flaw, and that the test makers didn't know that they were penalizing minor mistakes very heavily. No - it wasn't a design flaw - they designed the test that way on purpose. The questions test short-term memory as a proxy to IQ. I tried to avoid mistakes by being really systematic about my work, and not take shortcuts. But it wasn't enough given the time constraints - making 3 minor mistakes on any combination of 54 questions is enough to reduce one's score from 800 to 720.

It's plausible that something similar was true of Grothendieck.

It's probably intuitively clear even to readers who are not mathematicians that math is not about being able to avoid making 3 minor mistakes on 54 questions. It's very *helpful* to be quick and accurate, and my mathematical ability is far lower than it would have been if my speed and accuracy were substantially greater, but speed and accuracy are not the *essence* of mathematical ability.

What *is* the essence of mathematical ability?

I've only just scratched the surface of the subject of mathematical ability in this post, largely focusing on describing what mathematical ability *isn't* rather than what mathematical ability *is*. In subsequent posts I'll describe mathematical ability in more detail, which will entail a discussion of what math is. I'll also address the question of how one can improve one's mathematical ability.

Intelligence is highly relevant and largely genetic, but there are other factors that are collectively roughly as important, some of which are things that individuals are in fact capable of developing. For now, I'll offer a teaser, which will be obscure to readers who lack substantial additional context, and which paints a very incomplete picture even when understood deeply, but which should nevertheless serve as food for thought. Grothendieck wrote:

In our acquisition of knowledge of the Universe (whether mathematical or otherwise) that which renovates the quest is nothing more nor less than *complete innocence*. It is in this state of complete innocence that we receive everything from the moment of our birth. Although so often the object of our contempt and of our private fears, it is always in us. It alone can unite humility with boldness so as to allow us to penetrate to the heart of things, or allow things to enter us and taken possession of us.

This unique power is in no way a privilege given to "exceptional talents" - persons of incredible brain power (for example), who are better able to manipulate, with dexterity and ease, an enormous mass of data, ideas and specialized skills. Such gifts are undeniably valuable, and certainly worthy of envy from those who (like myself) were not so endowed at birth," far beyond the ordinary".

Yet it is not these gifts, nor the most determined ambition combined with irresistible will-power, that enables one to surmount the "invisible yet formidable boundaries " that encircle our universe. Only innocence can surmount them, which mere knowledge doesn't even take into account, in those moments when we find ourselves able to listen to things, totally and intensely absorbed in child play.

Readers are welcome to speculate on what Grothendieck had in mind in writing this.

[Cross-posted](#) from my [website](#).

If you can see the box, you can open the box

First post here, and I'm disagreeing with something in the main sequences. Hubris acknowledged, here's what I've been thinking about. It comes from the post "[Are your enemies innately evil?](#)":

On September 11th, 2001, nineteen Muslim males hijacked four jet airliners in a deliberately suicidal effort to hurt the United States of America. Now why do you suppose they might have done that? Because they saw the USA as a beacon of freedom to the world, but were born with a mutant disposition that made them hate freedom?

Realistically, most people don't construct their life stories with themselves as the villains. Everyone is the hero of their own story. The Enemy's story, as seen by the Enemy, *is not going to make the Enemy look bad*. If you try to construe motivations that *would* make the Enemy look bad, you'll end up flat wrong about what actually goes on in the Enemy's mind.

If I'm misreading this, please correct me, but the way I am reading this is:

1) People do not construct their stories so that they are the villains,

therefore

2) the idea that Al Qaeda is motivated by a hatred of American freedom is false.

Reading the Al Qaeda document released after the attacks called [Why We Are Fighting You](#) you find the following:

What are we calling you to, and what do we want from you?

1. The first thing that we are calling you to is Islam.

A. The religion of tahwid; of freedom from associating partners with Allah Most High , and rejection of such blasphemy; of complete love for Him, the Exalted; of complete submission to his sharia; and of the discarding of all the opinions, orders, theories, and religions that contradict with the religion He sent down to His Prophet Muhammad. Islam is the religion of all the prophets and makes no distinction between them.

It is to this religion that we call you ...

2. The second thing we call you to is to stop your oppression, lies, immorality and debauchery that has spread among you.

A. We call you to be a people of manners, principles, honor and purity; to reject the immoral acts of fornication, homosexuality, intoxicants, gambling and usury.

We call you to all of this that you may be freed from the deceptive lies that you are a great nation, which your leaders spread among you in order to conceal from you the despicable state that you have obtained.

B. It is saddening to tell you that you are the worst civilization witnessed in the history of mankind:

i. **You are the nation who, rather than ruling through the sharia of Allah, chooses to invent your own laws as you will and desire.** You separate religion from you policies, contradicting the pure nature that affirms absolute authority to the Lord your Creator....

ii. You are the nation that permits usury...

iii. You are a nation that permits the production, spread, and use of intoxicants. You also permit drugs, and only forbid the trade of them, even though your nation is the largest consumer of them.

iv. **You are a nation that permits acts of immorality, and you consider them to be pillars of personal freedom.**

"Freedom" is of course one of those words. It's easy enough to imagine an SS officer saying indignantly: "Of course we are fighting for freedom! For our people to be free of Jewish domination, free from the contamination of lesser races, free from the sham of democracy..."

If we substitute the [symbol with the substance](#) though, what we mean by freedom - "people to be left more or less alone, to follow whichever religion they want or none, to speak their minds, to try to shape society's laws so they serve the people" - then Al Qaeda is absolutely inspired by a hatred of freedom. They wouldn't call it "freedom", mind you, they'd call it "decadence" or "blasphemy" or "shirk" - but the substance is what we call "freedom".

Returning to the syllogism at the top, it seems to be that there is an unstated premise.

The conclusion "Al Qaeda cannot possibly hate America for its freedom because everyone sees himself as the hero of his own story" only follows if you assume that *What is heroic, what is good, is substantially the same for all humans, for a liberal Westerner and an Islamic fanatic.*

(for Americans, by "liberal" here I mean the classical sense that includes just about everyone you are likely to meet, read or vote for. US conservatives say they are defending the American revolution, which was broadly in line with liberal principles - slavery excepted, but since US conservatives don't support that, my point stands).

When you state the premise baldly like that, you can see the problem. There's no contradiction in thinking that Muslim fanatics think of themselves as heroic precisely for being opposed to freedom, because they see their heroism as trying to extend the rule of Allah - Shariah - across the world.

