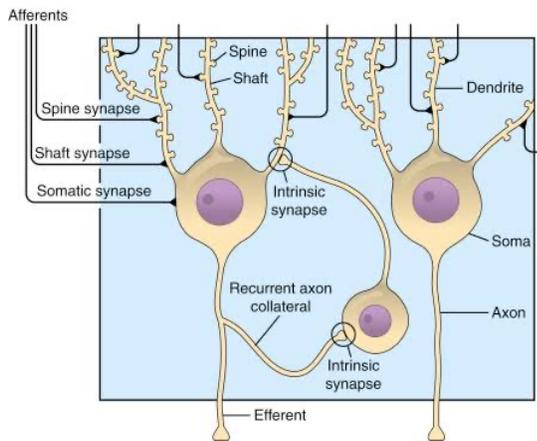


to put it simply, it helps to know that the human stress response is the same for all types of stressors, while the intensity & duration varies, the internal biochemistry is the same



So the brain interprets a stressful event, it releases some stress hormones that float down to the adrenal glands which then pump out their own set of stress hormones and the body gets ready to fight off whatever challenges it.

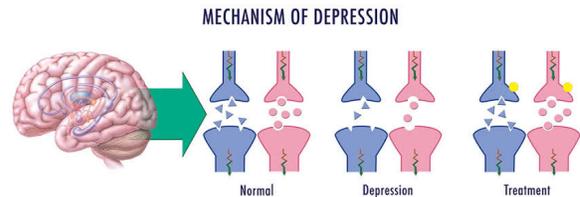
While the body will respond in different ways to heat or cold, this basic stress response is the same to all stressors. Add in that all stimulation runs through the brain and you can see that whether the pain is physical or psychic, the brain starts the cascade. So the brain is the reality center, the stress response is the same, and you end up having a physical stress response to a mental event and the response is every bit as real in your body as it would be if you'd just been assaulted).

He mentions snipping off the connection from the cortex to the rest of the brain. Moral of the story, a candidate for this would be someone who has nothing to lose in the way of pleasure because there was no pleasure to begin with.

this is the biologic element of Depression.

Thyroid hormones ! metabolism, body temperature energy levels. Some depressions are really hypothyroidism. Nutrition & hormone levels matter too...

Women are at about twice the risk of depression as men, **and the worst times are after birth, menopause, and around the time of their period. This is also a time of hormones bouncing around like crazy. Additionally, women tend to ruminate more on emotionally upsetting things than men.** Sapolsky jokes about men and how they "can't express their emotions." But of course there's a real truth in that which may be a big deal for depression - if it's at some level about the cortex expressing emotional thoughts to the rest of the brain, an incapacity to express those thoughts would be protective.

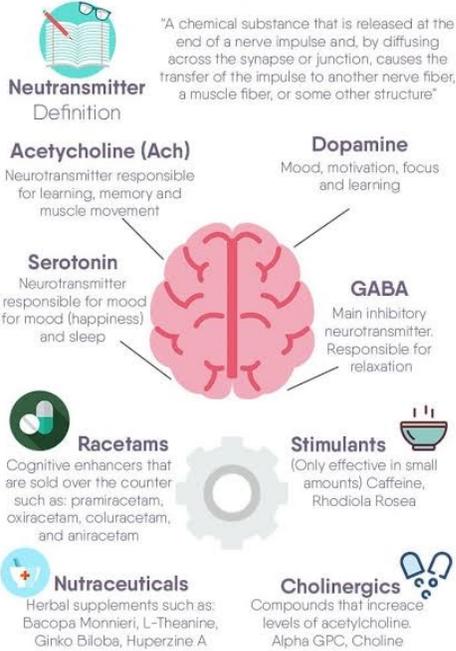


Sigman frued has got something good about depression mourning & melancholia.

---

cingulotomy is cut the cortex in brain to release of depression

# NEUROTRANSMITTERS 101



A portion of the brain known as the reticular activating system helps focus the brain on the thoughts and stimuli you want it to see.

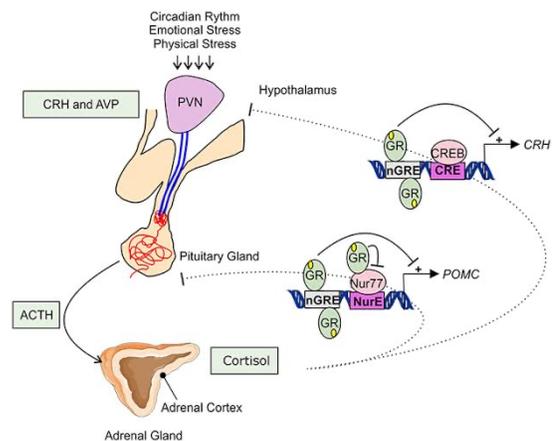
**For example, if you look around a room looking for brown colors, you'll see them more than green colors. Do the opposite and you'll see more green. It also applies to thinking processes.**

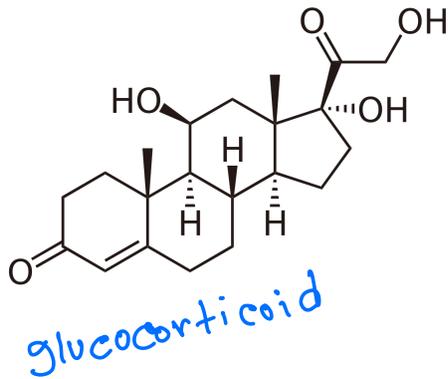
**If you ask your brain to come up with five things you did well today, it will do so. Ask it to come up with five things you screwed up, and it will do that too.**

So these thinking processes are hardwired to direct the rest of the brain and the body. Start obsessively thinking things through in the wrong direction and the

welcome to the party glucocorticoids. these are released by the adrenal glands

THESE INDICATE THAT THE FULL ON STRESS RESPONSE IS OCCURRING. THE MORE EXPOSURE TO GLUCOCORTICIDS, THE GREATER THE RISK. IT'S POSSIBLE THESE ARE THE GUYS THAT TURN RUMINATING THOUGHTS INTO THE DERAILED TRAIN OF DEPRESSION. GET YOURSELF A MASSIVE STRESSOR, ADD IN THE THOUGHTS, AND NEXT THING YOU KNOW THEY'RE THROWING THE SYSTEM OUT OF WHACK AND YOU DON'T BOUNCE BACK.





