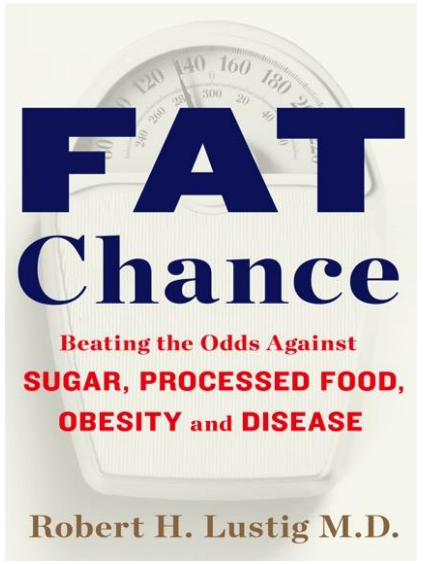
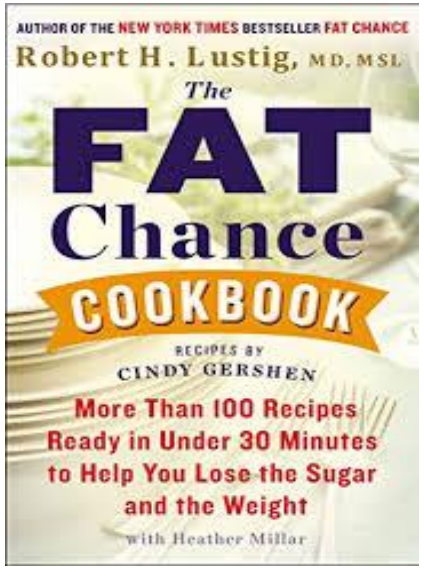
We have a systemic, mental, societal, and planetary health crisis.

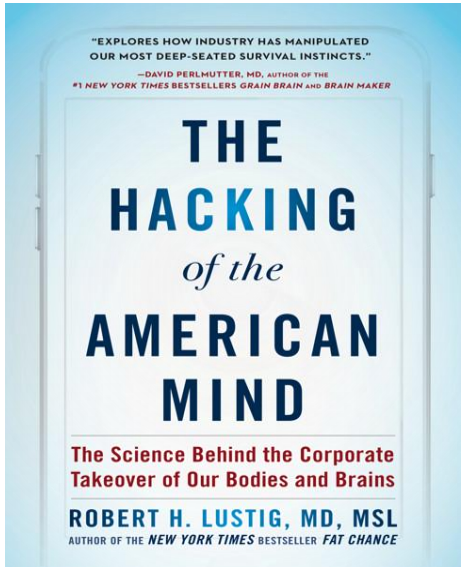
Coincidence or related?

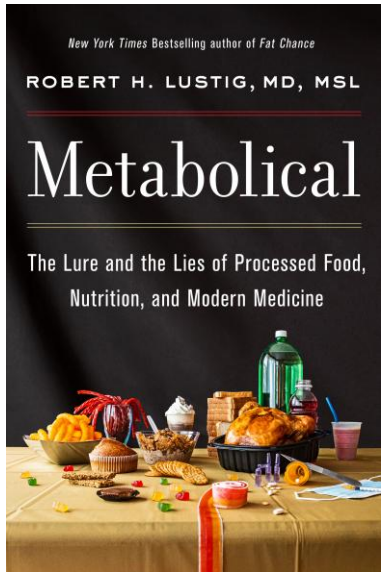
Robert H. Lustig, MD, MSL, Dept. of Pediatrics, UCSF