Now to the point - we all know the phrase "thinking outside the box". I submit that if you can recognize the box, you've already opened it. Real bias isn't when you have a point of view you're defending, but when you cannot imagine that another point of view seriously exists.

That phrasing has a bit of negative baggage associated with it, that this is just a matter of pigheaded close-mindedness. Try thinking about it another way. Would you say to someone with [dyscalculia](#) "You can't get your head around the basics of calculus? You are just being so *close minded!*" No, that's obviously nuts. We know that different peoples minds work in different ways, that some people can see things others cannot.

Orwell once wrote about the British intellectuals inability to "get" fascism, in particular in his essay on H.G. Wells. He wrote that the only people who really understood the nature and menace of fascism were either those who had felt the lash on their backs, or those who had a touch of the fascist mindset themselves. I suggest that some people just cannot imagine, cannot really believe, the enormous power of faith, of the idea of serving and fighting and dying for your god and His prophet. It is a kind of thinking that is just alien to many.

Perhaps this is resisted because people think that "Being able to think like a fascist makes you a bit of a fascist". That's not really true in any way that matters - Orwell was one of the greatest anti-fascist writers of his time, and fought against it in Spain.

So - if you can see the box you are in, you can open it, and already have half-opened it. And if you are really in the box, you can't see the box. So, how can you tell if you are in a box that you can't see versus *not being in a box*?

The best answer I've been able to come up with is not to think of "box or no box" but rather "open or closed box". We all work from a worldview, simply because we need some knowledge to get further knowledge. If you know you come at an issue from a certain angle, you can always check yourself. You're in a box, but boxes can be useful, and you have the option to go get some stuff from outside the box.

The second is to read people in other boxes. I like [steelmanning](#), it's an important intellectual exercise, but it shouldn't preclude finding actual Men of Steel - that is, people passionately committed to another point of view, another box, and taking a look at what they have to say.

Now you might say: "But that's steelmanning!" Not quite. Steelmanning is "the art of addressing the best form of the other person's argument, even if it's not the one they presented." That may, in some circumstances, lead you to make the mistake of assuming that what *you* think is the best argument for a position is the same as what *the other guy* thinks is the best argument for his position. That's especially important if you are addressing a belief held by a large group of people.

Again, this isn't to run down steelmanning - the practice is sadly limited, and anyone who attempts it has gained a big advantage in figuring out how the world is. It's just a reminder that the steelman you make may not be quite as strong as the steelman that is out to get you.

[EDIT: Link included to the document that I did not know was available online before now]

Easy wins aren't news

Recently I talked with a guy from [Grant Street Group](#). They make, among other things, software with which local governments can auction their bonds on the Internet.

By making the auction process more transparent and easier to participate in, they enable local governments which need to sell bonds (to build a high school, for instance), to sell those bonds at, say, 7% interest instead of 8%. (At least, that's what he said.)

They have similar software for auctioning liens on property taxes, which also helps local governments raise more money by bringing more buyers to each auction, and probably helps the buyers reduce their risks by giving them more information.

This is a big deal. I think it's potentially more important than any budget argument that's been on the front pages since the 1960s. Yet I only heard of it by chance.

People would rather argue about reducing the budget by eliminating waste, or cutting subsidies to people who don't deserve it, or changing our ideological priorities. Nobody wants to talk about auction mechanics. But fixing the auction mechanics is the easy win. It's so easy that nobody's interested in it. It doesn't buy us fuzzies or let us signal our affiliations. To an individual activist, it's hardly worth doing.

Don't estimate your creative intelligence by your critical intelligence

When I criticize, I'm a genius. I can go through a book of highly-referenced scientific articles and find errors in each of them. Boy, I feel smart. How are these famous people so dumb?

But when I write, I suddenly become stupid. I sometimes spend half a day writing something and then realize at the end, or worse, after posting, that what it says simplifies to something trivial, or that I've made several unsupported assumptions, or claimed things I didn't really know were true. Or I post something, then have to go back every ten minutes to fix some point that I realize is not quite right, sometimes to the point where the whole thing falls apart.

If someone writes an article or expresses an idea that you find mistakes in, that doesn't make you smarter than that person. If you create an equally-ambitious article or idea that no one else finds mistakes in, then you can start congratulating yourself.

Innate Mathematical Ability

In my present [sequence](#) of posts, I'm writing about the nature of mathematical ability. My main reason for doing so is to provide information that can help improve mathematical ability.

Along the way, I'm going to discuss how people *can't* improve their mathematical ability. This may seem antithetical to my goal. Focus on innate ability can lead to a sort of [self-fulfilling prophesy](#), where people think that their abilities are fixed and can't be improved, which results in them not improving their abilities because they think that doing so is pointless.

Carol Dweck has become well known for her growth mindset / fixed mindset framework. She [writes](#):

"In a *fixed* mindset students believe their basic abilities, their intelligence, their talents, are just fixed traits. They have a certain amount and that's that, and then their goal becomes to look smart all the time and never look dumb. In a *growth* mindset, students understand that their talents and abilities can be developed through effort, good teaching and persistence. They don't necessarily think everyone's the same or anyone can be Einstein, but they believe everyone can get smarter if they work at it." [...] This is important because individuals with a "growth" theory are more likely to continue working hard despite setbacks...

As I'll describe in my next post, I'm broadly sympathetic with Dweck's perspective. But it's not an either-or situation. Some abilities are innate and can't be developed, and other abilities can be.

One could argue that this idea is too nuanced for most people to appreciate, so that it's better to just not talk about innate ability. This seems to me paternalistic and patronizing. People need to know which abilities are fixed and which can be developed, so that they can focus on developing abilities that *can* in fact be developed rather than wasting time and effort on developing those that can't be.

Working to improve abilities that are fixed is unproductive

When I was in elementary school, I would often fall short of answering all questions correctly on timed arithmetic tests. Multiple teachers told me that I needed to work on making fewer "careless mistakes." I was puzzled by the situation - I certainly didn't feel as though I was being careless. In hindsight, I see that my teachers were mostly misguided on this point. I imagine that their thinking was:

"He knows how to do the problems, but he still misses some. This is unusual: students who know how to do the problems usually don't miss any. When there's a task that I know how to do and don't do it correctly, it's usually because I'm being careless. So he's probably being careless."