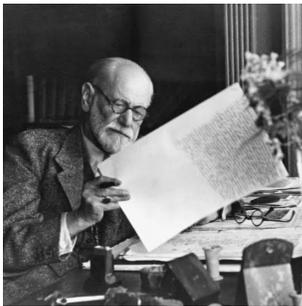
Have 4+ major depressions, and the cycle can just go on its own (remember the pathways).

In Cushing's, a boatload of these glucocorticoids are secreted. Common side effect of Cushing's? Depression. It's also seen when people have to be on immunosuppressant drugs (these are also the glucocorticoids) - common side effect? Depression.

### Cortisol



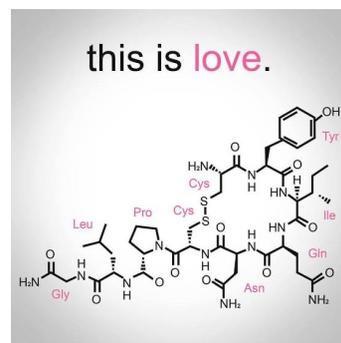
But wait you say, how can the hydrocortisone I use to reduce swelling be the same guy triggering a massive stress response and suppressing my immune system? Read Why Zebras Don't Get Ulcers to find out...



freud, mourning & melancholia. In mourning we bounce back in melancholia we don't start off with mixed views, lose alone & one (person, goal, concept, dream)

freud

You focus on the love and sense of loss. In melancholia you cannot put the negative in the background. Instead it grows. And thankfully as this is going this is just when all those helpful people in your life will start criticizing you and telling you to get over it, thus compounding and increasing the negativity. So you have the grief, but you also have the guilt and loss that goes with losing the chance to make things right.



oxytocin

"Depression is aggression turned inwards"

→ & that gets internalized & fires up the pathways.

lose a parent, when you're under 10, your risk skyrockets.

Depression is also a genetic disorder. It has some degree of heritability. 50% identical twins.

25% full sibling. So again we have the whole nature-nuture interaction.

Lack control and you learn to be helpless. You give up. You aren't able to accept that this thing is awful but it's not the whole world. Instead you globalize it and it becomes your whole world.

Research in this area can be sad; rats who have learned to be helpless in one area (shocks they can't control) will no longer bother pressing the lever when moved to a box where hitting the lever stops the shocks. And people aren't any different.

Have the bad gene (a serotonin one), add in major stressors and uh-oh. A 30 fold increase in the likelihood of depression at the extreme. Oh, and glucocorticoids regulate the expression of the gene.

## LECTURE 24 Part 2

### READ Schizophrenia

Foxp2 is transcription factor that impact language development, influencing both thought patterns & the ability to express them. Foxp2 is a common gene among many different animals with large differences between the expression in humans & other animals.

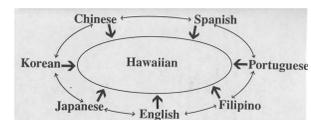
When knockout mice are created, their language occurs less frequently & is less complex. It's estimated that humans experienced massive mutation about 200,000 years ago & the gene was massively selected for.

When knockout mice and introduce the human version, the mouse becomes more vocal & demonstrates much more complex expression.

Pigeon (pidgin) languages emerge when people from different cultures come together (willingly or not) and have to develop an effective means of communication.

The initial pidgin language will show little to no complexity but over the next 1-2 generations it will evolve the characteristics of real language (syntax, grammar, etc.) and become a Creole language. And all of the Creoles have a similar grammatical structure. This suggests - as Chomsky would argue - that there's a default linguistic structure that humans use to create language which reflects hard wiring for language within the human brain.

And of all the 6,000 languages in the world, only about 14 different syntaxes are employed and the vast majority fit within 4 styles, again supporting Chomsky's views.



"language is how we outsmart plants"

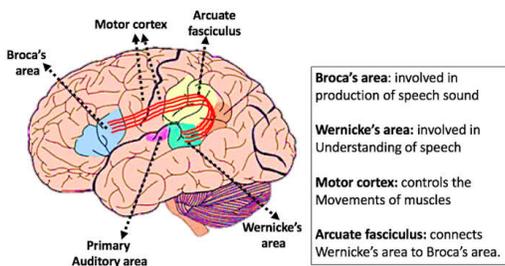
Sapolsky goes on to note that linguistic diversity is disappearing & we're moving towards a time when only a few languages will remain.

This doesn't sound like a big deal until you consider the Sapir-Whorf hypothesis which argues that our view of the world is heavily influenced/determined by our language. Lose language & you will lose the entire world view,

Furthermore, if we consider this from the viewpoint of Daniel Quinn's Ishmael, we're also losing a worldview that contributed to a successful style of human life that lasted for thousands of years (or longer). This is not good news.

Click languages may have been the initial form of human communication.

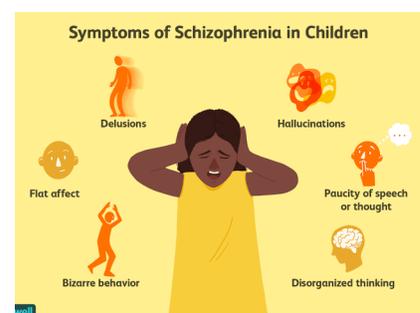
Language evolution is about sequence, with ever greater complexity emerging.



**Parts of the Brain that controls Speech**

At its core, Sapolsky suggest that schizophrenia is a disease of abnormal cognitive associations of loose associations

" A normal person can tell a story in a logical sequence that makes sense to others. This sequential association is lacking in the



#### Common misconceptions about schizophrenia

**MYTH: Schizophrenia refers to a "split personality" or multiple personalities.**

**FACT:** Multiple personality disorder is a different and much less common disorder than schizophrenia. People with schizophrenia do not have split personalities. Rather, they are "split off" from reality.

**MYTH: Schizophrenia is a rare condition.**

**FACT:** Schizophrenia is not rare; the lifetime risk of developing schizophrenia is widely accepted to be around 1 in 100.

**MYTH: People with schizophrenia are dangerous.**

**FACT:** Although the delusional thoughts and hallucinations of schizophrenia sometimes lead to violent behavior, most people with schizophrenia are neither violent nor a danger to others.

**MYTH: People with schizophrenia can't be helped.**

**FACT:** While long-term treatment may be required, the outlook for schizophrenia is not hopeless. When treated properly, many people with schizophrenia are able to enjoy life and function within their families and communities.

schizophrenic thought arrangement, leading to loose, or ostensibly confused, associations that make sense to the schizophrenic but which are often puzzling to the listener.