Disclosures









Freeing the Hostage Brain

Robert Lustig
Elissa Epel

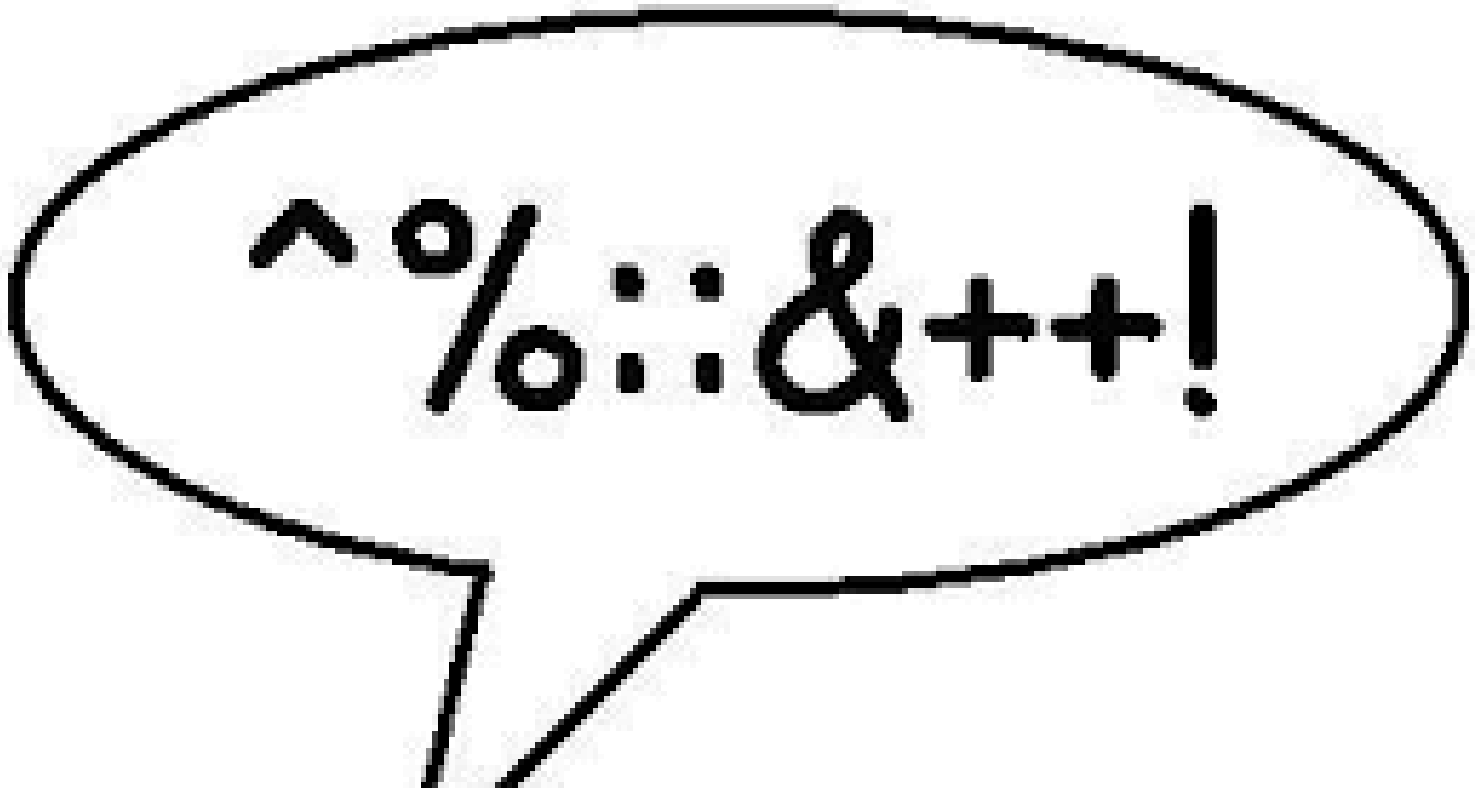
(in preparation)

Chief Medical Officer:
BioLumen
SnapRecall
Perfact

Paid Advisor:
Myka Bio
Levels Health

Unpaid Advisor:
Kuwaiti Danish Dairy
Blue Oak Nutraceuticals

What is the dirtiest 4-letter word in the English language?




