

Physiological Effects of Crunch: a Look at the Science

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#GDC22



The story behind this talk is that ever since the EA Spouse letter, I've asked everyone I could think of whether there's any actual scientific research showing the effects of crunch. Some people glorify crunch or say we need it, others say it's terrible and detrimental, but when I ask anyone if there's peer-reviewed research, I get silence. Or someone swears they saw a study once but when I ask for a citation suddenly they can't find it. So... I went ahead and did the

research myself so you don't have to.
These slides will have numbers, and I'll
give the bibliography at the end,
because we can do better than just gut
feelings here.

[Note for those reading these slides on
their own time: yes, there are some
"hidden" slides in here that I took out of
the talk, not because I didn't like the
content, but because I had so little time
and had to cut some stuff. So consider
those slides some free bonus material.]

Definitions

- Unpaid overtime
- Can be short (1 week) or extended (6+ months)
- Can be “light” (~50 hrs/wk) or “brutal” (>80 hrs/wk)
- Specific to salaried employees
- Subset of “death march”



1-3) Just to lay some boundaries, the term “crunch” doesn’t have an industry-standard definition, so for this talk when I say “crunch” really I’m just using it as a synonym for any amount of unpaid overtime, past 8 hours a day or 40 hours per week.

4) We usually talk about this in the context of salaried employees where extra hours are not compensated; that’s significant because there are Federal laws requiring at least time-

and-a-half compensation for overtime specifically to make it more cost-effective to just hire more hourly workers than have your existing workers do overtime, if you're going to make a habit of it... but salaried workers are exempt from those laws, so on the surface it means a company gets more work without having to pay more in that case. [There are some edge-case exceptions where some hourly workers don't get overtime pay and some salaried workers do but those tend to not apply in games.]

5) The other term I'll use is "death march" which is our colloquial term for a situation where a team is behind schedule, asked to work longer hours, then they get even further behind and work even longer hours, with crunch getting worse and worse over time until the project ultimately fails while causing high degrees of burnout and other problems, so that is kind of the extreme

end of the scale. But we'll be looking at the entire range.

Voluntary vs. Involuntary

- “Passion-led” crunch has the same outcomes as corporate-mandated crunch. [1][2]

One thing I did NOT include in my definition is calling crunch *mandatory* unpaid overtime. This has actually been studied, and whether overtime was strictly voluntary with a worker putting in more hours because they wanted to, versus it being required by management, the issues arising from crunch that we'll be discussing here are actually the same either way, with one small exception I'll get into at the end. So if you work long hours you WILL have certain fatigue

effects, period.

Key quote: "Good crunch faces many, if not all, of the issues that result from bad crunch, so its valorization perpetuates a relation of attachment to compromised conditions of possibility whose realization is discovered either to be impossible sheer fantasy or too possible and toxic."
[2]

[1] "The cruel optimism of 'good crunch': How game industry discourses perpetuate unsustainable labor practices" Amanda C. Cote, Brandon C. Harris (2021).
<https://doi.org/10.1177%2F14614448211014213>

[2] "Cruel Optimism" Berlant, L (2011)
Durham, NC: Duke University Press.

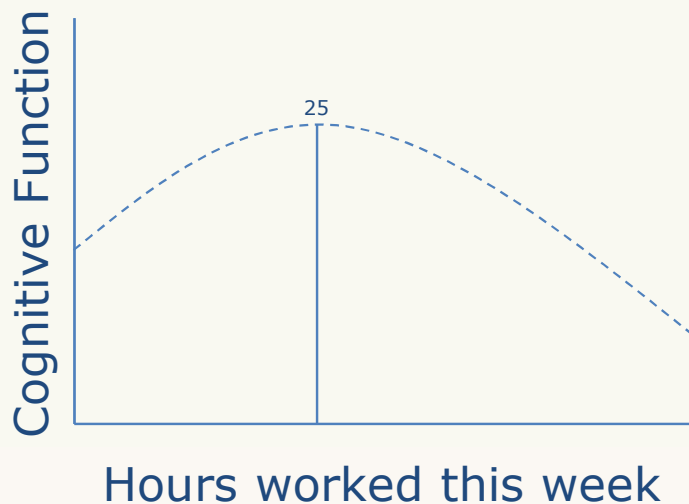
A Normal (non-crunch) Work Week[3]



This study was measuring cognitive function, not productivity, but basically simple tests like the ability to memorize and repeat a word list, do simple math, that kind of thing, and it turns out that your ability to process mentally is not constant, it gets better in the first part of the week as you get into the swing of things and then decays until you get a break.

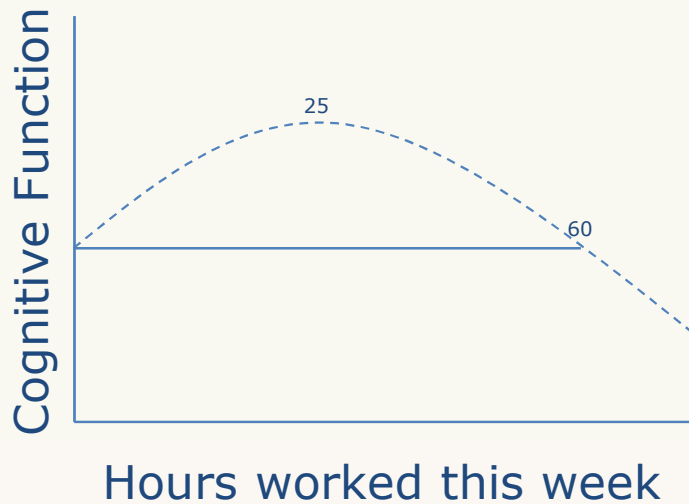
[3] “Use It Too Much and Lose It? The Effect of Working Hours on Cognitive Ability” Kajitani, S., McKenzie C., and Sakata K. (2016). *Melbourne Institute Working Paper Series*, 7(16)

A Normal (non-crunch) Work Week[3]



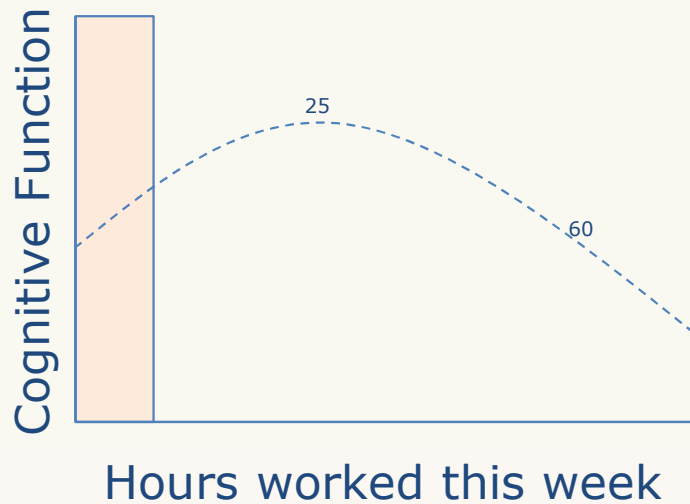
For working hours up to around 25 hours a week, an increase in working hours has a positive impact on cognitive function. After that, cognition slowly declines. The study also looked at gender differences and found none, this is the same curve for everyone."