A key element is the manner in which dual associations to a single word (boxer, caddy, jaguar) will send the speaker off in a seemingly unrelated manner. In some ways this suggests an overly unique perception of the world, whereas normal folks share a more normal set of conversational cues (this may relate to the earlier discussion on default linguistic constructions within the brain.)

next trouble is abstraction - is this literal? A parable? A rumor?

Schizophrenics are terrible at this; they tend to take things more concretely than they should. For example, if you ask for commonality among an apple/watermelon/Banana, Schizophrenic might respond they are all polysyllabic or use letters with closed loops instead saying they are fruits.

They are focused on the concrete elements of the words and sounds instead of seeing what is to the other observer the simple answer of them being similar types of foods.

"90% of the world language will disappear in next century"

The normal listener knows to disregard the structure or pronunciation of the words because they are irrelevant to the question, just as a normal listener can correctly interpret the meaning of "Yes, John resigned." from the context of the rest of the conversation despite completely contradictory meanings. These types of abstract linguistic leaps are very easy for most speakers but are lost on schizophrenics, resulting in an entirely different, and disorganized, communication style.



One effective test for schizophrenia is the proverb test. Proverbs like "birds of a father flock together", a "rolling stone gathers no moss" will be explained in a literal fashion by schizophrenic

Delusions are another hallmark of schizophrenia. This can include believing one was there or came up with certain ideas of historical importance.

Paranoia is also common.

Sapolsky points out that if the world makes very little sense to you (and it would if you were schizophrenic), then the world would be very threatening. It's not that crazy to become afraid of listening devices in bananas if your entire world is filled with people treating you like you're crazy and trying to give you pills so you'll behave differently.

In a world like that, there's really no reason why the bananas aren't also out to get you. Lastly hallucinations are another calling card. The vast majority of hallucinations are auditory. Sapolsky notes this isn't fully understood,

but if we tie together the concreteness of language & the delusions & the fact that everyone hears voices,

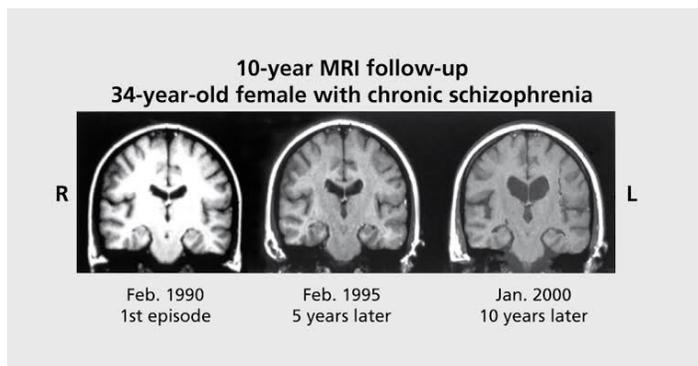
The shout-out to his student was nice, but the notion is off. if there are more fragmented visual image than the proportion of visual hallucinations would be higher since the opportunity is higher.



(bear in mind also that people have different learning styles - some people learn best from visual sources, some by doing and some by hearing.)

Get yourself a person that learns best by hearing, factor in that hearing is a neuronal process of conversion in the brain and then add in some concreteness in thinking that the "voice" you hear is real and you have yourself a hallucination.)

For it to be lower in the presence of more stimuli is backward since it requires the schizophrenic mind to actively and correctly interpret vast amounts of fragmented stimuli and only occasionally get it wrong. Psychiatric disorders aren't characterized by getting things right nearly all the time and then occasionally goofing up. That is unless the reader never thought they saw something they didn't. It's more about not being able to distinguish abstractions from realities. Stare in a mirror long enough and you'll see something that isn't really there. Be a schizophrenic doing that and you're going to crap your pants because you'll take what you see as something real.

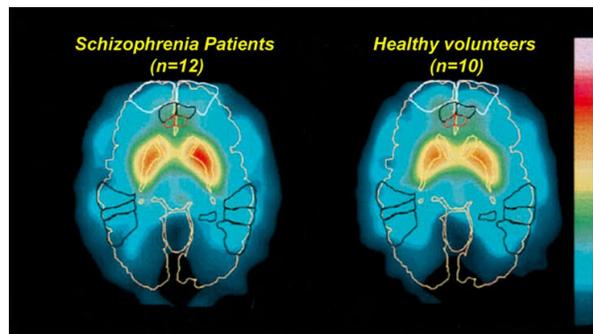


mri

Social withdrawal is also typical. Sadly the majority of the psychiatric drugs given to schizophrenics aim to eliminate the hallucinations but do little to alleviate the more social

isolation. And of course, the more estranged your thoughts & beliefs will become.

He points out that while stories of schizophrenics gone mad and bloody make for good news, the actual rate of violence is low, lower than with normal folks, with the exception of self-injury. Half of schizophrenics attempt suicide and suicide attempts are more common among those that have more periods of remission/clarity that permit them to assess how awful the experience truly is.



PET Scan

Schizophrenia typically begins in the late teen years & into the early 20's.

The typical victim is someone who was always a little odd, a little isolated & who had lots of imaginary friends at an age when others had let their imaginary friends go. )

This person then encounters a massive stressor and on comes the problem. This is around the same time that the frontal cortex gets its last big burst of growth. A line of thinking is that whatever prompts the schizophrenia has to do with this section basically getting kicked one too many times, creating a cascade of other problems.

Schizophrenia is rooted in the cortex (the cortex being responsible for coordination of thoughts, self control, reasoning, etc.)

Socially it's also been used as a diagnosis to deal with those who think differently than what the majority chooses to believe.

For example, an author has written a book claiming that the media is essentially a money driven machine that prints what the government and big business wants them to.

Furthermore, this author claims that the President of the United States consistently misled the public about the Vietnam War, its motivation, goals and meaning. The author also suggests that the government allies itself with the worst criminals in the world when it's profitable and resists democracy abroad if it will impact the bottom line of business in the US.

Furthermore, the author claims that the US military occupied Vietnam and conducted military raids into Cambodia when the Vietnamese crossed the border and attempted to stop Pol Pot's regime from murdering thousands of civilians.

The author also claims that the media is complicit in these things but chooses not to report them because they worry more about ad revenue than truth. In short, the author is into all kinds of wacky conspiracy theories and has the mental stability of a flighty, hallucinating schizophrenic, right?

anyone who read the book knows about this incident & after internet pretty much the whole world is aware about this program.