FEAR

Systemic Health

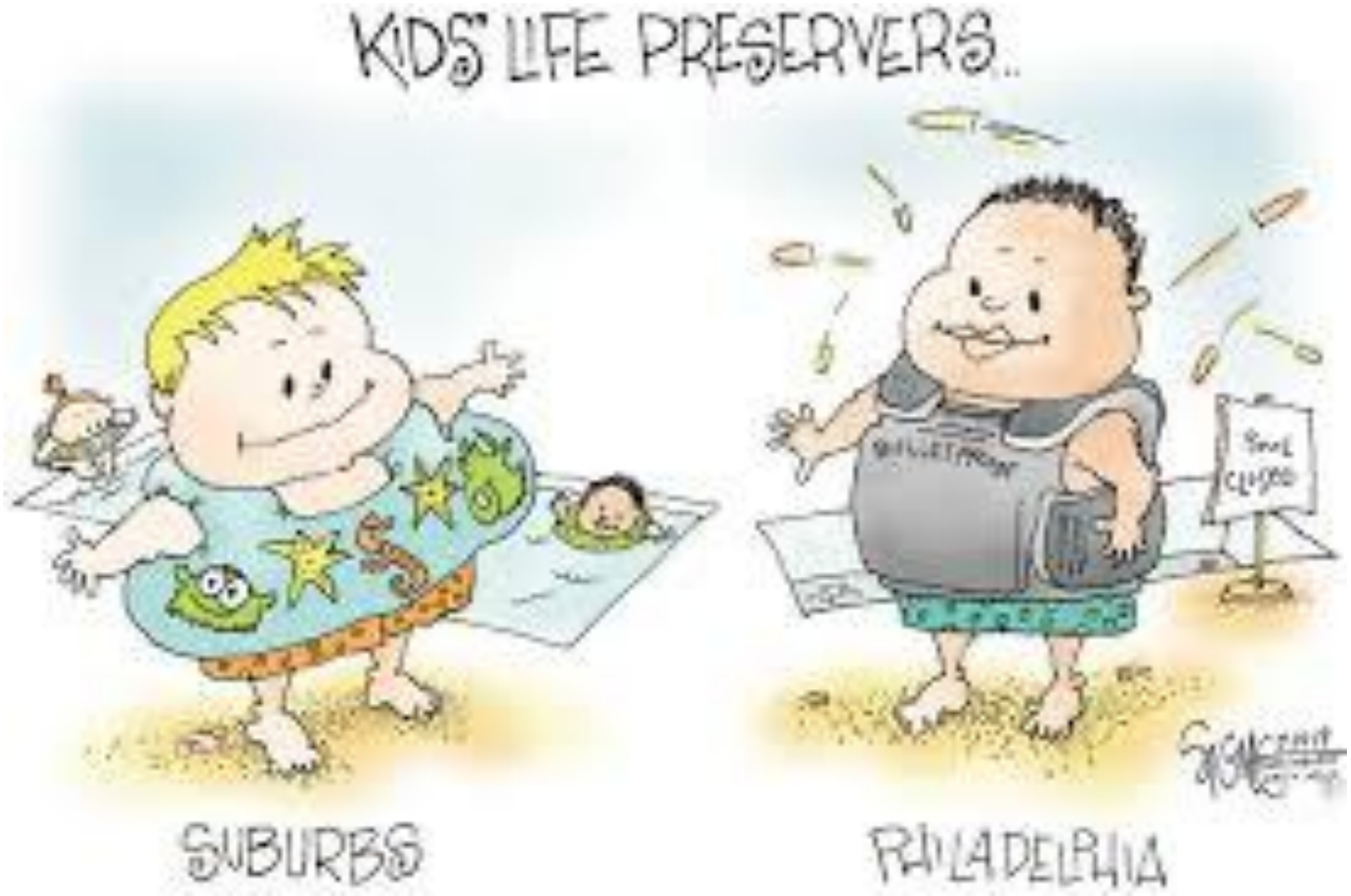
"With my new raise comes more responsibility
and my choice of four new stress related illnesses!"

Internal trauma — "Fear of failure"