If so, their error was in [assuming that I was like them](#). I wasn't missing questions that I knew how to do because I was being careless. I was missing the questions because my processing speed and short-term memory are unusually low relative to my other

abilities. With twice as much time, I would have been able to get all of the problems correctly, but it wasn't physically possible for me to do all of the problems correctly within the time limit based on what I knew at the time. (The situation may have been different if I had had exposure to [mental math techniques](#), which can substitute for innate speed and accuracy.)

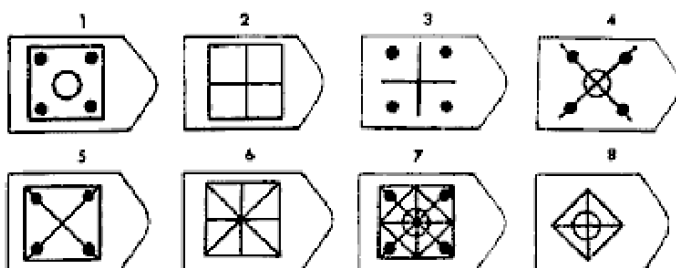
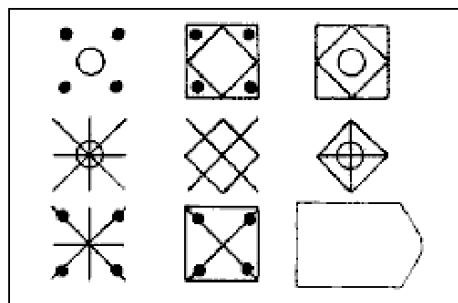
Even at that age, based on my introspection, I suspected that my teachers were wrong in their assessment of the situation, and so largely ignored their suggestion, while at the same time feeling faintly guilty, wondering whether they were right and I was just rationalizing. I made the right judgment call in that instance – making a systematic effort to stop making "careless errors" under time constraints wouldn't have been productive. To avoid such waste we need to delve into a discussion of innate ability.

Intelligence and innate mathematical ability

I think that mathematical ability is best conceptualized as ***the ability to recognize and exploit hidden structure in data***. This definition is nonstandard, and it will take several posts to explain my choice.

Abstract pattern recognition ability

A large part of "innate mathematical ability" is "abstract pattern recognition ability," which can be operationalized as "the ability to correct answer Raven's Matrices type items." Tests of Raven's Matrices type are perhaps the purest tests of IQ: the correlation between performance on them and the [g-factor](#) is ~ 0.8 , as high as any IQ subtest, and answering the items doesn't require any subject matter knowledge. One example of an item is:



The test taker is asked to pick the choice that completes the pattern. People who are able to pick the correct choice at all can usually do so within 2 minutes – the questions have the character "either you see it or you don't." Most people can't see the pattern in the above matrix. A small number of people can see much more subtle patterns.

There's fairly strong evidence that something like 30% of what differentiates the best mathematicians in the world from other mathematicians is the innate ability to see the sorts of patterns that are present in very difficult Raven's matrices type items. (I'll make what I mean by "something like 30%" more precise in a future post.)

Fields Medalist Terry Tao was part of the Study of Mathematically Precocious Youth (SMPY). Professor Julian Stanley [wrote](#):

On May 1985 I administered to [10 year old] Terry the Raven Progressive Matrices Advanced, an untimed test. He completed its 36 8-option items in about 45 minutes. Whereas the average British university student scores 21, Terry scored 32. He did not miss any of the last, most difficult, 4 items. Also, when told which 4 items he had not answered correctly, he was quickly able to find the correct response to each. Few of SMPY's ablest protégés, members of its "700-800 on SAT-M Before Age 13" group, could do as well.

People like Terry are perhaps 1 in a million, but I've had the chance to tutor several children who are in his general direction.

Descriptions of milestones like "scored 760 on the math SAT at age 8" (as Terry did) usually greatly **understate** the ability of these children when the milestone is interpreted as "comparable to a high school student in the top 1%," in that there's a connotation that the child's performance comes from the child having learned the usual things very quickly. The situation is usually closer to "the child hasn't learned the usual things, but is able to get high scores by solving questions that high school students wouldn't be able to solve without having studied algebra and geometry."

A impact of interacting with such a child can be overwhelming. I've repeatedly had the experience of teaching such a child a mathematical topic typically covered only in graduate math courses, and one that I know well beyond the level of textbook expositions, and the child responding by making observations that *I myself had missed*. The experience is surreal, to the point that I wouldn't have been surprised to learn that it had all been a dream 30 minutes later.

I'll give an example to give a taste of a visceral sense for it. In one of my high school classes, my teacher assigned the problem of evaluating 'x' in the equation below:

$$x = 1 + \frac{1}{2 + \frac{1}{2 + \frac{1}{2 + \frac{1}{2 + \frac{1}{2 + \ddots}}}}}$$

Tangentially, I don't know *why* we were assigned this problem, which is of considerable mathematical interest, but also outside of the usual high school curriculum. In any case, I remember puzzling over it. Based on my experiences with children similar to Terry, it seems likely that his 8-year old self would see how to answer it immediately, without having ever seen anything like the problem before. Roughly speaking, an 8-year old child like Terry can recognize abstract patterns that very few (if any) of a group of 30 high school students with the math SAT score would be able to recognize.

In [A Parable of Talents](#), Scott Alexander wrote:

IQ is so important for intellectual pursuits that eminent scientists in some fields have average IQs around 150 to 160. Since IQ this high only appears in 1/10,000 people or so, it beggars coincidence to believe this represents anything but a very strong filter for IQ (or something correlated with it) in reaching that level. If you saw a group of dozens of people who were 7'0 tall on average, you'd assume it was a basketball team or some other group selected for height, not a bunch of botanists who were all very tall by coincidence.

Of the sciences, pure math is the one where innate abstract pattern ability is most strongly correlated with success, and data suggest that many of the best mathematicians in the world have innate abstract pattern recognition possessed by fewer than 1 in 10,000 people. Terry Tao's innate abstract pattern recognition ability is much rarer than 1 in 10,000, perhaps 1 in 1 million: it's *extremely* improbable that someone with such exceptional innate ability would *by chance* also be someone who would go on to do Fields Medal winning research.

Interestingly, many mathematicians are unaware of this. Terry Tao himself [wrote](#):

A reasonable amount of intelligence is certainly a necessary (though not sufficient) condition to be a reasonable mathematician. But an exceptional amount of intelligence has almost no bearing on whether one is an exceptional mathematician.