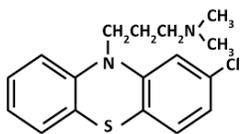
The chemical pathways for schizophrenia likely include excessive levels of dopamine ending up in the brain.

This is measured by checking out things like the breakdown marker of dopamine in the cerebrospinal fluid.

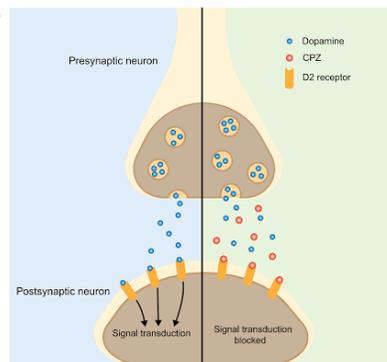
Flip the timeline though and have the conspiracy theories predate the massive, towering achievements in linguistics and you end up with a political nut.

The point being that psychiatry has a long history of using labels to help those in power preserve the current economic system. As Foucault noted numerous times in his later studies on power, this is still a very common purpose of psychiatry as a science of the normal.

A



B

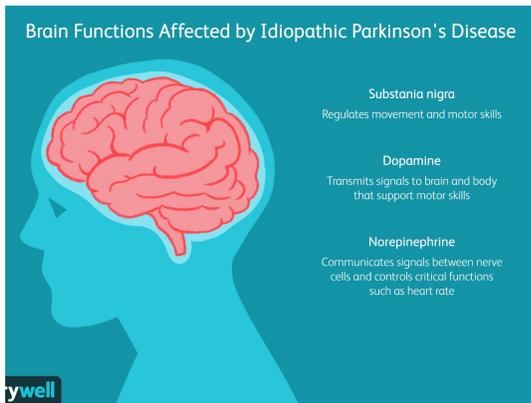


Drugs like Halidol or Thorazine that help with schizophrenia block dopamine receptors in the brain

18 countries over we find the substantia nigra. Get a little bit of damage there & you get the tremors of old age.

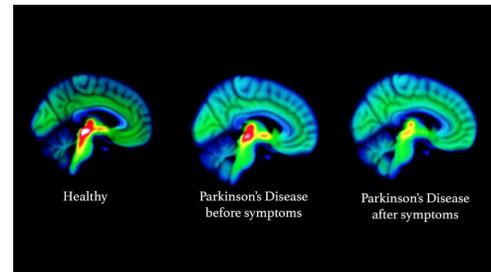
One downside here is that dopamine deficiency is implicated in depression; it's not out of the question that this ties in with the point made earlier that schizophrenics with more "remissions" attempt suicide more often.) Postmortem autopsies show elevated dopamine receptors in the frontal cortex.

get a lot of it & you get yourself a Parkinson's.



In Parkinson's 90% of the neurons have died. These are dopaminergic neurons. It's basically lose all the dopamine signaling in that part of brain

This led to the introduction in the 1960's of L-dopa which is converted into dopamine in the brain. People with Parkinson's who got too much L-dopa would begin exhibiting symptoms similar to those of a schizophrenic. This is also what amphetamines do. And if you overmedicate a schizophrenic, you'll get something that looks like Parkinson's disease because you've blocked dopamine signalling to the extent that the substantia nigra is also affected. This is called tardive dyskinesia.



of course there's also a drug for schizophrenia that increases dopamine, but that's life in the big city. Never simple. only for the Rich

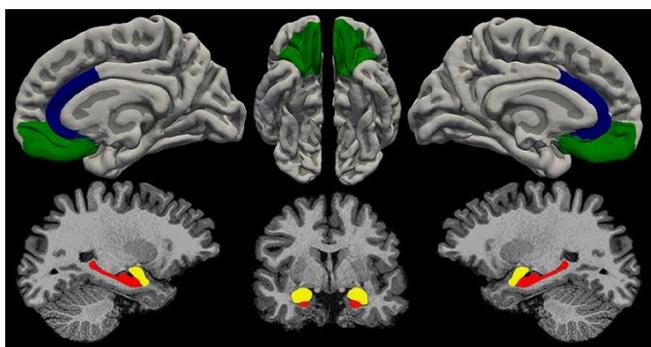
AT THE SAME TIME, AS SAPOLSKY COVERS IN DEPTH IN THE ZEBRAS BOOK, THE BODY WILL DOWNREGULATE IN RESPONSE TO EXCESSIVE LEVELS OF A NEUROTRANSMITTER, SO INCREASING THE AMOUNT CAN ACTUALLY LEAD TO IT BEING LESS EFFECTIVE (THINK TYPE II DIABETES AND INSULIN RESISTANCE).

Serotonin is also implicated, look at the structure of serotonin & compare it to LSD, mescaline, psilocybin, you will see they are structurally similar. They all are hallucinogens & they all fit into serotonin receptors.

The theory follows that schizophrenics that led to the hallucinations.

PCP, angel dust, phencyclidine all are stimulus on schizophrenics

GLUTAMATE HAS ALSO BEEN IMPLICATED. PCP WILDLY ACTIVATES THE GLUTAMATE RECEPTORS AND STIMULATES PSYCHOTIC ACTIONS. THIS LEADS TO THE SUGGESTION THAT GLUTAMATE IS ALSO PART OF THE CASCADE.



However, this doesn't fit overwhelmingly well with the earlier argument that schizophrenics are typically not violent. If it's involved, it's likely through the increased sensitivity of serotonin receptors.

THE BRAIN'S VENTRICLES ARE ENLARGED AND THEY EXERT PRESSURE ON THE FRONTAL CORTEX. THEY ALSO HAVE FEWER HIPPOCAMPAL NEURONS AND NEURONS POINTING IN THE WRONG DIRECTION. SOME STUDIES HAVE SHOWN FEWER NEURONS AND LESS GLIA IN THE FRONTAL CORTEX.

