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PLOS Science Wednesday: Hi reddit, my name is Michael and my research challenges the notion that self-control is a finite resource that diminishes with use over time – Ask Me Anything!

PLOSSCIENCEWEDNESDAY [R/SCIENCE](#)

Hi reddit,

My name is Michael Inzlicht and I am a professor at The University of Toronto. My research focuses on the topic of self-control and the related concepts of cognitive control and executive function.

I recently published a study titled, "[A pre-registered naturalistic observation of within domain mental fatigue and domain-general depletion of self-control](#)" in PLOS ONE. In this paper, we monitored over 16,000 students as they engaged in voluntary learning on an online program to examine the impact of time-of-day and within-task fatigue on participation and performance. Contrary to models of self-control that suggest that self-control is domain general and runs out, we did not find that task engagement decreased at the end of the day. These findings join others (e.g., <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0147770>) that cast doubt on the notion that self-control is based on some finite resource that diminishes with use.

I will be answering your questions at 1pm ET. Ask me Anything!

Don't forget to follow me on Twitter [@minzlicht](#)!

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After reading the abstract and methods I have to say I dont think the findings say much at all without controlling for several factors (which you haven't done i believe) In fact, the most glaring flaw is the following asumption -

Working under the assumption that our users engage in moderately mentally stressful activities throughout the day, the resource model of self-control would predict that users will be most willing to exert voluntary effort most in the morning and least in the evening.

Not only do college students sleep late, but they have horribly irregular schedules. (Not questioning your sample group, just the complications thereof) Did your questionnaire take into consideration the known differences in attention between night owls and morning birds (so to speak) Did you control for sleeping schedules? Did you control for the last time they ate (BSL is know to relate to attention)? If theyre reponding via email, what prevents them for reponding when attention is highest? Did you find a correlation for users as to when the task was performed (ie were some night responders/morning responders. I didnt see that in the methodology.) Which is to say, did each subject respond at a varied time, and were their individual scores considered.

I think these considerations should be addressed. If I missed them in the abstract or methodology, please let me know. I actually think attention/will power research is an incredibly important part of psych. And I think many of the factors can be controlled for with the data you already have.

[exfarker](#)

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Thanks for your question. It's a very good one.

In short, you are correct that we were unable to control for these variables. This was an observational study and we had very little information about our user's basic habits, including whether they are early-birds or night-owls. This is important because work into people's individual chronotypes (i.e., time of day preferences) suggests that college-aged people are more alert in late afternoon, with their circadian rhythms shifted over by a few hours. What this means is that our results might be produced by this shift in circadian rhythms. What it also means is that our results cannot be explained by a model assuming that self-control diminishes across the day. That is, prevailing models of self-control strongly suggest that control diminishes the more you use control, implying it diminishes after each waking hour. Even if we allow that undergrad students wake up late, engage in less self-control, and have far more breaks throughout the day than working adults, they should still show some declines in performance from waking to sleeping (even if that decline only starts at 5pm), at least according to resource models. And, in fact, in a supplement to the paper, we demonstrate this at the population level with a number of simulations. But, we did not find this pattern at all, but instead found patterns of increasing engagement and motivation throughout the day. This is inconsistent with any resource model and more consistent with biological explanations (e.g., circadian rhythms).

That said, your broader comment about controlling for confounding variables is a good one and we are further collaborating with Cerego to get more user information so that we can code for these very things. Is it possible that some small depletion effect would emerge after we control for chronotype? Maybe. But, even with this, it would be clear that this depletion effect is much smaller in magnitude than the possible effect of chronotype.

Hi Michael, thanks for doing an AMA!

How is this tied in with general mental fatigue? Some experiments indicate that strenuous physical activities become harder after being exposed to low-reward tasks that heavily engage the work memory.

[helm](#)

This study is very much related to general mental fatigue. It suggests that at least when performing one task continuously, that you should expect performance to start declining after about 30 minutes, with significant declines by about 50 minutes. And, to be honest, this might be an underestimate given the structure of the data we observed.

You also ask about the relation between physical and mental fatigue. It would be natural to lump them together because they share similar phenomenology—being mentally tired feels similar to being physically tired—but more research is needed to know if they are indeed so similar. Right now, it's unclear.

You also ask about about how mental effort impacts physical effort. This is even less clear. There is some interesting work suggesting that physical performance (performance in various soccer tasks) might be impacted by prior cognitive exertion, but then there is also work suggesting that cognitive performance is *enhanced* when it follows physical exertion. So, while there might be an empirical link between the two, there is still so much to explore.

Does self control operate with some specific emotion? Is it easier to control 'happy' impulses than 'angry' impulses?