A Normal (non-crunch) Work Week[3]



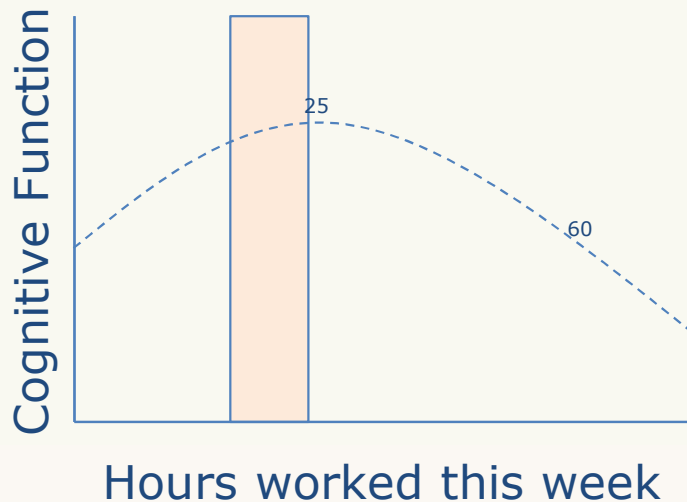
Once you get past 60 hours, your cognitive function is lower than someone who wasn't working at all.

A Normal (non-crunch) Work Week[3]



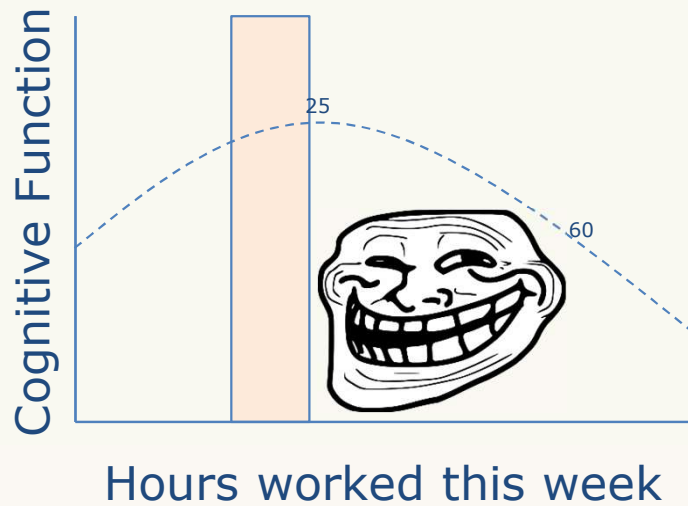
So, the fact that Mondays suck is actually backed by science.

A Normal (non-crunch) Work Week[3]



Wednesday as “hump day” is NOT supported by science, you actually peak at early Thursday, but we knew Wednesday isn’t hump day because most people do it on the weekend.

A Normal (non-crunch) Work Week



[pause for comedic effect]

Under crunch conditions:

- Performance degrades within a single week [4][5]
- Working shorter hours = higher output per hour [6][7]
- Any overtime hours = lower average output per hour [8]
- **Overtime effects are worse for cognitively intense and creative work [9]**

This was also consistent with a number of other studies that didn't look hour-to-hour but did confirm that longer hours show performance degradation per hour.

I'd like to draw your attention to the bottom study – there is a difference in crunch effects depending on the type of work done. Knowledge work and creative work are hit harder than rote, repetitive tasks.

(Worth noting that I won't be able to just give a spreadsheet with numbers to optimize, because there's too much variability between people and between different kinds of tasks, among many other variables.)

[4] "Impact of Overtime on Electrical Labor Productivity: A Measured Mile Approach" Hanna, A (2011). ELECTRI International

[5] "White collar project management questionnaire report" Nevison, J (1992). Oak Associates: Concord, MA.

[6] Holman, C.; Joyeux, B.; Kask, C. 2008. "Labor productivity trends since 2000, by sector and industry", in Monthly Labor Review, Vol. 131, No. 2, pp. 64-82.

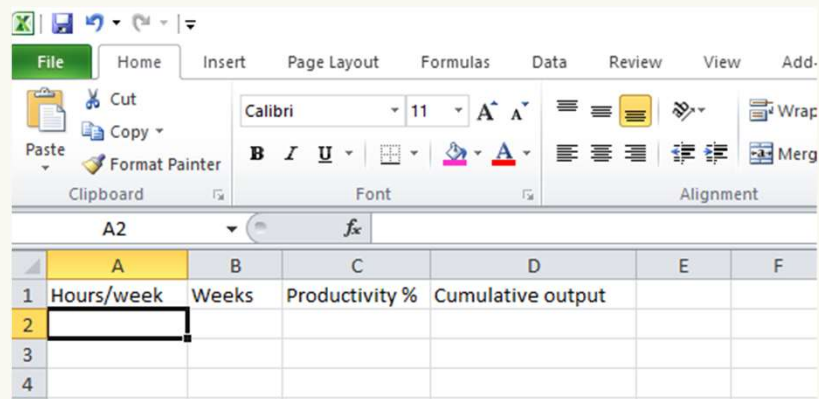
[7] Cette, G.; Chang, S.; Konte, M. 2011. "The decreasing returns on working time: an empirical analysis on

panel country data", in *Applied Economics Letters*, Vol. 18, No. 17, pp. 1677-1682.

[8] Shepard, E.; Clifton, T. 2000. "Are Longer Hours Reducing Productivity in Manufacturing?", in *International Journal of Manpower*, Vol. 21, No. 7, pp. 540-553.

[9] "Fault generation model and mental stress effect analysis" Furuyama, T. (1994). *Journal of Systems and Software* 26(1):31-42. DOI: 10.1016/0164-1212(94)90093-0

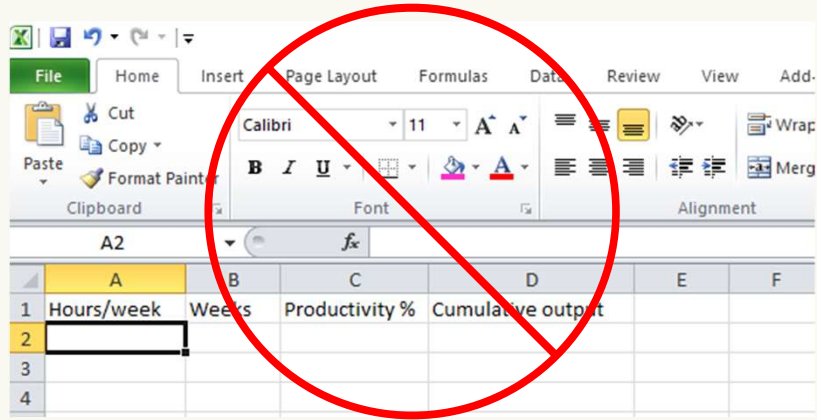
A Normal (non-crunch) Work Week



	A	B	C	D	E	F
1	Hours/week	Weeks	Productivity %	Cumulative output		
2						
3						
4						