Next we see the gene variant. Nothing if you have an identical twin with schizophrenia you've got a 50% chance of getting it.

full siblings 25% , half siblings 12%  
 Random 1-2%

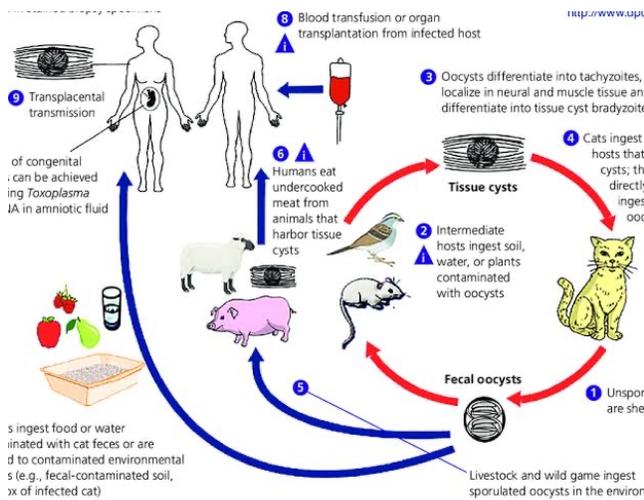
there are countless contributing factors & points out that it isn't a disease,

Genes in the MHC, major histocompatibility complex, have been shown to be significantly different in schizophrenics in 3 studies. This relates to the immune system and markers on the body's own cells to identify them as part of the body's team or outsiders.

This isn't cholera - it's a whole complex of interrelated systems being off to a greater or lesser extent.



anish people



Toxoplasmosis may be implicated. Schizophrenics report a significantly higher medical history of it and blood tests show a significantly higher level of antibodies for it.

Sapolsky notes that some of their current studies suggest that toxo can actually make a rat like the smell of cats and go toward them, thus providing a chance for it to spread.

As for the question of how this maladaptive behavior hangs around, he closes the class by saying more to come, hinting that it may be beneficial in some instances in the relatives that have the mild versions that make them quirky and maybe provide them an adaptive advantage....

Parental effects on Schizop...  
 => audio 2046.00

⇒ double binding theory of parenting was wrong

⇒ Schizophrenics is a biochemical disorder not parenting

⇒ they have lower incidents on cancer like lung

## LECTURE 25

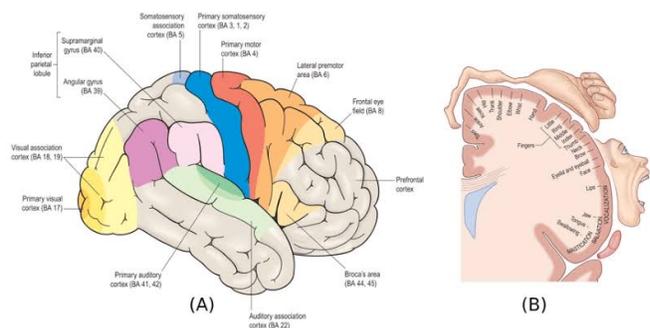
In the last lecture of the series, Sapolsky touches on the history of psychology, highlighting the way that our understanding and compassion toward others has improved with many diseases as our knowledge of their underpinnings has evolved.

Simultaneously, he reminds us that our understanding & compassion toward other diseases is lacking, with a penchant for viewing the world as "them & their diseases" instead of "us & our individual differences"

Remembering that there was a time when seizures could get us burned at stake helps us remain humble when we express our opinions about someone with depression, schizophrenia or any other psychiatric disease that we don't fully comprehend.

The more we learn about neurobiology, the more we come to see that those diseases are influenced and even controlled by biological factors and that the difference between them and us is often very small and can, and possibly even should, be viewed in the same way that we view differences among normal people in their personalities, discipline, inhibition, courage, intelligence and more.

In the end we are all a mixed bag of biology, psychology and neurology. Subtle differences cut both ways. Characteristics go both ways. A controlled, disciplined mindset makes you more likely to cram for the big exam but it also makes you more inhibited about taking risks. You get praised for one and criticized for the other and all along it's the same trait.

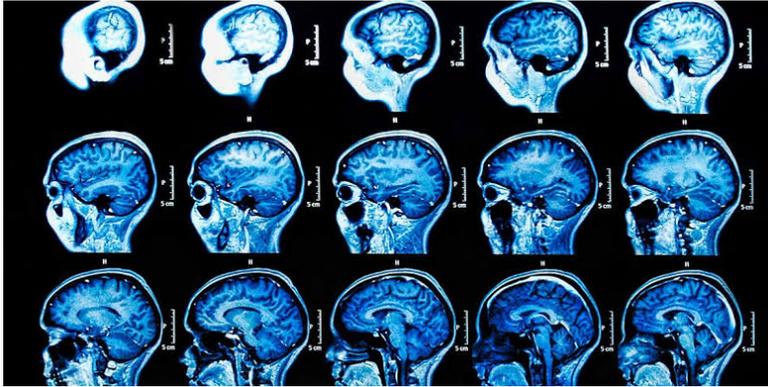


⇒ the more we understand this the more we feel & express compassion towards ourselves & others.

⇒ the more we understand this the less

we criticize ourselves & others for the day to day failures, disappointments & frustration

⇒ when you understand that very things you like best about yourself can be the things you like you the least. in yourself as well as in others.



⇒ Understand these little nuances & you start to see how the world might not be them & their disease

but rather us & our individual differences, quirks & idiosyncracies. So let's get started.....

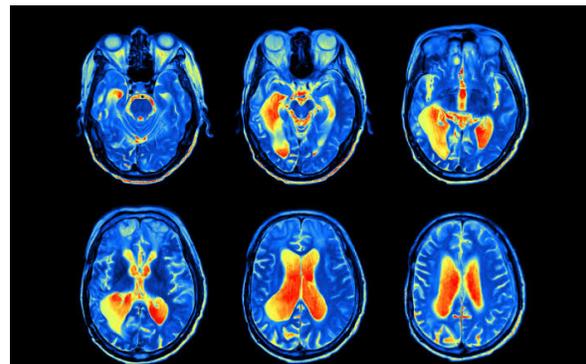
So, a behavior occurs...

Whose fault is it? Now we're talking about volition, culpability, free will.

**Personally I walk away from the lecture series both more and less of a believer in free will.**

On the one hand we have all this biology and clear ways it can compel behavior. On the other we have endless evidence of ways in which we can free ourselves from our own genes and DNA and how the environment changes everything.

Free will doesn't exist. it's a myth as same as equality.



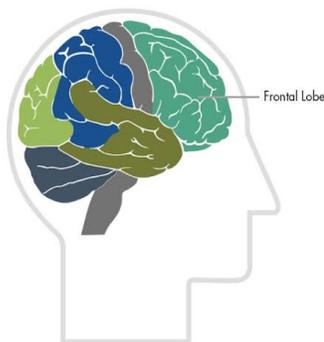
learning disabilities -  
Lazy, Stupid

A lot of people struggle to see the difference between the essence of who a person is & the biological constraints that go on top of it.