It's not entirely clear to me how somebody as mathematically talented as Tao could miss the basic Bayesian probabilistic argument that Scott Alexander gave, which shows that Tao's own existence is very strong evidence against his claim. But two hypotheses come to mind.

Verbal reasoning ability

Like Grothendieck, [like Scott Alexander](#), and like myself, Tao has very uneven abilities, only in an entirely different direction:

Yet at age 8 years 10 months, when he took both the SAT-M and the SAT-Verbal, Terry scored only 290 on the latter. Just 9% of college-bound male 12th-graders score 290 or less on SAT-V; a chance score is about 230. The discrepancy between being 10 points above the minimum 99th percentile on M and at the 9th percentile on V represents a gap of about 3.7 standard deviations. Clearly, Terry did far better with the mathematical reasoning items (please see the Appendix for examples) than he did reading paragraphs and answering comprehension questions about them or figuring out antonyms, verbal analogies, or sentences with missing words.

Was the "lowness" of the verbal score (excellent for one his age, of course) due to his lack of motivation on that part of the test and/or surprise at its content? A year later, while this altogether charming boy was spending four days at my home during early May of 1985, I administered another form of the SAT-V to him under the best possible conditions. His score rose to 380, which is the 31st percentile. That's a fine gain, but the M vs. V discrepancy was probably as great as before. Quite likely, on the SAT score scale his ability had risen appreciably above the 800 ceiling of SAT-M.

It's likely that [principal component analysis](#) would reveal that Tao's relatively low verbal scores reflect still lower ability on some aspect of verbal ability, which he was able to compensate for with his abstract pattern recognition ability, just as my relatively low math SAT score reflected still lower short-term memory and processing speed, which I was able to compensate for in other ways.

Aside from abstract pattern recognition ability, verbal reasoning ability is another major component of innate mathematical ability. It's reflected in performance on the analogies subtests of IQ, which like Raven's Matrices, are among the IQ subtests that correlate most strongly with the g-factor.

Broadly, the more theoretical an area of math is, the greater the role of verbal reasoning is in understanding it and doing research in it. As one would predict based on his math / verbal skewing, Tao's mathematical research is in areas of math that are relatively concrete, as opposed to theoretical. Verbal reasoning ability is also closely connected with [metacognition](#): awareness and understanding of one's own thoughts. Tao's apparent lack of awareness of the role of his exceptional abstract reasoning ability in his mathematical success may be attributable to relatively low metacognition.

[Edit: Some commenters found the above paragraph confusing. I should clarify that the standard that I have in mind here is extremely high — I'm comparing Tao with people such as [Henri Poincare](#), whose [essays](#) are amongst the most penetrating analyses of mathematical psychology.]

My own inclination is very much in the verbal direction, as may be evident from my posts. I used to think that it was a solely a matter of preference, but after reading the IQ literature, I realized that probably the reason that I *have* the preference is because verbal reasoning is what I'm best at, and we tend to enjoy what we're best at the most.

Charles Spearman, the researcher who discovered the g-factor [found](#) that the more intellectually gifted somebody is, the less correlated his or her cognitive abilities, and that when one takes this vantage point, Tao's math / verbal ability differential is not so unusual. For further detail, see [Cognitive profiles of verbally and mathematically precocious students](#) by Benbow and Minor.

I'll have more to say about the role of verbal reasoning ability in math later on.

Is this all depressing?

Another reason that Tao may have missed the evidence that his mathematical success can be in large part attributed to his exceptional abstract reasoning ability is that he might have an [ugh field](#) around the subject. Terry might find it disconcerting that the main reason that many of his colleagues at UCLA are unable to produce work that's

nontrivial relative to his own is that he was born with a better brain (in some sense) than the brains of his colleagues were. Such a perspective can feel dehumanizing.

An analogy that may offer further insight. Like Tao, [Natalie Portman](#) is talented on many different dimensions. But had she been less physically attractive than the average woman (according to [the group consensus](#)), she would not have been able to become Academy Award winning actress. Women of similar talent probably failed where she succeeded simply because they were less attractive than she is. If asked about the role of her physical appearance in her success, she would probably feel uncomfortable. One can imagine her giving an accurate answer, but one can also imagine her trying to minimize the significance of her appearance as much as possible. It might remind her of how painfully unfair life can be.

But whether or not we believe in the existence and importance of individual differences in intelligence, they're there: we can't make them go away by ignoring them. Furthermore, if not for people with unusually high intelligence, there would have been no Renaissance and no industrial revolution: Europe would still be in the dark ages, as would the rest of the world. We're very lucky to have people with cognitive abilities like Tao's, and he would have no reason to feel guilty about having being privileged. He's given back to the community through efforts such as his [blog](#). Even if one doubts the [value of theoretical research](#), one can still appreciate the fact that his blog serves as a proof of concept showing how elite scientists in all fields could better communicate their thinking to their research communities.

To be continued

I'll have more to say about innate later ability, but I've said enough to move on to a discussion of the connection between innate ability and mathematical ability more generally, with a view toward how it's possible to improve one's mathematical ability.

Since people's primary exposure to math is generally through school, in my next post I'll discuss math education as it's currently practiced.

My basic premise is that math education as it's currently practiced is extremely inefficient for reasons that I touched on earlier on: what goes on in math classes in practice is often very similar to studying for intelligence tests. Students and teachers are effectively trying to build abilities that are in fact fixed, rather than focusing on developing abilities that *can* be improved, just as I would have been if I were to have worked on making fewer "careless mistakes" in elementary school. Things don't have to be this way – math education could in principle be much more enriching.

More soon.

The Galileo affair: who was on the side of rationality?

Introduction

A [recent survey](#) showed that the LessWrong discussion forums mostly attract readers who are predominantly either atheists or agnostics, and who lean towards the left or far left in politics. As one of the main goals of LessWrong is overcoming bias, I would like to come up with a topic which I think has a high probability of challenging some biases held by at least some members of the community. It's easy to fight against biases when the biases belong to your opponents, but much harder when you yourself might be the one with biases. It's also easy to cherry-pick arguments which prove your beliefs and ignore those which would disprove them. It's also common in such discussions, that the side calling itself rationalist makes exactly the same mistakes they accuse their opponents of doing. Far too often have I seen people (sometimes even [Yudkowsky](#) himself) who are very good rationalists but can quickly become irrational and use several fallacies when arguing about history or religion. This most commonly manifests when we take the dumbest and most fundamentalist young Earth creationists as an example, [winning easily](#) against them, then claiming that we disproved all arguments ever made by [any theist](#). No, this article will not be about whether God exists or not, or whether any real world religion is fundamentally right or wrong. I strongly discourage any discussion about these two topics.