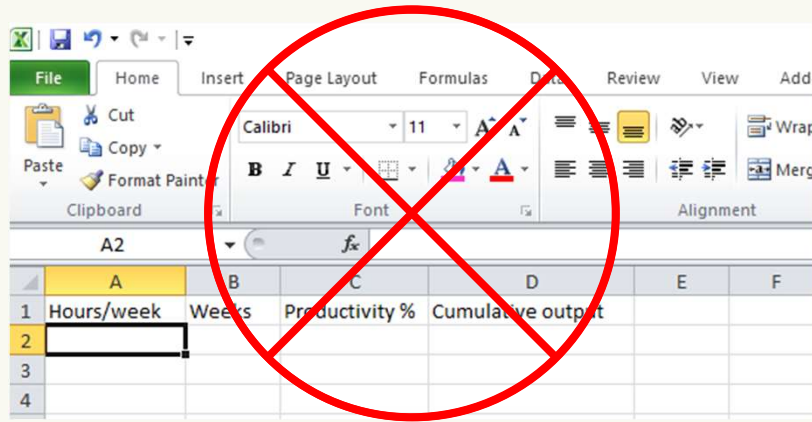
What I would have LOVED to do is provide a nice set of formulas for you about the relationship between work hours and productivity so that you could optimize, like if you're behind schedule and need to squeeze a little extra work out of this week and you need to know what it'll cost you, here's the formula.

A Normal (non-crunch) Work Week



Unfortunately, I can't do that, because there isn't any science that provides these measurements.

A Normal (non-crunch) Work Week



[9] "Fault generation model and mental stress effect analysis" Furuyama, T. (1994). Journal of Systems and Software 26(1):31-42. DOI: 10.1016/0164-1212(94)90093-0

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In fact, we'll NEVER have this, because there are too many variables. There's some variation between individuals, between cultures, between fields, between the nature of the work, general level of job satisfaction, how healthy a person was at baseline... all kinds of things.

[6] flex hours associated with higher productivity (I'll mention this later)

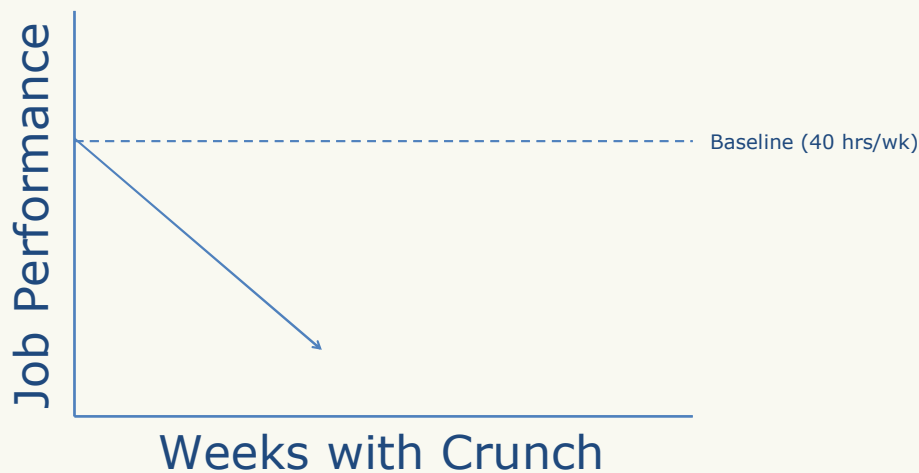
[9] overtime effects are worse for cognitively intense work and creative work than for mind-numbing repetitive tasks

Crunch vs. Time



Now let's talk week-to-week. Suppose you just work 40-hour weeks, no overtime at all, and we track your weekly performance instead of hourly. Yes, you'll have good weeks and bad weeks, going too many weeks without any time off can degrade performance, and you get more experienced and skilled over time so your performance will increase year to year, but over the course of a few months, say, let's treat this as sort of constant.

Crunch vs. Time [10][11]



Under crunch, there's a degradation of productivity over time that continues to go down the longer you're crunching. There isn't a single study that measures this (too many variables) but there are a LOT of studies in different contexts that tell the same story, so this is a repeated pattern across a number of fields, countries, and studies that comes through consistently.

[10] and [11]: sustained overtime increases errors due to fatigue.

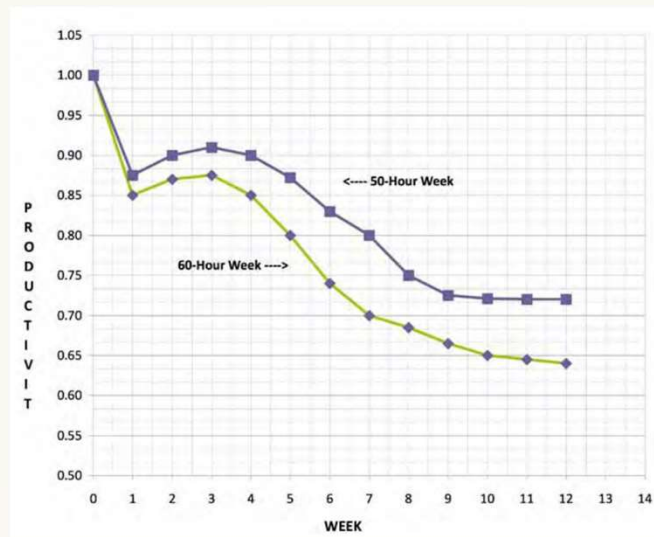
[10] "System Dynamics Applied to Project Management: A Survey, Assessment, and Directions for Future Research." Lyneis, J & Ford D (2007). System Dynamics Review 23(2-3): 157-89.

<http://doi.wiley.com/10.1002/sdr.377>
(December 16, 2018).

[11] "The dynamics of project performance: Benchmarking the drivers of cost and schedule overrun." Reichelt L & Lyneis J (1999). European Management Journal. 17(2): 135-150.

I drew this as a linear curve, but it's probably not a linear shape. In fact...

Crunch vs. Time [4]

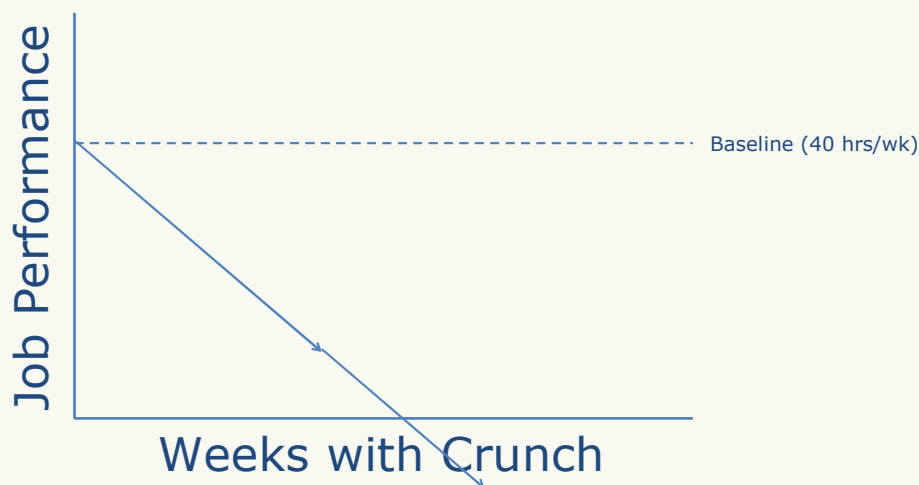


This is an example of what an actual productivity curve might look like. This is NOT from game dev but it is from real data, collected over 10 years from a processing plant, calculating “productivity” as time it takes to do a short-term task during crunch compared to how long it takes under normal baseline conditions.