Mental Health

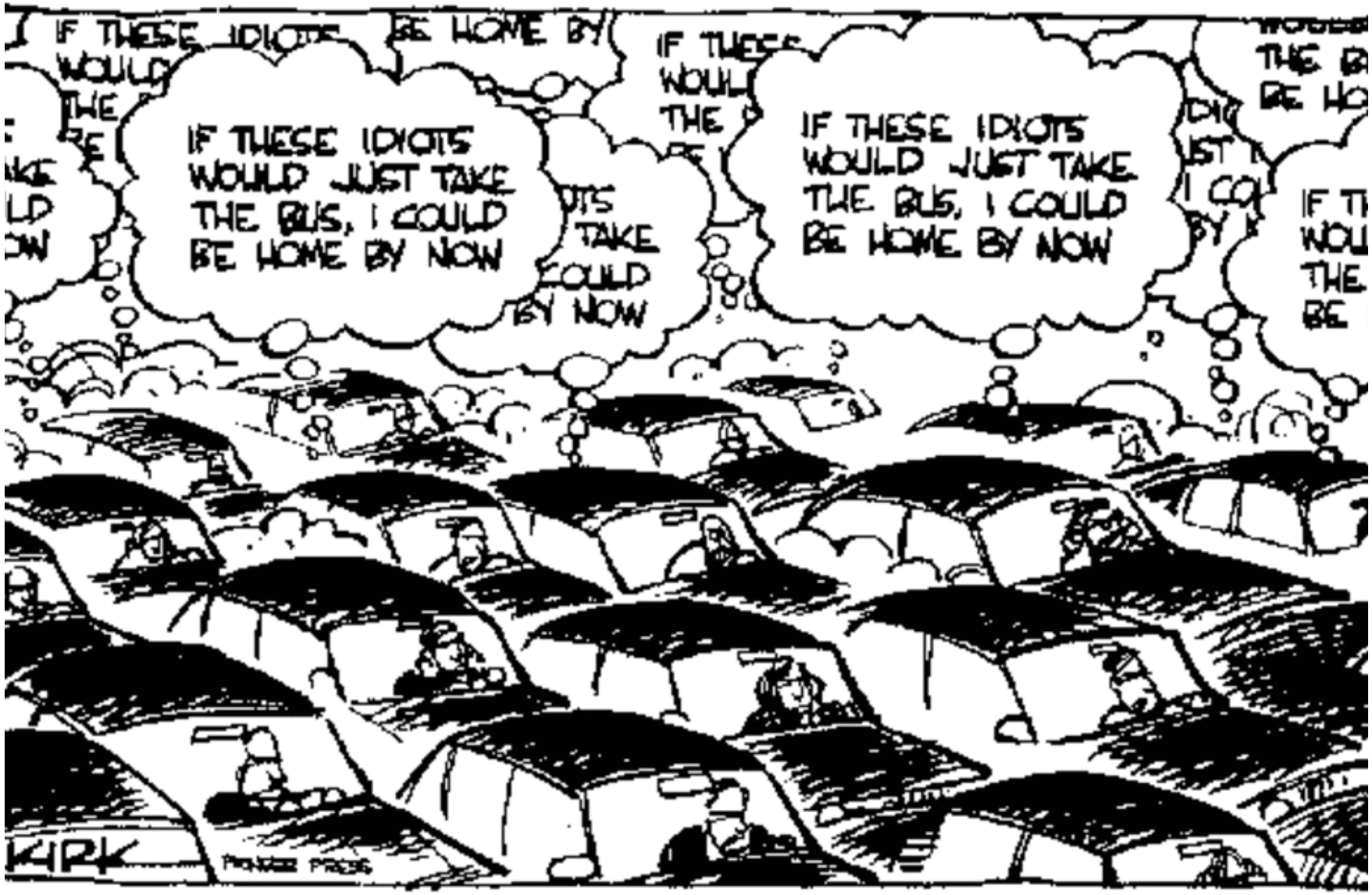
External trauma — “Fear of others”

Societal Health



Gun violence — ”Fear of ‘the other’”

Planetary Health



Tragedy of the Commons — ”Fear of use it or lose it”

The Last 60 Years

The Last 60 Years

Systemic Health

Hypertension
Fatty liver
Diabetes
Heart disease
Sleep disturbance
Cancer

The Last 60 Years

Systemic Health

Hypertension
Fatty liver
Diabetes
Heart disease
Sleep disturbance
Cancer

Mental Health

Addiction
Depression/Suicide
PTSD
Anxiety
Inattention/ADHD
Dementia

The Last 60 Years

Systemic Health

Hypertension
Fatty liver
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Mental Health

Addiction
Depression/Suicide
PTSD
Anxiety
Inattention/ADHD
Dementia

Societal Health

Nationalism/Authoritarianism
Cellphone Psychosis
Inequality/Poverty
School/Political Violence
Terrorism
Xenophobia/War