This article has two main purposes:

1. To show an interesting example where the scientific method can lead to wrong conclusions

2. To overcome a certain specific bias, namely, that *the pre-modern Catholic Church was opposed to the concept of the Earth orbiting the Sun with the deliberate purpose of hindering scientific progress and to keep the world in ignorance*. I hope this would prove to also be an interesting challenge for your rationality, because it is easy to fight against bias in others, but not so easy to fight against bias on yourselves.

The basis of my claims is that I have read [the book](#) written by Galilei himself, and I'm very interested (and not a professional, but well read) in early modern, but especially 16-17th century history.

Geocentrism versus Heliocentrism

I assume every educated person knows the name of Galileo Galilei. I won't waste the space on the site and the time of the readers to present a full biography about his life, there are plenty of on-line resources where you can find more than enough biographic information about him.

The controversy?

What is interesting about him is how many people have severe misconceptions about him. Far too often he is celebrated as the one sane man in an era of ignorance, the sole propagator of science and rationality when the powers of that era [suppressed any scientific thought](#) and ridiculed everyone who tried to challenge the accepted theories about the physical world. Some even go as far as claiming that people [believed the Earth was flat](#). Although the flat Earth theory was not propagated at all, it's true that the heliocentric view of the Solar System (the Earth revolving around the Sun) was not yet accepted.

However, the claim that the Church was suppressing evidence about heliocentrism "to maintain its power over the ignorant masses" can be disproved easily:

- The common people didn't go to school where they could have learned about it, and those commoners who did go to school, just learned to read and write, not much more, so they wouldn't care less about what orbits around what. This differs from 20-21th century fundamentalists who want to teach young Earth creationism in schools - back then in the 17th century, there would be no classes where either the geocentric or heliocentric views could have been taught to the masses.

- Heliocentrism was not discovered by Galilei. It was first proposed by Nicolaus Copernicus almost 100 years before Galilei. Copernicus didn't have any affairs with the Inquisition. His theories didn't gain wide acceptance, but he and his followers weren't persecuted either.

- Galilei was only sentenced to house arrest, and mostly because of insulting the pope and doing other unwise things. The political climate in 17th century Italy was quite messy, and Galilei did quite a few unfortunate choices regarding his alliances. Actually, Galilei was the one who brought religion into the debate: his opponents were citing Aristotle, not the Bible in their arguments. Galilei, however, wanted to redefine the Scripture based on his (unproven) beliefs, and insisted that he should have the authority to push his own views about how people interpret the Bible. Of course this pissed quite a few people off, and his case was not helped by publicly calling the pope an idiot.

- For a long time Galilei was a good friend of the pope, while holding heliocentric views. So were a couple of other astronomers. The heliocentrism-geocentrism debates were common among astronomers of the day, and were not hindered, but even encouraged by the pope.

- The heliocentrism-geocentrism debate was never an atheism-theism debate. The heliocentrists were committed theists, just like the defenders of geocentrism. The Church didn't suppress science, but actually funded the research of most scientists.

- The defenders of geocentrism didn't use the Bible as a basis for their claims. They used Aristotle and, for the time being, good scientific reasoning. The heliocentrists were much more prone to use the "God did it" argument when they [couldn't defend the gaps](#) in their proofs.

The birth of heliocentrism.

By the 16th century, astronomers have plotted the movements of the most important celestial bodies in the sky. Observing the motion of the Sun, the Moon and the stars, it would seem obvious that the Earth is motionless and everything orbits around it. This model (called geocentrism) had only one minor flaw: the planets would sometimes make a loop in their motion, "moving backwards". This required a lot of [very complicated formulas](#) to model their motions. Thus, by the virtue of Occam's razor, a theory was born which could better explain the motion of the planets: what if the Earth and everything else orbited around the Sun? However, this new theory (heliocentrism) had a lot of issues, because while it could explain the looping motion of the planets, there were a lot of things which it either couldn't explain, or the geocentric model could explain it much better.

The proofs, advantages and disadvantages

The heliocentric view had only a single advantage against the geocentric one: it could describe the motion of the planets by a much simpler formula.

However, it had a number of severe problems:

- Gravity. Why do the objects have weight, and why are they all pulled towards the center of the Earth? Why don't objects fall off the Earth on the other side of the planet? Remember, Newton wasn't even born yet! The geocentric view had a very simple explanation, dating back to Aristotle: it is the nature of all objects that they strive towards the center of the world, and the center of the spherical Earth is the center of the world. The heliocentric theory couldn't counter this argument.
- Stellar parallax. If the Earth is not stationary, then the relative position of the stars should change as the Earth orbits the Sun. No such change was observable by the instruments of that time. Only in the first half of the 19th century [did we succeed in measuring it](#), and only then was the movement of the Earth around the Sun finally proven.
- Galilei tried to use the tides as a proof. The geocentrists argued that the tides are caused by the Moon even if they didn't know by what mechanisms, but Galilei said that it's just a coincidence, and the tides are not caused by the Moon: just as if we put a barrel of water onto a cart, the water would be still if the cart was stationary and the water would be sloshing around if the cart was pulled by a horse, so are the tides caused by the water sloshing around as the Earth moves. If you read Galilei's book, you will discover quite a number of such silly arguments, and you'll see that Galilei was anything but a rationalist. Instead of changing his views against overwhelming proofs, he used all possible fallacies to push his view through.

Actually the most interesting author in this topic was [Riccioli](#). If you study his writings you will get definite proof that the heliocentrism-geocentrism debate was handled with scientific accuracy and rationality, and it was not a religious debate at all. He defended geocentrism, and presented 126 arguments in the topic (49 for heliocentrism, 77 against), and only two of them (both for heliocentrism) had any religious connotations, and he stated valid responses against both of them. This

means that he, as a rationalist, presented both sides of the debate in a neutral way, and used reasoning instead of appeal to authority or faith in all cases. Actually this was what the pope expected of Galilei, and such a book was what he commissioned from Galilei. Galilei instead wrote a book where he caricatured the pope as a strawman, and instead of presenting arguments for and against both world-views in a neutral way, he wrote a book which can be called anything but scientific.