It isn't a psychiatric disease to consult astrologers. It isn't a psychiatric disease to go to Star Trek conventions.

*500 years ago if you had an epileptic seizure, it was clear where it was coming from - demonic possession. So if you struck someone in the process, you were to blame. These days the notion is ludicrous because somewhere around 1900 we learned a new concept; it's not him, it's his disease.*

*We are spectacular at doing something like that with epilepsy. We are lousy at doing it in all other sorts of domains.*



SO SCHIZOTYPALISM, SCHIZOTYPAL PERSONALITY AND SCHIZOPHRENIA ARE THERE ALONG A CONTINUUM. **THE DIFFERENCE ISN'T US AND THEM.**

**THE DIFFERENCE IS US AND OUR INDIVIDUAL DIFFERENCES.** ONE PERSON DRESSES UP LIKE SPOCK AND ATTENDS COMIC-CON, ANOTHER WEARS A CROWN AND ENDS UP IN A PSYCH WARD. AND A THIRD PERSON DOES NEITHER. INSTEAD HE WEARS A PATRIOTS SWEATSHIRT AND WATCHES THE FOOTBALL GAME, PRETENDING THAT HIS SUPPORT HAS ANY KIND OF MEANINGFUL IMPACT ON THE TEAM.

the frontal lobe we heard about  
the easy examples  
when it gets blown out of the water.

No cortex no control. This is simple  
But

what about the minor differences?  
what " " question who study more?  
who is modified by attention?

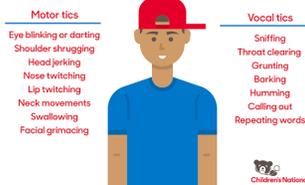
How many neurons? Synapses?

The genes?

AT SOME POINT WE LEAVE THE  
REALM OF PATHOLOGY AND  
MOVE INTO DAY TO DAY  
BEHAVIOR AND THE WHOLE TIME  
THE BIOLOGY IS RIGHT THERE,  
HAVING ITS SAY.

#### What is Tourette syndrome?

Tourette syndrome is a neurological condition that causes involuntary motor and vocal tics.



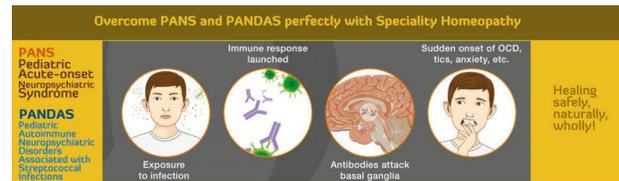
Huntington's  
& mid life  
crisis.

A single gene mal-unction or a jerk?

Tourette's this is not the expression  
of secret desires & thoughts  
Rather there are these weird hiccups of

the id. At the minor level it's not a disease; it's individual differences.

PANDAS - 3 year old kid gets a strep infection. A couple of weeks later you get Tourette's like behavior with the tics and expressions. Someone gives the kid immunosuppressant drugs and the behaviors stop. Then there's another fever. Two weeks later the problem happens again. What's happening? The blood-brain barrier opens the immune system gets to where it should not be. Antibodies form against constituents of the nervous system and the brain itself. Take bloodwork from someone with Tourette's or OCD and you find these antibodies.



In 1600's we knew that a girl shouting out obscenities & sexual innuendo was possessed & needed burning. today she would take the MACT in a different room & have extended time.

In OCD the basal ganglia (which is involved in movement) is more active than in others. Treat 'em with SSRI & the metabolic rate in the basal ganglia goes down.



Jerusalem Syndrome. Here's the description - highly religious Southern Baptist from the US making their first trip to the Holy Land, alone at the end of the day and suffering from jet lag. Mix these elements together and you end up with someone using the white bed sheet as a toga down on the corner yelling out prophecies to the masses. Often.

One way to appreciate these off the wall disorders is that we didn't even have names for them 50 years ago. So what else is out there?

At some point all of us will have some of these labels. It's the same biology on the same continuum. We go from full blown schizophrenia with hallucination & delusions all the way down to simply day dreaming & it's all on the same line.

Rapunzel's Syndrome :

eating hair &  
due to excess  
it blocks  
Stomach

The difference is degrees not substance, which is how we ended up with these disorders in the first place.

So what happens as we get more & more of these diseases & they start

# describing us instead of them?

Some neurological disorders →

Fear. Both of what this means for us and our individuality as well as a sense that science is digging too deep and explaining too much.

He mentions an example, the story "The Nine Billion Names of God" by Arthur C. Clarke. The story is about a Buddhist belief that God has 9 billion names and in the tale they team up with some computer scientists and begin printing them out.

As each one prints, a star in the sky goes out until we're left in the dark. Such is the concern that each new discovery threatens the underpinning of what it means to be a human in this complicated world with its mix of our genes and environment and experience.

As the labels expand, there are possible social repercussions. Be poor & get another label & there goes your house, job, or any of a number of things. Or maybe it goes the other way & people begin to see a continuum instead of a disease.

we are utterly unique & there's no way you can explain this.

getting  
amputee  
→ strength  
aroused by amputees  
→ believe one day  
they will have  
their lumb removed

But science  
is never going  
to go & explain  
everything.

If you were to go back 500 years ago and told the most compassionate, learned person that epilepsy was a disease and not possession, it would make no sense at all. These things go from being diseases and things to be punished to people who need assistance and protection.

"the purpose of science is not to  
cure us of a sense of mystery,  
rather constantly reinvent it"

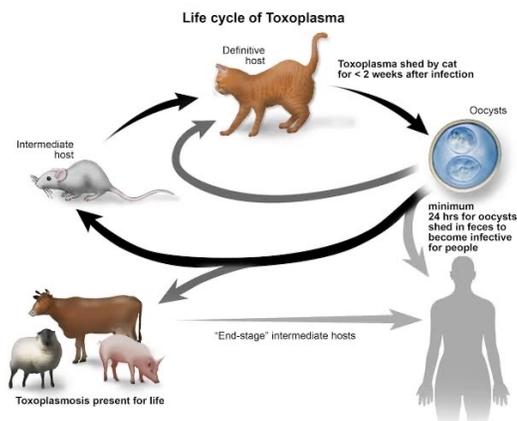
# LECTURE Toxoplasmosis

<http://edge.org/conversation/toxo>

This is one of the most fascinating topics he covers. In this brief discussion, Sapolsky comments on toxoplasmosis and reveals some startling research that suggests this parasite can not only invade your body but maybe can have effects on your decision making as a result.