[aditseth03](#)

Self-control has an intrinsic feeling attached to it. It typically feels aversive (associated with words like difficult, anxiety, frustration, stress), and is associated with all sorts of physiological responses indicative of an organism on high alert, possibly distressed. That said, these feelings are generally low in intensity, so not overwhelming. But even with that said, I note that people (and other animals) generally avoid effortful (i.e., controlled) tasks; they simply don't like it.

re: is it easier to control happy vs angry impulses; I'm just not sure. Control is often called upon to restrain "happy" impulses (e.g., "give me that food!"); but also to restrain angry ones (e.g., "I want to punch that person"). As to which is harder to restrain, I'm not aware of any research on this interesting question.

Hi there! I've got a question regarding the concept of mental fatigue in general.

I've taken lots of psychology tests as a healthy volunteer. Those where you need to do the highest possible number of increasingly difficult exercises in a short amount of time. At times, I feel the need to stop in the middle of the 3 minutes timespan for some seconds. I'd say it's exactly the same feeling like when I'm lifting weights and get to the failure point, but this time "in the brain". I can't even describe how it feels exactly to have overexercised the brain. And it's not like I exactly "rest" to recover when I "stop thinking" for 5 seconds... It's not like I left and went watching TV.

Can you clarify this? What's happening inside us? Is this related to the kind of mental fatigue that you observe in larger timescales?

[lucaxx85](#)

This is a hard question to answer: why does effort feel so overwhelming, as if we can't go on? Some have speculated that this occurs because effort relies on some limited metabolic resource in the brain that runs out (e.g., brain glycogen). But this has been VERY controversial and essentially disconfirmed as a biologically plausible mechanism. A second explanation is that the feeling of effort occurs when one is incurring opportunity costs (when one could be using cognitive capacity on other, more rewarding things). A third possibility suggests that effort feels the way it does to prevent cross-talk from other, related brain processes.

The Q of why control feels like it does is super interesting and one that is an area of active research

Is there a difference in voluntary participation and compulsory participation?

[practeerts](#)

Can we please keep this focused on Rampart?

Do you think there is a saturation point for self control? After a point post which the control is Practically nothing?

[aditseth03](#)

Another great question!

Depends on who you ask. Resource theorists say "yes", that control eventually runs out. My own analysis suggests otherwise. I suspect that control is less a question of ability and more a question of willingness or motivation. So it's not that control runs out, per se, but that motivation starts waning. When I grab that bag of Doritos on my couch at the end of a hard day, is it that I *can't* control myself, or

is it that I allow myself that indulgence as a reward to myself?

It might seem like I'm splitting hairs here, but this distinction between ability and willingness is important for improving people's ability to reach their goals. If it's about ability, we might want to train up that ability to increase people's capacity. If it's the latter, we might need to change how people relate to their own goals.

Than what is it limited by?
Our genes, practice or only our beliefs?

[PetarKing](#)

My answer is controversial. I think our ability to effortfully control ourselves is largely determined by our own beliefs! There is this interesting research by Veronika Job (<http://journals.sagepub.com/doi/abs/10.1177/0956797610384745>) suggesting that what people believe about their own self-control moderates how well they exert control.

That said, self-control is a multifaceted construct. So if we broaden it out to include traits such as conscientiousness or grit, then it's also clear that genes play a very big role in determining how well people plan, how organized they are, and how well they are at meeting their goals.

Depletion models have argued that renewal comes from eating and resting, not exclusively from sleeping. How does this data falsify that?

[Rimfax](#)

Great Q!

Not sure our data falsify this directly, but if we examine our time of day effects, we DO NOT see an increase in performance or engagement after typical lunch or dinner times, for example. If food restored people, you'd expect this...

More of a personal question: is your hypothesis inspired by your own life experience e.g. Introspection or behavior of family members or friends ?

[dw_jb](#)

Not really. I got into work on self-control to understand the impact of belonging to a stigmatized group. I wondered if it could impact self-control. I quickly realized, though, that to answer that question I needed to know a lot more about self-control. So I started learning...and never left!

Do you have any ideas, findings, or hypotheses relating to things that people can do to increase or train their on-task will power, or will power in general?

[muggledave](#)

I addressed this a bit above, but let me share some of my more recent ideas. I recently examined the literature on "learned industriousness," which is the idea that some people (and other animals) learn that effort pays, that is that high effort often begets high reward. To the extent that you've learned this (e.g., experiencing how practice improves outcomes; that hard work translates to better outcomes) you might start valuing effort, hard work, and control. So, can we leverage this to improve self-control? In

contrast to the current reward structure, where sometimes children get prizes for just showing up, what if we trained effort by rewarding it systematically? Will this increase people's willingness to exert effort? We are testing this right now.