(once again) [4] “Impact of Overtime on Electrical Labor Productivity: A

Measured Mile Approach” Hanna, A
(2011). ELECTRI International

Crunch vs. Time

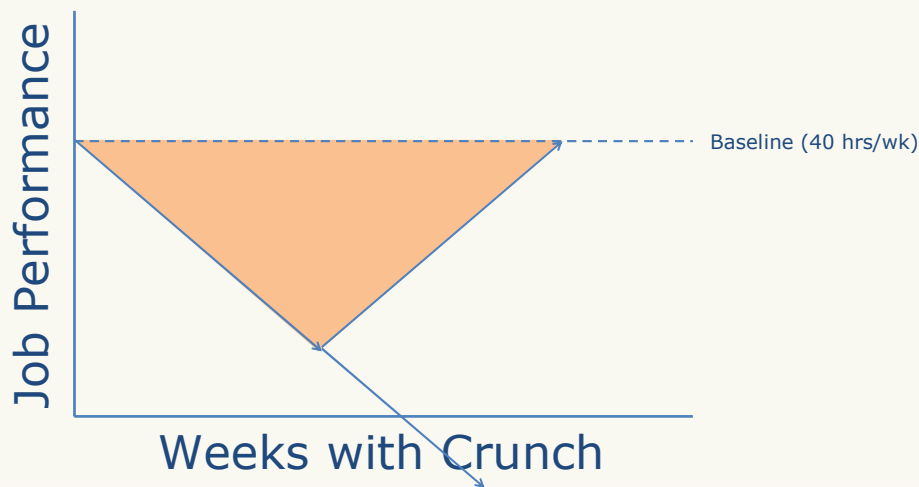


Yes, this can sometimes go negative, because the more fatigued you are, the more likely you are to make catastrophic errors. If you spend three hours fixing a simple bug and create another bug in the process, you're at zero productivity. If you see a deprecated file in the git repository and go to remove it but accidentally delete the entire repo and cost the entire company a person-month's worth of work as a bunch of people have lost their most recent check-ins

because everything had to be restored from backup... well, that's what negative productivity looks like.

This is what happens during a death march. The project is behind schedule, people work longer hours, but if it happens for too long this can actually put the team further behind if you're unlucky, until the entire thing just collapses under its own weight.

Crunch vs. Time [12]



There's also some amount of recovery time that it takes to get back to baseline after crunch (comp time), so you can see pretty clearly here that a short-term crunch followed by a recovery period is a net productivity loss compared to just working continual 40-hour weeks. Short term you might need this to hit a milestone, with the understanding that it's less efficient. Long term, there's no science showing any productivity benefits here – just the

opposite. There's no justification for crunch beyond a month or so. Sure, "if people work longer hours you get more out of them" seems intuitive, but it's not supported by reality because humans aren't machines, we don't have a constant output per hour, we get tired.

(Yes, you do get more DONE during the initial weeks because you're less productive per hour but make it up with more hours... but when you factor in the lower productivity the following weeks as you get back to baseline, it is still a net long-term negative.)

Key concept from [12]: Although vacations and time off following intense projects can aid recovery to some degree, pre-vacation levels of stress tend to recur rapidly after return to work. The ability to recover daily and on weekends is more important for aiding recovery, health and performance.

[12] "The impact of vacation and job stress on burnout and absenteeism"
Westman M & Etzion D (2001).
Psychology and Health (special issue on burnout) 16(5):595-606.

Crunch vs. Humans



It gets worse when you're not just looking at productivity but the actual effects on human physiology.

Crunch vs. Humans

- Linear increase in injury/illness working >8 hrs/day or >40 hrs/week [13][14][15]

This is from a pretty big study of over 10k Americans over 13 years, comprising about 90k person-years' worth of on-the-job data, so they were able to control for age, gender, occupation, industry, and religion, and within that were able to show a pretty clear linear relationship between hours worked above 8/day or 40/week with greater incidence of injury or illness. Yes, you don't typically deal with any workplace injury beyond a paper cut, but this

includes things like heart attack, stroke, stomach ulcer, or other medical conditions that can either kill you or at least take you out of the game for awhile. This is consistent with two other studies that showed a link between overtime hours and heart disease, stroke, and injury hazard rate.

[13] "The impact of overtime and long work hours on occupational illnesses and injuries" AE Dembe, JB Erickson, RG Delbos, SM Banks (2005). *Occup Environ Med*; 62(9):588-97. PubMed ID: 16109814.

[14] "Long working hours and risk of coronary heart disease and stroke: a systematic review and meta-analysis of published and unpublished data for 603 838 individuals" Kivimäki M et al (2015). *The Lancet*, 385(10005), 1739-1746

[15] "The impact of overtime and long work hours on occupational injuries and illness: new evidence from the United

States" Dembe AE, Erickson JB, Delbos RG, Banks SM (2005). *Occupational & Environmental Medicine*. 62(9). 588-597

(It's actually hard to study overtime work effects because there are so many confounding variables, like for example if people in lower socioeconomic classes are more likely to be working long hours, and they have greater health problems, is that because of crunch or is it because they're living in poverty? The [13] study did a lot to overcome those issues.)

Crunch vs. Humans

- Linear increase in injury/illness working >8 hrs/day or >40 hrs/week [13][14][15]
- Increased psychological effects for extended crunch
 - Decreased incidence of healthy habits, increased incidence of unhealthy ones
 - Increased incidence of depression [16][17][18][19]

Another study here looked at a survey of almost 4000 Canadians asking them lifestyle questions and also whether they were consistently working short, normal, or long hours, and basically found that you've got increased chances of mental health issues, decreasing healthy habits like eating well and exercise, and increasing unhealthy habits like smoking, drinking, and illicit drug use if you're consistently working long hours. This is also backed up by

three other studies that show increased incidence of anxiety and depression disorders, as well as increased anger and hostility at work, leading to greater incidence of interpersonal conflict on a team and lower team morale as a result.

[16] "Long working hours and health" M Shields (1999). Health Rep; 11(2): 33-48. PubMed ID: 10618741.

[17] "Influence of overtime work, sleep duration, and perceived job characteristics on the physical and mental status of software engineers" Nishikitani M, Nakao M, Karita K, et al. (2005). Industrial Health 43(4): 623-629.

[18] "Overtime Work as a Predictor of Major Depressive Episode: A 5-Year Follow-up of the Whitehall II Study" Virtanen M, Stansfeld SA, Fuhrer R, Ferrie JE, Kivimäki (2012) *Plos ONE*. 7(1), 1-5
doi:10.1371/journal.pone.0030719

[19] "Working overtime is associated with anxiety and depression: the Hordaland Health Study" Kleppa E, Sanne B, Tell GS (2008). *Occupational & Environmental Medicine*. 50(6), 658-66

Crunch vs. Humans

- Linear increase in injury/illness working >8 hrs/day or >40 hrs/week [13][14][15]
- Increased psychological effects for extended crunch
 - Increased incidence of starting/increasing smoking, drinking
 - Increased incidence of depression [16][17][18][19]
- Long working hours increase stress. [20][21]
 - Chronic stress increases vulnerability to mental illness, decreases cognition. [22]

So, there's an actual mechanism for WHY overtime affects mental and physical health, and that mechanism is increase in stress, because chronic stress is known to cause all kinds of health problems.