By the way, Riccioli was a Catholic priest. And a scientist. And, it seems to me, also a rationalist. Studying the works of such people like him, you might want to change your mind if you perceive a conflict between science and religion, which is part of today's public consciousness only because of a small number of very loud religious fundamentalists, helped by some committed atheists trying to suggest that all theists are like them.

Finally, I would like to copy a short summary about this book:

[Graney, Christopher M.](#)

Journal for the History of Astronomy, Vol. 43, No. 2, p. 215-226

In 1651 the Italian astronomer Giovanni Battista Riccioli published within his *Almagestum Novum*, a massive 1500 page treatise on astronomy, a discussion of 126 arguments for and against the Copernican hypothesis (49 for, 77 against). A synopsis of each argument is presented here, with discussion and analysis. Seen through Riccioli's 126 arguments, the debate over the Copernican hypothesis appears dynamic and indeed similar to more modern scientific debates. Both sides present good arguments as point and counter-point. Religious arguments play a minor role in the debate; careful, reproducible experiments a major role. To Riccioli, the anti-Copernican arguments carry the greater weight, on the basis of a few key arguments against which the Copernicans have no good response. These include arguments based on telescopic observations of stars, and on the apparent absence of what today would be called "Coriolis Effect" phenomena; both have been overlooked by the historical record (which paints a picture of the 126 arguments that little resembles them). Given the available scientific knowledge in 1651, a geo-heliocentric hypothesis clearly had real strength, but Riccioli presents it as merely the "least absurd" available model - perhaps comparable to the Standard Model in particle physics today - and not as a fully coherent theory. Riccioli's work sheds light on a fascinating piece of the history of astronomy, and highlights the competence of scientists of his time.

The full article can be found under [this link](#). I recommend it to everyone interested in the topic. It shows that geocentrists at that time had real scientific proofs and real experiments regarding their theories, and for most of them the heliocentrists had no meaningful answers.

Disclaimers:

- I'm not a Catholic, so I have no reason to defend the historic Catholic church due to "justifying my insecurities" - a very common accusation against someone perceived to be defending theists in a predominantly atheist discussion forum.

- Any discussion about any perceived proofs for or against the existence of God would be off-topic here. I know it's tempting to show off your best proofs against your carefully constructed straw-men yet again, but this is just not the place for it, as it would detract from the main purpose of this article, as summarized in its introduction.

- English is not my native language. Nevertheless, I hope that what I wrote was comprehensive enough to be understandable. If there is any part of my article which you find ambiguous, feel free to ask.

I have great hopes and expectations that the LessWrong community is suitable to discuss such ideas. I have experience with presenting these ideas on other, predominantly atheist internet communities, and most often the reactions was outright flaming, a hurricane of unexplained downvotes, and prejudicial ad hominem attacks based on what affiliations they assumed I was subscribing to. It is common for people to decide whether they believe a claim or not, based solely by whether the claim suits their ideological affiliations or not. The best quality of rationalists, however, should be to be able to [change their views](#) when confronted by overwhelming proof, instead of trying to come up with more and more convoluted explanations. In the time I spent in the LessWrong community, I became to respect that the people here can argue in a civil manner, listening to the arguments of others instead of discarding them outright.

An alarming fact about the anti-aging community

Past and Present

Ten years ago teenager me was hopeful. And stupid.

The world neglected aging as a disease, Aubrey had barely started spreading memes, to the point it was worth it for him to let me work remotely to help with Metuselah foundation. They had not even received that initial 1,000,000 donation from an anonymous donor. The Metuselah prize was running for less than 400,000 if I remember well. Still, I was a believer.

Now we live in the age of Larry Page's Calico, 100,000,000 dollars trying to tackle the problem, besides many other amazing initiatives, from the research paid for by Life Extension Foundation and Bill Faloon, to scholars in top universities like Steve Garan and Kenneth Hayworth fixing things from our models of aging to plastination techniques. Yet, I am much more skeptical now.

Individual risk

I am skeptical because I could not find a single individual who already used a simple technique that could certainly save you many years of healthy life. I could not even find a single individual who looked into it and decided it wasn't worth it, or was too pricy, or something of that sort.

That technique is freezing some of your cells now.

Freezing cells is not a far future hope, *this is something that already exists, and has been possible for decades*. The reason you would want to freeze them, in case you haven't thought of it, is that they are getting older every day, so the ones you have now are the youngest ones you'll ever be able to use.

Using these cells to create new organs is not something that may help you if medicine and technology continue progressing according to the law of accelerating returns in 10 or 30 years. *We already know* how to make organs out of your cells. Right now. Some organs live longer, some shorter, but it can be done - for instance to bladders - and is being done.

Hope versus Reason

Now, you'd think if there was an almost non-invasive technique already shown to work in humans that can preserve many years of your life and involves only a few trivial inconveniences - compared to changing diet or exercising for instance- the whole longevist/immortalist crowd would be lining up for it and keeping back up tissue samples all over the place.

Well I've asked them. I've asked some of the adamant researchers, and I've asked the superwealthy; I've asked the cryonicists and supplement gorgers; I've asked those who work on this 8 hour a day every day, and I've asked those who pay others to do so. I asked it mostly for selfish reasons, I saw the TEDs by Juan Enriquez and Anthony Atala and thought: hey look, clearly beneficial expected life length increase, yay! let me call someone who found this out before me - anyone, I'm probably the last one, silly me - and fix this.

I've asked them all, and I have nothing to show for it.

My takeaway lesson is: whatever it is that other people are doing to solve their own impending death, they are far from doing it rationally, and maybe most of the money and psychology involved in this whole business is about buying hope, not about staring into the void and finding out the best ways of dodging it. Maybe people are not in fact going to go all-in if the opportunity comes.

How to fix this?

Let me disclose first that I have no idea how to fix this problem. I don't mean the problem of getting all longevists to freeze their cells, I mean the problem of getting them to take information from the world of science and biomedicine and applying it to themselves. To become users of the technology they are boasters of. To behave rationally in a CFAR or even homo economicus sense.

I was hoping for a grandiose idea in this last paragraph, but it didn't come. I'll go with a quote from this emotional song sung by us during last year's Secular Solstice celebration

[Do you realize? that everyone, you know, someday will die...](#)

[And instead of sending all your goodbyes](#)

[Let them know you realize that life goes fast](#)

[It's hard to make the good things last](#)

The Value of a Life

This is a linkpost for <http://mindingourway.com/the-value-of-a-life/>

This post is cross-posted from [MindingOurWay](#). It's about some of my reasons for being an effective altruist. It's targeted more towards people who aren't EAs or who haven't heard of effective altruism, but some people here may also find it inspiring.

