Twitter Thread by foone



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You want to know something about how bullshit insane our brains are?
OK, so there's a physical problem with our eyes: We move them in short fast bursts called "saccades", right? very quick, synchronized movements.
The only problem is: they go all blurry and useless during this

having your vision turn into a blurry mess every time you move your eyes is obviously not a good idea, so our brains hide it from us. Now, imagine you're an engineer and you have this problem.

You've got some obvious solutions you could do.
1. make the vision go black during movement. (Some VR games do this!)
2. just keep showing the last thing we saw prior to movement

both are good options with different downsides, but OH NO. this is assuming everything makes sense and is chronological and (regular) logical.
Your brain does neither of these options, really.

first, it basically puts your visual system on "pause". You're not seeing blackness or even nothing, you're just not seeing period.
then when you finish your saccade, it shows you what you now see at the new position. and then it pretends it can time travel.

it seriously shows you the image at the new point, but time-shifts it backwards so that it seems like you were seeing it the whole time your eyes were moving.
And because your brain is not a computer with a consistent clock, this shit works.

you can see this effect happen if you watch an analog clock with a second hand.
Look away (with just your eyes, not your head), then look back to the second hand.
It'll seem like it takes longer than a second to move, then resumes moving as normal.

that's because your freaking visual system just lied to you about HOW LONG TIME IS in order to cover up the physical limitations of those chemical camera orbs you have on the front of your face.

we've known about this effect for over 100 years, it's called "Saccadic masking" and more specifically Chronostasis. Your visual system lies to you about WHEN things happen by up to half a second(!) just to avoid saccades blurring everything.

So while I firmly believe we're basically just overgrown biological computers, we're apparently computers programmed by batshit insane drunkards in Visual Basic 5.

and you might think "hey wait, wouldn't my vision 'pausing' for half a second have all kinds of weird effects on moving objects? why don't they appear to stutter when moving?"
and the answer is simple! your brain has EVEN MORE UGLY HACKS on top of this to avoid you seeing that

if you've got a clock where the second hand doesn't "tick" but instead smoothly rotates, you won't see this. Because your brain recognizes it's moving and adjusts what you see to make sure it sees the "right" thing.

it's only really obvious with periodically moving things like a clock hand, because it's not moving (so not triggering the movement-during-chronostatis hack) but it moves at a set rate, so you can notice that rate appearing to change.

It's tempting to think of your eyes and visual system as a camera just dumping a video feed into your conscious brain but that's so very, very not the case. What you think you see and what your eyes can actually see are two exceptionally different things.

The big obvious one being the blind spot. Vertebrate eyes are wired backwards so we've got a blind spot in each eye were the nerves enter into the eye. About 6 degrees of your vision in each eye is just not there, as there's no light sensitive cells there.

do you see a blind spot, right now? no, you probably don't. Close one eye! there's now no way for the other eye to fill in the gaps. Still, no blind spot... Your visual system is lying, and making up content it thinks is there. You literally cannot see what you think you see.

Here's another one: You can see in color, right? (well, some of you can't. Sorry)
You can see in color all throughout your vision, it's color everywhere?

Well, most of your cone cells (Which are sensitive to color) are in the fovea, a little spot in the center of your vision

So outside of that center-of-vision spot, you have very little color perception. There's some but it's very limited compared to your main color vision.
But I bet if you shift your attention to your peripheral vision right now, it's in color.

your vision system is lying. it's remembering what colors things are and guessing and filling in the gaps. It's basically doing a Ted Turner colorization process on your non-central vision.

There's even weird effects like what's called "Action-specific perception". If you get a bunch of white balls of various sizes and toss them at people then ask them to estimate the size of the balls thrown at them, they'll have a certain size estimate, right?

now repeat the experiment but ask them to try to hit the balls back with a bat, and suddenly all the estimates shift larger. They actually see the ball as bigger because they need to hit it. their vision is exaggerating it to make it easier to see!

which just goes to show, like I said, your vision is not a camera. perfect accuracy is not one of its goals. it does not give any shits about "objective reality", that's not important.

what's important to the evolution of the visual system is any trick that helps you survive, no matter how "dumb" or "weird" it is.

So if you want an accurate visual representation of what things look like? Use a camera. Not your eyes.

in any case the original point was that while you might know this about your eyes being poor cameras that lie to you, you might still think that at least they're consistent, time-wise. they don't screw with your sense of time passing, just to make up for visual defects. NOPE!

if you can't get it done in time, turn back the clock and pretend you did. That's a perfectly good solution when you're the visual system.

BTW @hierarchon reminded me of a neat trick with saccadic masking: go look in a hand mirror. no matter how close you bring it to your eyes, and how much you look around, you will never see your eyes move.
You're blind during those moments. But you still think you are seeing.

she additionally pointed out that your phone's selfie-mode is NOT a mirror, and it has a slight delay, so you can see your eyes moving in it.

And for fun, here's wikipedia's example of the blindspot.
Stare at L with only your left eye, adjust the distance, and the R will disappear. You don't see "nothing" or "black", you see the background, because you expect to.

This is why laser damage your retina can be so insidious. Your visual system already can hide "holes" in your vision, what's one more to hide?
So you damage a small spot of your retina and your visual system covers it up.

but since you didn't go "WELL THAT WAS TERRIBLE I BETTER TAKE BETTER CARE OF MY EYES" and stop fucking with lasers, you keep doing it
eventually you accumulate so much damage that your visual system simply cannot manage hiding it all and your vision rapidly degrades.

the other reason lasers are so dangerous is that they don't necessarily trigger the same responses as regular incoherent light. your pupil reflex is only triggered by some special cells in the center of your eye, so an off-center laser might not cause your iris to contract

and infrared laser light is just as dangerous as visible laser light, but can't trigger your blink reflex. Your eyes automatically close when exposed to bright light, but they can't detect infrared light. Despite not seeing it, it still causes damage.

Anyway, back on how amazing and crazy your vision is:
There was an experiment back in 1890 where someone wore glasses made with mirrors in them to flip their vision.
After about 8 days, they could see just fine with them on. Their vision system had started "flipping" the image.

(I say flipping in quotes because it's not as simple as it started showing the pixels at the top row on the bottom row, cause our vision doesn't work like that)
It only took them a few hours to get back to normal after taking these glasses off, though.

The last really fun part about this flipping experiment: your eyes already do it. Based on how our vision is wired, we should be seeing everything upside down.

We don't, but only because our visual system has had our whole life to adapt to this.

BTW, since a few people have brought it up: There's a great sci-fi novel by Peter Watts called Blindsight. In it humans encounter an alien race they call Scramblers, who can move very fast and precisely, and they exploit saccades.

because if they only move during saccades, we never see them moving. and since so much of our vision is based on just filling in what we think is there, if they stay out of the direct center of our vision, we'll just visually fill them in, like they were never there.

Check it out if you're into hard SF stories of first contact. It's got some really neat ideas about human vision, very unique aliens, the nature of conciousness, the future of humanity in the face of perfect VR, and vampires.
(Really, it has "vampires", while still being hard-SF)

BTW, remember how I said "vertebrate eyes" up there?
Guess who has eyes which are wired forwards instead of backwards (no have no blindspot), have an internal lens, and can even see polarization of light?
our good friends the Cephalopods!