Now when I say "stress" here, for the purpose of these studies, I'm NOT just talking about self-reporting or observational stress. [20] shows

numerous biomarkers for chronic stress, including cortisol, catecholamines, glucose, HbA1c, triglycerides, cholesterol, prolactin, oxytocin, and a bunch of others. So when I say “chronic stress” here I’m talking about alterations in blood chemistry, and there’s a vast body of literature that links these biomarkers with a number of physical illnesses, mental illnesses, and cognition deficits. I could give an entire presentation just on showing the biochemical pathways that get you from stress to poor outcomes.

So this isn’t just “weak humans fold under crunch, hire people who are tougher than that” – this is a physiological response to stress that you can’t get around with your bootstraps.

[20] “Mental Health and Working Conditions in Europe” Cottini and Lucifora (2013). *Industrial and Labor Relations Review*. 66. 958-988. DOI

10.1177/001979391306600409

[21] "Physiological biomarkers of chronic stress: A systematic review" Noushad S et al. (2021). Int J Health Sci Qassim 15(5): 46-59. Pubmed ID: 34548863

[22] "Chronic stress, cognitive functioning and mental health" Marin M-F et. Al. (2011). *Neurobiology of Learning and Memory*. Volume 96(4):583-595

Crunch vs. Humans

- Overtime work significantly correlated with HDS, POMS
 - HDS = Hamilton Depression Scale
 - POMS = Profile of Mood Status [16]

[16] "Influence of overtime work, sleep duration, and perceived job characteristics on the physical and mental status of software engineers" Nishikitani M, Nakao M, Karita K, et al. (2005). Industrial Health 43(4): 623-629.

Another paper showing correlation with depression in both sexes. POMS measures several things. In particular, anger-hostility score in both sexes increases, suggesting greater incidence of angry outbursts and interpersonal conflicts at work – this effect disappeared when controlling for sleep duration and job strain index, so this may be more related to sleep deprivation and stressful work conditions than JUST overtime itself – but more on sleep

dep later. Sleep dep also related to total symptom count in men and tension-anxiety scores in women. Job strain index related to anger-hostility scores in both sexes AND to male HDS and tension-anxiety scores.

Crunch vs. Humans

- Overtime work significantly correlated with HDS, POMS
 - HDS = Hamilton Depression Scale
 - POMS = Profile of Mood Status [16]
- Long hours related to negative health outcomes
 - Increased risk of experiencing anxiety and depression [17,18]
 - Increased risk of heart disease and stroke [19]
 - Higher injury hazard rate [20]

[16] "Influence of overtime work, sleep duration, and perceived job characteristics on the physical and mental status of software engineers" Nishikitani M, Nakao M, Karita K, et al. (2005). *Industrial Health* 43(4): 623-629.

[17] "Overtime Work as a Predictor of Major Depressive Episode: A 5-Year Follow-up of the Whitehall II Study" Virtanen M, Stansfeld SA, Fuhrer R, Ferrie JE, Kivimäki (2012) *Plos ONE*. 7(1), 1-5
doi:10.1371/journal.pone.0030719

[18] "Working overtime is associated with anxiety and depression: the Hordaland Health Study" Kleppa E, Sanne B, Tell GS (2008). *Occupational & Environmental Medicine*. 50(6), 658-66

[19] "Long working hours and risk of coronary heart disease and stroke: a systematic review and meta-analysis of published and unpublished data for 603 838 individuals" Kivimäki M et al (2015). *The Lancet*, 385(10005), 1739-1746

[20] "The impact of overtime and long work hours on occupational injuries and illness: new evidence from the United States" Dembe AE, Erickson JB, Delbos RG, Banks SM (2005). *Occupational & Environmental Medicine*. 62(9). 588-597

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[17] People who work 11+ hour days have an almost 2.5 times higher risk of experiencing a major depressive episode, compared to those working 7-8 hour days.

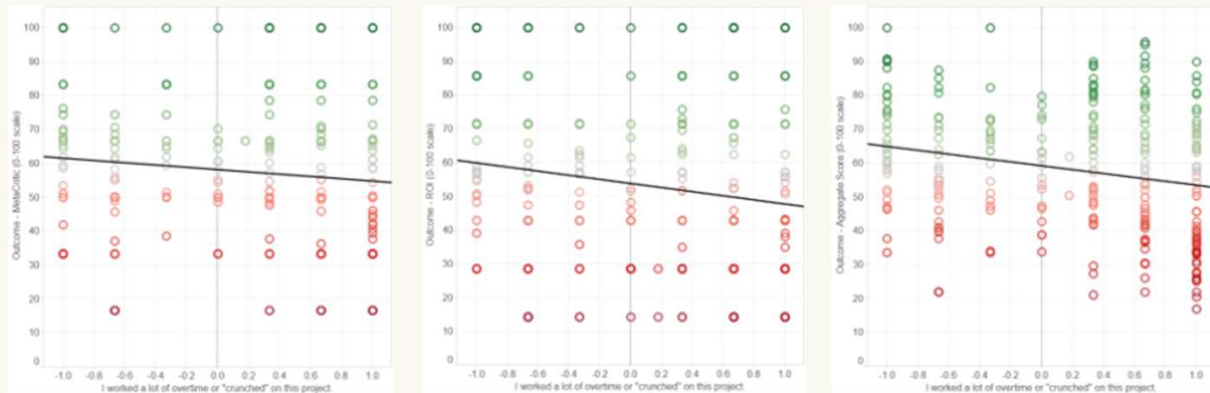
[18] Overtime workers were found to have significantly higher anxiety and depression levels and higher prevalence of anxiety and depressive disorders compared with those working normal hours.

[19] People working 55 hours a week

or more are at higher risk for heart disease and stroke incidence compared to people who work normal working hours (35-40).

[20] People working in jobs with overtime schedules experienced a 61% higher injury hazard rate compared to jobs without overtime.

Crunch vs. Project Outcomes [23]



In case anyone was thinking that these are just the sacrifices we have to make in order to make good games... I think we all know game dev is a bit more messy than that, you can't draw a clear line between a single variable like crunch and the outcome.

BUT, there was a Gamasutra study specifically relating people's self-reports of whether they worked a lot of overtime or "crunched" on a

project vs. the project's Metacritic score (left), financial ROI (center), and an aggregate score that the study authors calculated from a combination of factors (right)*.

As you can see, the data is all over the place – each dot is the game's score versus how much crunch there was. Some games did a lot of crunch and did well, others poorly, same for games with no crunch. But spread across a large number of games spanning the range from AAA to small-indie, there's a very mild negative correlation between working overtime and making a successful game.