If you have money and want to save lives, you had better put a price on life. [Scott Alexander explains it better than I can](#).

But don't mix up the *price* of a life with the *value* of a life. I see this happen all too frequently. To correct this mistake, I'm going to tell a little story.

Once upon a time, there was a village of peaceful immortal humans. They did not age past their primes, but they could still die from starvation or injury. But perhaps because their lives were so long and full, they all valued each other very highly and lived in peace. Indeed, there were no lengths to which the villagers would not go in order to save one of their fellows from unwanted annihilation.

Or, at least, that's how life was before the dragon came.

Dragons desire two things from people, as I'm sure you know: gold, and flesh. And this dragon, woe be upon the villagers, was powerful indeed — nigh invincible, with a cunning to match. The dragon, easily capable of killing the entire village outright, gave a grim ultimatum:

Each person in this village must pay a tax of gold, every year, in proportion to that person's age. Anyone who cannot pay the tax will be eaten.

The villagers begged and pleaded, they wept and raged, but the dragon was unmoved. It merely showed them a few heaps of rock that looked likely to make good gold mines, and told them to get to work.

The villagers tried their best. They really did. They were not miners, but they were fast learners. They worked themselves ragged, throwing aside stones, digging at the earth with their bare hands until their fingers bled, hunting and gathering as little as possible, letting their shelters deteriorate — yet still, they could not make the dragon's tax. At the end of a year, the dragon returned, and took all the gold they had, and ten of the oldest villagers (for giving up the eldest villagers was the way to save the most lives).

Distraught, the villagers resolved to try harder next time. They pushed themselves to their limits and beyond. They raced against time. They grew gaunt and ragged. Their eyes sank, their skin grew sallow, their arms thinned. They pushed themselves too hard, until they were collapsing in the mines. The next time the dragon came, it took all their gold and fifty of their number.

Their strategy wasn't working.

But these villagers were born of humanity, and ingenuity is humanity's birthright. So in their third year, the surviving villagers came to bitter terms with their situation, and set to hunting and gathering and growing stronger, accepting that they had to take care of themselves before they could take care of their friends. They set to building picks and shovels, realizing that they could not save themselves with their hands alone.

At the end of the third year, the dragon took all their gold and one hundred of their number, for their infrastructure had not yet started paying off.

But by the end of the fourth year, the dragon only took two.

Shortly thereafter, the dragon (delighted by their progress) informed the villagers that the tax would now begin increasing faster; exponentially in age.

This time, the villagers only nodded, and forged their hot fury into cold resolve.

It has been many, many years since the dragon came to the village. In fact, it is not a village any more: the village grew to a city, and the city grew to a civilization.

The population is quite a bit younger now. The elders are wiser and more productive, and can get more gold out of the ground per hour, but there simply comes a time when this increased productivity is not worth the cost in lives. When that time comes, the elders go willingly to their fate, for these people are not the type to buy their own lives at the cost of two others.

In fact, hard tradeoffs such as these are commonplace. The villagers long ago discovered specialization and economics, and now most of them don't work in the mines. Some of them spend time growing or preparing food, others spend time maintaining shelter, others spend time inventing new tools and mechanisms that can keep pace with the dragon's dreadful tax. Indeed, some spend their lives on art and entertainment — for the villagers have learned the importance of maintaining motivation and morale.

(And some villagers, deep underground, far from the dragon's prying eyes, are designing weapons.)

So you will find, in this civilization, that there are people who dedicate their lives not to mining gold, but to writing books — but if you look closely, you'll notice that this only happens when the author can save *more* lives through increased morale and productivity than they can through working in the mines directly. And so this civilization, hellbent on saving as many people as it can every year, still produces books and plays and movies.

Which means that in modern times, you can calculate the exact cost of saving an additional life. It turns out that one life goes for about the same price as a thousand movie tickets.

As it happens, two of the citizens of this dragon-ridden world, Alice and Bob, are having a conversation about the value of a life, right now. Let's listen in:

Alice: So you see, the true value of a life is equivalent to about a thousand views on the latest blockbuster.

Bob: Nonsense! A life is worth much more than two thousand hours of movie-viewing! A life is nigh invaluable! You can't put a price tag on a human life!

Alice: What hollow indignation! If your actions are inconsistent with putting a price tag on life, then there are ways you could shuffle money around to save more lives. If you want to save as many people as possible with a limited amount of money, then you *must* put a price on life!

Bob: But a thousand viewings of a movie simply isn't worth the same as a life! If I got to choose between a thousand people watching another blockbuster and the life of my mother, I'd choose the life of my mother any day!

Alice: Yes, but this intuition is inconsistent. The market for lives here is effecient, and the market has spoken, and the market says that a life is equal to about a thousand views of the latest blockbuster. Your mother's life *isn't* worth more than the accumulated pleasure that a thousand people experience when watching the latest blockbuster! The viewing experience and your mother's life just turn out to have the same value, and if your intuition disagrees, you'll have to fix your intuition!

Do you see the errors here?

Alice and Bob are both right, and both wrong.

Alice is correct in that the villagers *must* treat a life as equivalent to a few thousand hours worth of watching movies. Given that the villagers are all still trying to save each other, those thousand people only go to the movies if the resulting boost in motivation and morale leads them to collectively generate enough additional wealth to save *more* than one additional person. If you stopped those people going to the movies, and put their money towards producing gold instead, then *less* gold would be produced overall, and more people would die. Bob *must* trade off two thousand movie-hours against one life, if he wants to maximize lives saved.

But Bob is correct in that the value of a life is worth much more than two thousand hours of viewing movies!

Alice's claim is that the *sum experience* of two thousand movie-hours is equal to the intrinsic value of a life. The market has spoken, and so you must not protest, if you want to save lives.

But in fact, the very reason that Bob must treat the thousand movie-viewings as equivalent to a life is because those viewings lead to increased morale, which leads to *more than one life being saved*. This fact *does not* equate the experience of a life lived to the pleasure of the viewers.

What Alice has forgotten is that the village is *plagued by a dragon*.