As an analogy, I don't think the reader will struggle to relate to times when one simply could not help but pick at that zit, even though doing so would inflame it, rupture surrounding cell walls, and quite possibly result in a bigger outbreak. Try as one might, a persistent, unwanted thought would relentlessly pop into the mind. And the zit would be telling you the whole time not to worry, I'm one of those that you just pop, the system clears, all is well. Instead what's really happened is a thought in your mind - arising from we know not where - has convinced you to take the action most likely to spread the infection.

Perhaps a stretch? Nevertheless, it's an analogy to what may happen with toxoplasmosis infections.



He opens up the discussion by letting the viewer know his philosophical stance here - there's a whole lot less free will than we would like to believe. here we are not talking about your pop psychology freshman philosophy course where determinism is argued through -

"I did what I did & couldn't have done differently" straw men, but rather through the subtle but substantial way in which biological underpinnings impact & even control behaviour.

A more apt framework would be the impact of heightened neural connections running from the amygdala to other brain centers. This is impacted by biology as well as environment and experience, but once it's unfolded the neural connections themselves will exert tremendous influence on the person's thoughts, emotions and behaviors independent of the person's desire to have such thoughts, emotions or behaviors so influenced.

Here the focus will be on parasites that are able to change the host actions for their own benefit. As an

opening example he mentions a barnacle parasite that can feminize male crabs, inducing them to burrow & thus create

a nice place for the barnacle to have its offspring.

That's why you shouldn't have cats around pregnant women

Toxo comes into the picture by way of an old wives' tale forbidding mothers from having cats around during pregnancy. Basically the only spot that toxo can reproduce itself is within a cat's stomach. The toxo then goes out with the feces (which is where the caution comes from) and rodents eat the feces. Toxo's mission is to get that rodent back into the stomach of a cat.

Rodents themselves are genetically wired to fear cats. A rat that smells cat urine will go the other way. However, get that same rodent infected with toxo and it will suddenly be attracted to the scent. Thus it checks out cat urine and becomes more likely to find itself in the stomach of a cat.

So you'd think toxo is wreaking havoc with all sorts of element within the rat, turning it into a deranged rat. Nope. Everything remains & function normally

olfaction, social behavior, learning and memory, and even fear behaviors all stay the same.

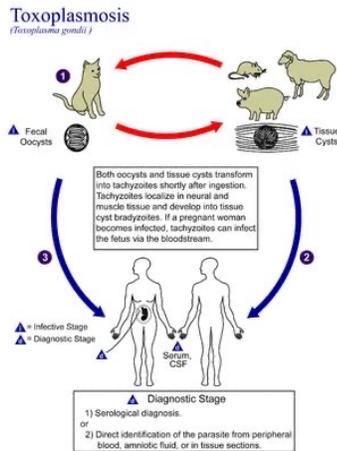


It takes about 6 weeks for toxo to migrate from the gut to the brain. In the brain it forms cysts in multiple locations, but mainly in the amygdala region. The amygdala is the brain's center for fear and anxiety. It is also the brain center for forming predator aversion pathways. Once in the amygdala toxo is able to take dendritic nerve cell endings and cause them to shrivel up.

Shrivel up the dendritic spine, shrivel up the fear pathway.

Taking the creepiness up several notches, recall that other fear/anxiety based behaviors remain constant. The parasite is actually locating and unwiring the very pathway it needs to destroy.

Amazingly, it does not stop there. Toxo wants to make cat urine attractive and it is able to do so by hijacking another well known pathway; sexual attraction. Part of the neural connection for sexual activity passes through the amygdala. This gets rewired and a rodent infected with toxo will no longer have a fear response to the urine but it will have activation of this sexual response pathway, resulting in attraction to the scent.



They are mapping out the toxo genome. One curious element discovered is that this protozoan parasite has two genes for tyrosine hydroxylase. This is responsible in part for the production of dopamine, which is all about rewards and the anticipation of rewards (really it's the thing that gets you to do the thing needed for the reward). It acts as a catalyst in the conversion of L-tyrosine into L-DOPA, which is in turn a precursor for dopamine.

Supplement Facts		
Serving Size 14.5g (1 scoop)		
Servings Per Container: 30		
	Amount Per Serving	% DV†
Calories	10	
Total Carbohydrates	2 g	1%
Sugars	2 g	*
Vitamin C (Ascorbic Acid)	500 mg	833%
Vitamin E (as Alpha Tocopherol Acetate)	200 IU	667%
Niacin	60 mg	300%
Vitamin B6 (as Pyridoxine Hydrochloride)	15 mg	750%
Vitamin B12 (as Methylcobalamin)	90 mcg	1500%
Calcium (as Silicate, Phosphate and Citrate)	196 mg	20%
Sodium	50 mg	2%
Potassium	40 mg	1%
<b>ATP AMPLIFIER</b>	3500 mg	*
Carnosyn® Patented Beta-Alanine (2,000mg), L-Tyrosine, L-Aspartic Acid, Red Beet Extract High in Nitrates, (DMG) Dimethylglycine HCl.		
<b>CELLULAR TRANSPORT &amp; INSULIN ACTIVATOR</b>	2952 mg	*
Dextrose, L-Glycine, Ribose, Cinnulin PF® (Cinnamomum burmannii) Bark Extract.		
<b>ATHLETE PERFORMANCE BLEND</b>	2000 mg	*
FEATURING "ION-3 NITRATE TECHNOLOGY MATRIX" CreNitrate, ArgNitrate, BCAA Nitrate 3:1:2 Ratio (L-Leucine, L-Valine, L-Isoleucine).		
<b>ENERGY &amp; NEURO IGNITER</b>	1750 mg	*
Choline Bitartrate, Glucuronolactone, PurEnergy™ Matrix (Pterostilbene-Caffeine), Huperzine A.		
<b>HYDRATION SYSTEM</b>	1,200 mg	*
Taurine, Coconut Water Powder, L-Glutamine.		

†Percent Daily Values are based on a 2,000 calorie diet.  
\*Daily Value not established.

so at the right moment, the parasite secretes the enzyme, thus driving the neurons to create dopamine

at that time the toxo wants them to, thus associating dopamine with the neural pathway that toxo wants used.

Do other parasites that are closely related to toxo share this gene? No. Strangely it does not have genes for other common hormones - just this one that allows it to plug into the key for mammalian reward systems. And it starts generating it after it has penetrated into the brain and formed cysts, especially cysts in the amygdala.