[23] "The Games Outcome Project"
Tozour P, et al (2015). Retrieved from
<https://www.gamedeveloper.com/business/the-game-outcomes-project-part-4-crunch-makes-games-worse>

* The four equally-weighted factors were

Metacritic, ROI, extent of release date delays, and subjectively asking the team if they were happy with the game they released relative to what they were trying to make .

Sleep



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If you thought that was the worst of it, actually it gets **EVEN WORSE**, because if you're working **REALLY** long hours, those hours have to come from somewhere, and the chances are pretty good they're coming from your sleep.

Sleep

- Overtime is correlated with:
 - Lower total sleep hours
 - Difficulty falling asleep
 - Waking without feeling refreshed
 - (Severity/probability increases with duration of crunch) [24]

Key concepts from [24]: People who work more than 55 hours a week compared to those working 35-40 hours a week are twice as likely to experience shortened sleep hours, 3.7 times more likely to find it difficult to fall asleep and twice as likely to wake up without feeling refreshed. Repeated exposure to long work hours greatly increases these odds.

[24] "Long working hours and sleep disturbances: the Whitehall II prospective cohort study." Virtanen M et al (2009). *Sleep* 32(6): 737-745.

Sleep

- Baseline: ~8 hours/day

Most humans need somewhere around 8 hours of sleep per night to function optimally, there is some variation here, we fall along a bell curve, but if you're convinced that YOU can function just fine on 6 hours of sleep, the odds are extremely high that you're fooling yourself and you really can't, and you honestly are not in a position to actually know unless you've had this measured in the lab in an actual sleep study, because as we're about to see, your self-

perception is not great even under normal conditions, but gets even worse with sleep deprivation.

Sleep

- Baseline: ~8 hours/day
- Reduced sleep equivalent to alcohol intake (for most metrics)
 - 17-19 hours without sleep = BAC 0.05 [25][26]

Going without sleep is almost indistinguishable from drinking alcohol, other than the effect on a breathalyzer test. This is literally what sleep loss does. So next time you hear someone talk about pulling an all-nighter or staying up late working on a project, just mentally translate that to “did a tequila shot every couple of hours” before you start trying to glorify what they did. “Oh, that Ian, last night he got totally drunk and then balanced our game

economy, what a hero, he does that a lot.” That sounds crazy, but if you say “stayed up all night” that’s really what is happening here.

[25] Williamson, A., Feyer, A. 2000. Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occup Environ Med.* Oct; 57(10): 649-655/ doi: 10.1136/oem.57.10.649

[26] “Ethanol and Sleep Loss: a ‘Dose’ Comparison of Impairing Effects” Roehrs, T. et al (2003). *Sleep* 26(8):961-967. <https://doi.org/10.1093/sleep/26.8.961>

Sleep

- Baseline: ~8 hours/day
- Reduced sleep equivalent to alcohol intake (for most metrics)
 - 17-19 hours without sleep = BAC 0.05 [25][26]
- Self-assessment cannot be trusted [26][27][28]

Kind of like being drunk, you always think you're less drunk than you are, being tired is like that too. It reduces your ability to self-assess so just being tired prevents you from realizing how tired you actually are. However tired you think you are, it's probably worse.

This is what the "second wind" is. You aren't actually more alert suddenly at 3am, you've reached the point where the part of your brain

that detects fatigue is so tired that it's shut down. (It doesn't FEEL that way, to be sure you need to actually measure it in a lab, but when you do that, you find that "second wind" is purely perception, your *actual* abilities show a progressive, smooth slide downward.)

[26] "Ethanol and Sleep Loss: a 'Dose' Comparison of Impairing Effects" Roehrs, T. et al (2003). Sleep 26(8):961-967.

<https://doi.org/10.1093/sleep/26.8.961>

[27] Sasaki, M., Kurosaki, Y., Mori, A., & Edo, S. (1986). Patterns of sleep-wakefulness before and after transmeridian flight in commercial airline pilots. In R. C. Graeber (Ed.), Crew factors in flight operations: IV. Sleep and wakefulness in international aircrews.

NASA Technical Memorandum No. 88231, Moffett Field, CA: Ames Research Center

[28] "The Ability to Self-Monitor Performance During a Week of Simulated

Night Shifts" Dorrian J. et al (2003).
Sleep 26(7):871-877.
<https://doi.org/10.1093/sleep/26.7.871>

Sleep

- Baseline: ~8 hours/day
- Reduced sleep equivalent to alcohol intake (for most metrics)
 - 17-19 hours without sleep = BAC 0.05 [25][26]
- Self-assessment cannot be trusted [26][27][28]
- Memory still affected after 18 on / 32 off [29]

Also, if you pull an all-nighter then take a full day of rest, you're **STILL** not back to baseline, so this can be extremely dangerous and inefficient – this was a study where experienced night-shift workers had mental performance measured at baseline, after a night shift, and again after a full day of recovery, and found that even after a full night's sleep **AND** a full day off, subjects were not recovered all the way back to their baseline levels.

[29] "The after-effects of night work on short-term memory performance"
Meijman T, van der Meer O & van
Dormolen M (1993). *Ergonomics* 36(1-3):37-42. PMID: 8440228

Caffeine?



But this is a cheat code... right? In some ways yes, caffeine does have effects that counteract the effects of being tired, BUT there's a bunch of caveats and limitations. Most importantly, you reach caffeine tolerance in just a week, meaning one week of regular caffeine use and it's no longer actually giving you any kind of stat bonus, it's just bringing you back to your baseline prior to using caffeine. So IF you don't normally use caffeine AND you need

a boost for a short period of time – one week or less – you can do this to make up for some of the adverse mental effects of short term crunch, as long as you stop using it immediately after. For anything longer than that, no, this will not actually help you.

Caffeine?

- Alertness++, Focus++, Anxiety++, Creativity--

First, it's worth understanding exactly what caffeine actually DOES. It's a drug in the class known as Stimulants, and as with most Stimulants it increases your energy and your ability to focus on tasks, which is GREAT for productivity, but it comes at a cost: as with most stimulants, one possible side effect is anxiety, and also specifically because you're better at focusing, you're not so great at out-of-the-box creative thinking. So this can be great if you

know exactly what you need to do and just need to get it done, but if you need to do a bunch of creative design work, this might make it harder for you to get the results you need. Incidentally, this is pretty much the opposite of the effect of alcohol, which is a depressant; alcohol – and yes, sleep deprivation too – unfocus your mind and make it harder for you to get any practical work done, but because your brain is going off on all kinds of random tangents you tend to do better at finding creative solutions – you'll just have to wait until the next day to actually implement them.

Caffeine?

- Alertness++, Focus++, Anxiety++, Creativity--
- Peak: T+3h. Half-life: 6h.

The other annoying thing about caffeine is that it doesn't act on your brain immediately – it takes time for your body to process, so you might feel some immediate effects but the actual peak effect doesn't happen until a few hours later. And what's worse, the pharmacodynamics of caffeine vary widely from person to person, so you can't really even just time it ahead of time unless you've done some experimentation on yourself to figure out exactly how

your own body handles this and what your personal caffeine curve looks like. Also, it has a half-life of 6 hours, meaning that your body takes 6 hours to clear half of the caffeine you just drank, and that's cumulative so it means at 12 hours you still have a quarter of the caffeine in your system. And yes, that means if you have, say, a triple-shot of espresso with lunch and plan on going to sleep at midnight, that's going to wreck your sleep schedule. And I already talked to you about what sleep deprivation does to you. So if you want to optimize caffeine use you have to plan ahead and think carefully about dosages and timelines so you don't end up paying for it later.