Were it not for the dragon, these villagers would go to almost any lengths to save each other from unwanted death. There might be *some* lengths to which they would not go, *some* price they would not pay, in pain, sorrow, and decreased quality of life among the rest of the villagers, in order to save a friend. But, in the absence of a dragon, this cost would be a *hell of a lot higher* than two-thousand hours worth of watching movies.

Enough analogies. Let's look at our universe, now. Our economy is *not* efficient — it costs a few million dollars to save a life in developed nations, and a few thousand dollars to save a life in underdeveloped nations (where "save a life" really only means "push death back a bit", in these dark times). Furthermore, our economy is *not* maximizing for lives: humans are prone to scope insensitivity and a whole slew of other biases that [dampen their ability to care](#) about other humans dying against their will. Furthermore, it is important to care not only about the lives we save, but about the lives we *live*.

Despite all this, we are not all that different from those villagers in the lengths we would go to save each other if death was not inevitable.

I don't know how the future will turn out. I don't know how we'll end up trading off the preservation of a life against the improvement of a life against the creation of a life, if and when we make it past this phase of scarcity. But I can tell you this: *There may well come a day when humanity would tear apart a thousand suns in order to prevent a single untimely death.*

That is the value of a life.

You still have to put a price tag on lives, and that price tag still has to somewhere between a few thousand dollars and a few million dollars.

Imagine a button which, when pressed, picks a random number between 1 and a million. If that number is 1, it kills a randomly selected person. How much would somebody have to pay you to press that button?

[Many people react with disgust, saying they wouldn't press such a button at any price.](#) They say that the value of a life is high inconceivable.

And this intuition is correct!

But when somebody offers you ten dollars to press that button, press it anyway. Press it, and worry about it less than you worry about driving a car for a year (which, if I did my math right, is like pressing a button that has a one in ten thousand chance of killing somebody each year, in return for the convenience of driving [1] [2]). If you want to save the most lives, then you press that button for \$10, and you put the money towards saving lives.

But don't confuse the cost of a life with the value of a life!

In some parts of this world, it costs as little as a few thousand dollars to save a life. If you act like the price on a life is higher than a few thousand dollars, if you *actually* refuse a million dollars to press the button, or pay a billion dollars to save a single life, then there were other things you could have done to save more lives. If you want to save the most people, you *must* put a price tag on life according to the *actual* cost of saving a life.

But you don't have to confuse the *current cost of saving a life* with the *intrinsic value of a life*.

There is a gap there. There is a gap between how much a life is *really worth*, and the price tag that you *must assign*. That gap is not there because your intuitions are wrong. That gap is there because *our village is being plagued by a goddamn dragon*.

That gap is a direct measure of the difference between the universe that is, and the universe that should be.

That price difference, the difference between a few thousand dollars and a few thousand suns, is a direct measure of how fucked up things are.

Most people start with an intuition that they should refuse to press the button at any price, because lives are nigh invaluable. You can go to these people, and show them that in order to save as many lives as possible with a bounded amount of money, they must put a price on life. Most people, at that point, react one of two ways.

Some accept the logic and reject their intuitions. They see that, to save the most lives, they *must* use a price tag. It sounds repugnant to say that the pleasure experienced by a few million people drinking a can of soda is equivalent to the value of a life, but (they think) that's exactly the sort of reasoning that leads someone to thinking that life is invaluable, which is a deadly misconception. And so, wanting to save as many people as they can with the money allotted to life-saving, they bite the bullet, and conclude that lives were never worth all that much anyway.

Others reject the logic, and continue to claim that life is invaluable, and then try to back up their intuitions with some strange version of ethics where saving as many lives as possible with the money available is not the right thing to do, for convoluted reasons.

But there's a third option here! All these people have forgotten about the dragon!

It is possible to live in a universe where it is *both* the case that (1) lives are nigh invaluable, and (2) people are being annihilated constantly, against their will, in ways that can be prevented using relatively small sums of money.

The universe is not fair! Pressing the button for \$10 is the way to save the most lives, *and this very fact is a horrible thing*. Lives are nigh invaluable, *but you have to treat them as if they're worth only a few thousand dollars*.

This gap between price and value is *unacceptable*, but physics wasn't written according to what we would accept. We live in a cold, uncaring universe; a universe [beyond the reach of God](#).

One day, we may slay the dragons that plague us. One day we, like the villagers in their early days, may have the luxury of going to any length in order to prevent a fellow sentient mind from being condemned to oblivion unwillingly. If we ever make it that far, the worth of a life will be measured not in dollars, but in *stars*.

That is the value of a life. It will be the value of a life then, and it is the value of a life *now*.

So when somebody offers \$10 to press that button, you press it. You press the hell out of it. It's the best strategy available to you; it's the only way to save as many people as you can. *But don't ever forget that this very fact is a terrible tragedy*.

Don't ever forget about the gap between how little a life costs and how much a life is worth. For that gap is an account of the darkness in this universe, it is a measure of how very far we have left to go.

I don't want to turn this into a sermon. But some of you, seeing the great abyss between cost and worth clearly for the first time, may decide that this gap is worth closing, that our dragons are dragons are worth slaying. Some of you may be wondering, what now? What next? This last part is for you.

Know that there are those of us who fight.

Some of us [work in the mines](#) to [make the dragon's tax](#). Others [prepare for the day we will confront the dragon](#) — for the weapons we must bring to bear will be powerful indeed, [and may prove difficult to aim](#).

And this is a fight you can join. For some of you, fighting means joining an effective cause. But for most of you, fighting means putting a low price tag on lives, and then honoring it — by purchasing lives wherever they are cheapest; by donating to highly effective causes. Remember that just as courage is about doing the right thing even though you're afraid, [caring is about doing the right thing even when you're not overwhelmed by emotion](#).

If this is a fight you wish to join, then I urge you to remember the first lesson that the villagers learned: you must care for yourself before you care for others. You do not need to become destitute to struggle against the darkness in this universe. Any small amount of money or effort you can put towards saving lives is money and effort well spent. [Pledging 10% of your earnings to an effective cause is a difficult achievement worthy of great acclaim](#).

If you are going to stand beside us in this fight, then I will welcome you no matter what — but I would rather you join us filled with hot fury or cold resolve, rather than with guilt or shame.

Oh, Death was never an enemy of ours!
We laughed with him, we leagued with him, old chum.
No soldier's paid to kick against his powers.
We laughed, knowing that better men would come,
And greater wars; when each proud fighter brags
He wars on Death, for lives; not men, for flags.

— Final stanza of *The Next War*, by Wilfred Owen