For humans the current clinical dogma is that it's a disaster for a fetus but otherwise runs its course and goes latent. However, a small literature exists suggesting that males in particular become more impulsive after a toxo infection and that people who are toxo infected are 3-4 times more likely to be killed in car accidents that involve reckless speeding.

He quips that this is a protozoan parasite that knows more about the neurobiology of fear and motivation than 25,000 neuroscientists standing on each others' shoulders.

And it's not alone. The rabies virus knows how to control the neurobiology of aggression. It makes the animal more likely to bite and pass on the rabies infection.

behaviour? Do these 3 amount to the whole list? Or there five more parasites viruses or bacterial organisms that can be

So here is the paradox box opens. We know a little about a barnacle parasite

We know a little about toxo, we know a little about rabies. what else out there that we don't know about but has the same capacity to alter

alter behaviour ? 10 ? 100 ?

o

on the scary side, Sapolsky mentions that what military is interested in toxo. which makes sense it's the core behaviour that the mammal would otherwise flee from.

As a corollary, if toxo can do this, what other subconscious realms exist within us that influence our behavior every bit as much as toxo influences the rat's? Philosophically that may be a loaded, presumptive question since it implies its own conclusion, but it remains a very interesting question regardless.

As a completely unscientific anecdote, when I first picked up my dog he was, though from a good breeder, nevertheless attempting to eat wild cat poop that was in the vicinity. My current Malamute is significantly less risk averse than the prior Malamute. And he plays with cats.

There's a high rate of toxo in the tropics - estimated that 50% of people have had a toxo infection (barefoot traveling). Another anecdote - a doctor from Stanford hospital remembered that during his residency one of the old surgeons had mentioned that he should check organs for toxo when examining people that had died in motorcycle accidents. The toxo was usually there.

One would hypothesize that this would be an area of limited returns though, since volunteer military combatants would be expected to have a higher toxo infection rate than the population as a whole since the very act of volunteering requires a lower level of risk aversion.

There's a link between toxo and schizophrenia. Schizophrenics have higher than expected rates of having been infected with toxo, mothers with cats during pregnancy, etc. Interestingly, excessive dopamine release is connected with schizophrenia and is a hallmark of toxo. Additionally, if you take a toxo infected rat and introduce dopamine blockers - the same kind of drugs used to treat schizophrenia - the rats stop being attracted to cat urine.



People with toxo have a higher probability of being killed in a car accident in a high speed driving.

HE NEXT TOUCHES ON SOME RECENT RESEARCH ON STRESS RELATED DISEASE. TELOMERES ARE AT THE END OF THE CHROMOSOME AND, MUCH LIKE THE PLASTIC END OF A SHOELACE, FUNCTION TO KEEP THE DNA WRAPPED TIGHTLY, AND CORRECTLY, TOGETHER.

THEY GROW SHORTER WITH EACH DIVISION UNTIL THEY HIT A POINT WHERE THEY BECOME SENESCENT (NO LONGER CAPABLE OF DIVIDING BUT STILL ALIVE AND METABOLICALLY ACTIVE).

Relatively little is known about the basic biology of senescent cells, particularly in vivo, but mounting evidence that cell senescence plays a role in ageing and age-related disease has stimulated interest in the topic. Here Jan van Deursen reviews recent work on the role of senescent cells in ageing.

New findings suggest that senescence is not a static cellular endpoint. Rather, it is a dynamic series of cellular states linked to tissue repair and cancer as well as to ageing. van Deursen goes on to discuss how the new information that is emerging could be exploited to clear detrimental senescent cell populations selectively to improve healthy lifespan.

A study on telomere length in mothers of chronically disabled children found that their telomeres were significantly shorter than the length that would be expected of someone of the same age in the population.

Major long term clinical depression results in shortened telomeres in white blood cells.

## LECTURE *Are humans Just another primates*

In this lecture at the Cal Academy of Sciences, Sapolsky provides a high level overview of his research findings in biology, neurology, and primatology. Also, bizarrely, he wears a tie.

[https://m.youtube.com/watch?v=YWZAL64E0DI&feature=emb\\_logo](https://m.youtube.com/watch?v=YWZAL64E0DI&feature=emb_logo)

He begins with a story about a fly neurogenetic researcher. This individual made the argument that flies and humans are very similar and it's only people's lack of knowledge that leads them to think otherwise. How can this be? Well, roughly the same number of genes, in some cases identical genes, the neurons are the same - same resting potentials, action potentials, neurotransmitters, etc. But of course Sapolsky is much smarter than that guy and he points out that his take was that it establishes the fact that these genes, neurotransmitters, etc. are not what makes humans human because it had just been shown that there is nothing distinct in that realm. Instead the topics for this talk will focus on the following three themes that actually do address what makes humans human.

1. Ways in which humans are just like any other animal.
2. Ways in which humans have the same basic design but use it in a novel way.
3. Ways in which humans are entirely different.

① ways in which humans are just like any other animal.

**First up is the Wellesley Effect. A female hamster placed in a cage with another female hamster will soon sync its ovulation and menstrual cycle up with the other female. The pattern is consistent with the more submissive female adjusting to the more dominant female. Add in a male, or even just the scent of the male's pheromones, and the effect goes away.**

**Extraordinary and odd as this is, humans do the same thing. First discovered at Wellesley College in 1971. Wellesley is a private liberal arts college in Massachusetts for women.**

② ways in which human have the same basic design but use it in a novel way?

Next he describes a chess match between two grand masters who, despite being engaged in no activity other than sitting and thinking, will demonstrate a chemical profile consistent with a marathon runner and who will have adrenaline and glucocorticoid spikes mirroring a lion bringing down its prey when they make a winning move. The remarkable point here is the extent to which the human brain can drive the behavior of cells through thought alone. The downside to this is that it makes us susceptible to stress related diseases because we are turning on the stress response with our thoughts and concerns over abstract items like mortality and 30 year mortgages and the repeated release of these glucocorticoid storms wreaks havoc on our bodies. (This is the focus of his book, *Why Zebras Don't Get Ulcers*.)

③ ways in which humans are entirely different

Here the example is a straightforward one - a human couple that goes to work, comes home, has dinner, goes to bed, has sex, talks, sleeps, repeats. No other animal would find this a normal pattern. As he states, hippos would be repulsed by it. Perhaps Bonobo Monkeys would be similar but non-reproductive mating is not a common thing in the animal kingdom.