Caffeine?

- Alertness++, Focus++, Anxiety++, Creativity--
- Peak: T+3h. Half-life: 6h.
- Tolerance: 1 week

Now this last one here is the real killer: like any addictive substance – and yes, caffeine is legal but it's still a psychoactive drug with addictive properties – you reach a point called “tolerance” where the drug is no longer giving you the beneficial effect it once did, instead you have to take some amount of it just to go to your baseline BEFORE you stopped using. And most people don't know this but it turns out that you reach tolerance with caffeine in a shockingly short

period of time, about 1 week of daily use. Which means if you drink a cup of coffee a day for a boost for just 7 days in a row, by the second week it's no longer doing anything positive for you other than preventing you from crashing.

Caffeine?

- Alertness++, Focus++, Anxiety++, Creativity--
- Peak: T+3h. Half-life: 6h.
- Tolerance: 1 week
- Withdrawal: varies (usually several months)

How long does it take once you're tolerant to get back to your baseline levels of alertness without caffeine, so that it provides an actual benefit for you again? That depends on a lot of factors, mainly how long you've been regularly using caffeine and how much per day, but it's usually within the range of one to three months or so. As drugs go the withdrawal symptoms aren't like alcohol or hard drugs where they'd kill you, but from all the people I

know who have gone through this process, there are times when you wish it would.

Caffeine?

- Alertness++, Focus++, Anxiety++, Creativity--
- Peak: T+3h. Half-life: 6h.
- Tolerance: 1 week
- Withdrawal: varies (usually several months)

- Optimal strat:
 - Don't use at all most of the time
 - Short bursts only if needed

Because you reach tolerance so fast, if you want it specifically for its psychoactive properties, don't use it regularly, so that it will have maximal effect when you do. And then if you do choose to use it for a boost, keep in mind your window of opportunity is very short, so do this only for a few days at a time or less, and then go back to non-use. So for example maybe if you know a big deadline or milestone is coming up and you need to squeeze a little more time into

your day, or if you're going to a conference like GDC and don't want to be falling asleep in the middle of a session, that would be a reasonable case for bringing out the coffee or tea or caffeinated soda or whatever. But if you really want it to have a useful effect above what your normal productivity and alertness would be, you need to go cold again as soon as that burst is done.

Other solutions?

- 5-minute stretch/walk break per hour [30]
- 20+ minutes for relaxed eating at meal breaks [31]

Is there any good news, anything you CAN do to improve your effectiveness at work? Well, yes.

[30]: If you want to optimize time, whether in crunch or not, short attention breaks (10-second attention break, stretching every 10 minutes, taking a 5-minute break to walk around each hour) can refresh attention.

[31]: Taking at least 20 minutes for relaxed eating improves nutrition of

the food and improves digestion and relaxation.

Also of course any techniques you can use to reduce stress. Obviously stress reduction is a huge field and could be a whole talk of its own. But if you've noticed lots of companies offering things like yoga, meditation, and mindfulness classes, that DOES have a solid basis in science for positive health outcomes due to stress-reduction... it's just that it comes across as disingenuous when the company offering stress reduction programs is also the primary cause of your stress in the first place.

[30] "De-stress for success" Cohen, S (1997). *Training and Development*, 51(11): 76-80

[31] "Nutritional boost for medical stress" Neville, K (2006). *Environmental Nutrition*, 29(11): 1-6

Related: Flex Time

- Allowing employees to set their own hours:
 - Improved health, well-being, job satisfaction [32]
 - Increased productivity, efficiency [33, 34, 35]
 - Common justifications for fixed schedules, inconvenient or mandatory overtime not supported when tested empirically [36, 37]

Another thing found across multiple studies is allowing people to choose their own work hours – this has nothing but positive effects, either under normal baseline conditions OR crunch conditions.

Key quotes/concepts:
[32]: aside from an inverse correlation between total hours worked and output per hour, “flexible working time arrangements” have positive effects on individual and

organizational productivity that directly improve unit labor costs of production, improve employee health and well-being and job satisfaction, without raising labor costs. This saves the relatively hidden costs of job dissatisfaction (employee turnover).

[33]: “Companies using flexitime seem to operate more productively as well as more efficiently and employers appear to be sharing the marginal returns of flexible working time arrangements with at least some of their employees”

[34]: “there is virtually no research finding that employees working on flexitime have lower productivity than those on traditional fixed work schedules”

[36] and [37] : “the theoretical justification for the existence or persistence of inflexible, inconvenient or mandatory overtime has received little or weak support when tested empirically”

[32] Lonnie Golden. International Labour Office Geneva. Conditions of work and employment series No. 33. Travail. Conditions of work and employment branch. Research synthesis paper initially prepared for the tripartite meeting of experts on working time arrangements. 2011. First published 2012

[33] Shepard, E.; Clifton, T.; Kruse, D. 1996. "Flexible Work Hours and Productivity: Some Evidence from the Pharmaceutical Industry". Industrial Relations. Vol. 35. No. 1 pp 123-139

[34] Wolf, E.; Beblo, M. 2004. Does Work Time Flexibility Work? An Empirical Assessment of the Efficiency Effects for German Firms, Discussion Paper No. 04-47 (Mannheim, Germany, Centre for European Economic Research(ZEW))

[35] Yang, S.; Lu Z. 2011. "The paradox of de-coupling: A study of flexible work program and workers' productivity", in *Social Science Research*, Vol. 40, No. 1, pp 299-311

[36] Ehrenberg, R.; Schumann, P. 1984. "Compensating wage differentials for mandatory overtime", in *Economic Inquiry*, Vol. 22, No. 4, pp. 460-478

[37] Altonji, J.; Paxson, C. 1988. "Labor supply preferences, hours constraints, and hours-wage trade-offs" in *Journal of Labor Economics*, Vol. 6, Issue 2, pp. 254-276

Game Jams and Crunch



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One last thing you might be wondering about at this point is game jams. I am one of the four initial co-founders of Global Game Jam, and everyone knows game jams take place over a sleepless weekend, so does that make me a hypocrite?

I will say that game jams in general and GGJ in particular do have an image problem where a lot of people think it glorifies and encourages

crunch culture. I have talked with GGJ leadership about fixing this by making some very public statements about crunch, and so far that hasn't happened but I'll keep pushing on it. But I should address this elephant in the room now.

Game Jams and Crunch

- Short term

First off, as we've seen, the worst health effects of crunch happen in the long term. With game jams, you can short yourself on sleep over 48 hours, but that won't have nearly the same effects of depression and illness that a longer crunch period would have, so a weekend jam isn't really a fair comparison to a 6-month death march.

Game Jams and Crunch

- Short term
- Crunch not required

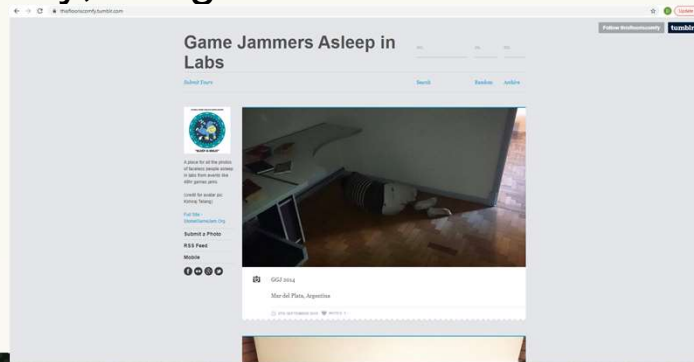
More importantly, you don't have to crunch at game jams! In fact, knowing what I've just said about the effects of long hours and sleep deprivation, if you treat a game jam as a short term crunch, **YOU ARE DOING IT WRONG**. You can work an 8-hour day, two days on a weekend, and probably make a better overall project than if you worked two 16-hour days, and definitely better than if you pulled two adjacent all-nighters.

If you want to do some empirical research on yourself, game jams are a good way to do this relatively safely: schedule several game jams that are at least a month apart to give yourself time to recover, and time it so you're going into each jam equally fresh. And then try one jam where you only work 8 hours per day, one where you work until you're tired, and one where you go with as little sleep as possible and push to your limit – and then compare the quality of your work on the resulting games, and how you felt during and after each jam. Just let your team know so they can scope accordingly.

And if you do that, it isn't glorifying crunch, it's learning more about yourself and the effect crunch has on you, so you can make better decisions when your actual job is on the line.

Game Jams and Crunch

- Short term
- Crunch not required
- This is mockery, not glorification:



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Every now and then you'll see a thread where people will post pics of jammers asleep on the floor or at their desks. Just keep in mind the ThisFloorIsComfy tumblr isn't glorifying what they're doing, it's mocking them. This is not aspirational, don't treat it as such.

Summary

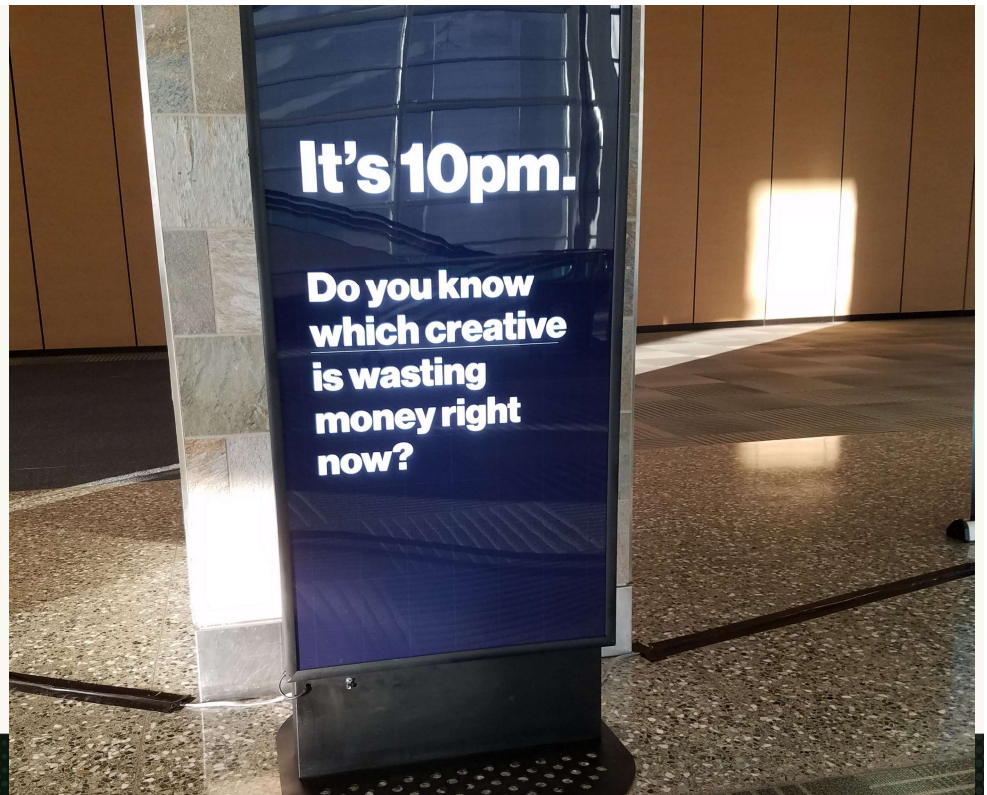
- Lower productivity per hour during crunch
- Lower productivity per hour when sleep-deprived
- Short-term return to baseline via comp time
 - Extended fatigue permanently lowers your CON score instead
- Short-term fatigue: increased danger when driving, operating heavy machinery, performing neurosurgery, coding, etc.

So, if you take nothing else away from today, these are the points I want you to remember. Know that your productivity per unit time decreases if you work long hours or you're short on sleep, and these effects stack with each other and get worse until you catch up in the short term. If you do it long enough that you can no longer catch up in the short term, it's taken off your lifespan with permanent health damage, and if you're fatigued

enough you'll be in the territory where you create more messes than you can clean up and you're a net liability to your team. If your entire team is under these conditions, you're in a death march. And even when you're short on sleep for a single day, remember that during that time you ARE operating as if drunk, so avoid doing anything where you can kill someone with a mistake, like driving, and for god's sake stay off the critical path of your project.

(There are other things I didn't even cover here: effect of crunch on family life and relationship stress, and decrease in job satisfaction that can lead to increased absenteeism and employee turnover, and employees are quite expensive to replace. Burnout also a factor – this doesn't just increase employee turnover but costs the industry senior+ level experience overall.)

Summary



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So next time you see this sign in Moscone West, your first thought should be, probably whichever one is in the office working?

Corollary

- Being behind schedule is usually a project management failure (unrealistic scope), not a team failure (underperformance)
- Solution isn't "work more" but "control scope"

So, just to leave you with some final thoughts – you might wonder, how do we avoid crunch if we get behind schedule, what's the alternative? Let's be clear that we usually don't get behind because the engineering team was lazy and playing games all day, or because they were unskilled and didn't know how to build the game. Those both happen on student teams a lot, but in the industry we tend to filter those people out when hiring – professional developers tend

to be good at what they do. So the cause of crunch is usually an unrealistic schedule, expectations that are too high, which is a project management fail. Even if there IS a technical skill problem, that's STILL arguably a project management fail, because it's the PM's job to know the capabilities of their team. If they overestimated the team's skills, that's on them.

So if you do find yourself behind schedule with too much work and not enough time to do it, the solution isn't just "work harder" or "work longer hours" because you're just as likely to cause damage to the project as to advance it. The solution is to reassess how much you can realistically get done, and if you can't get done what's currently spec'd, you'll need to redo the spec so that it's possible to get done. Or knock back the release date to give the team the extra time to get more done,

or to hire more people to the team with enough ramp-up time that they're a net productivity gain.

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Yes, I do actually have real citations for sources, these are on the comments on the individual slides as well as this slide here, if anyone wants to look these up for themselves to do more research on this topic.

Questions?

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Slides available at:
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David Byron Queen
@byron_queen

"this is more of a comment
than a question"



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