The Last 60 Years

Systemic Health

Hypertension
Fatty liver
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Inattention/ADHD
Dementia

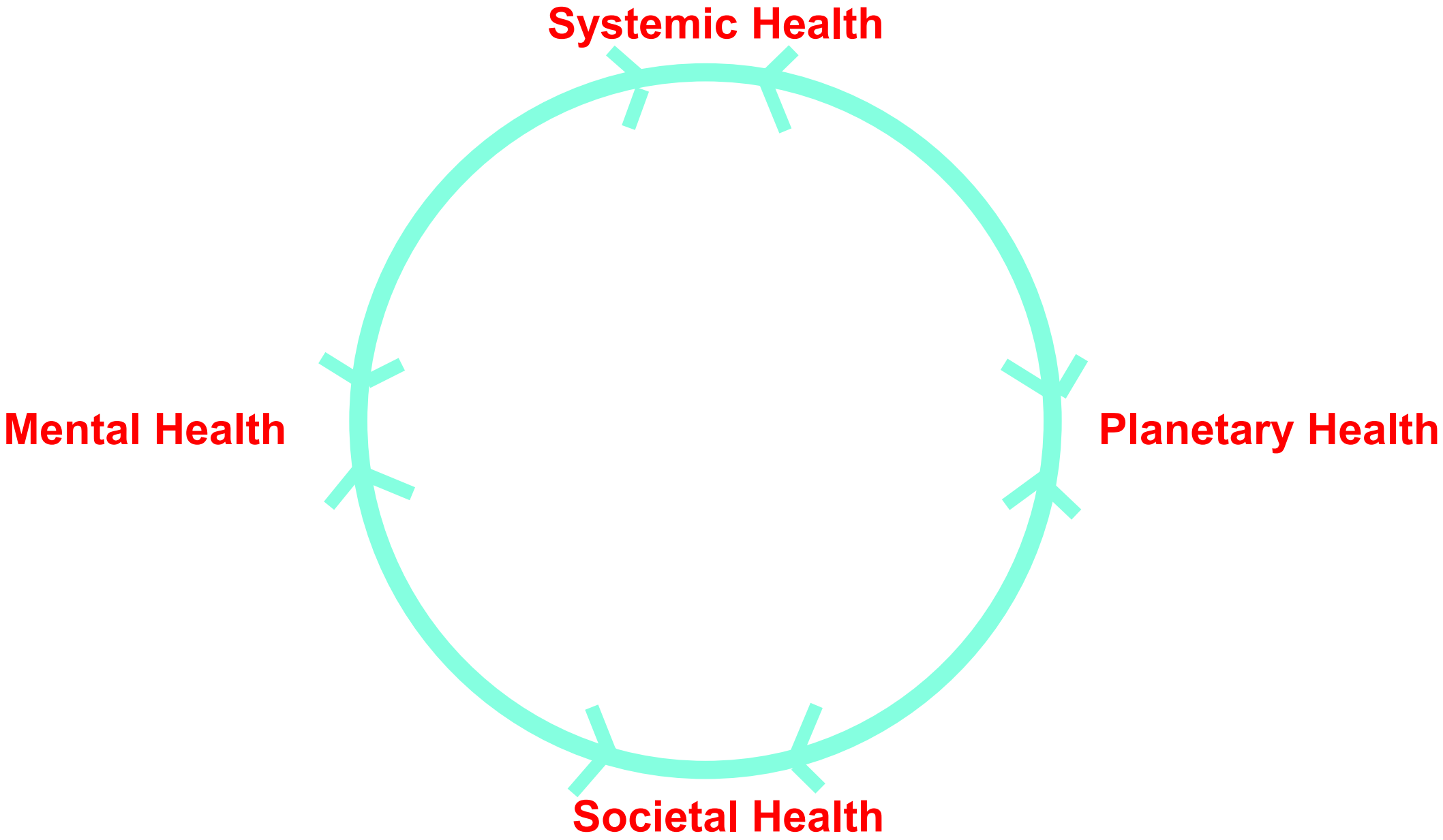
Societal Health

Nationalism/Authoritarianism
Cellphone Psychosis
Inequality/Poverty
School/Political Violence
Terrorism
Xenophobia/War

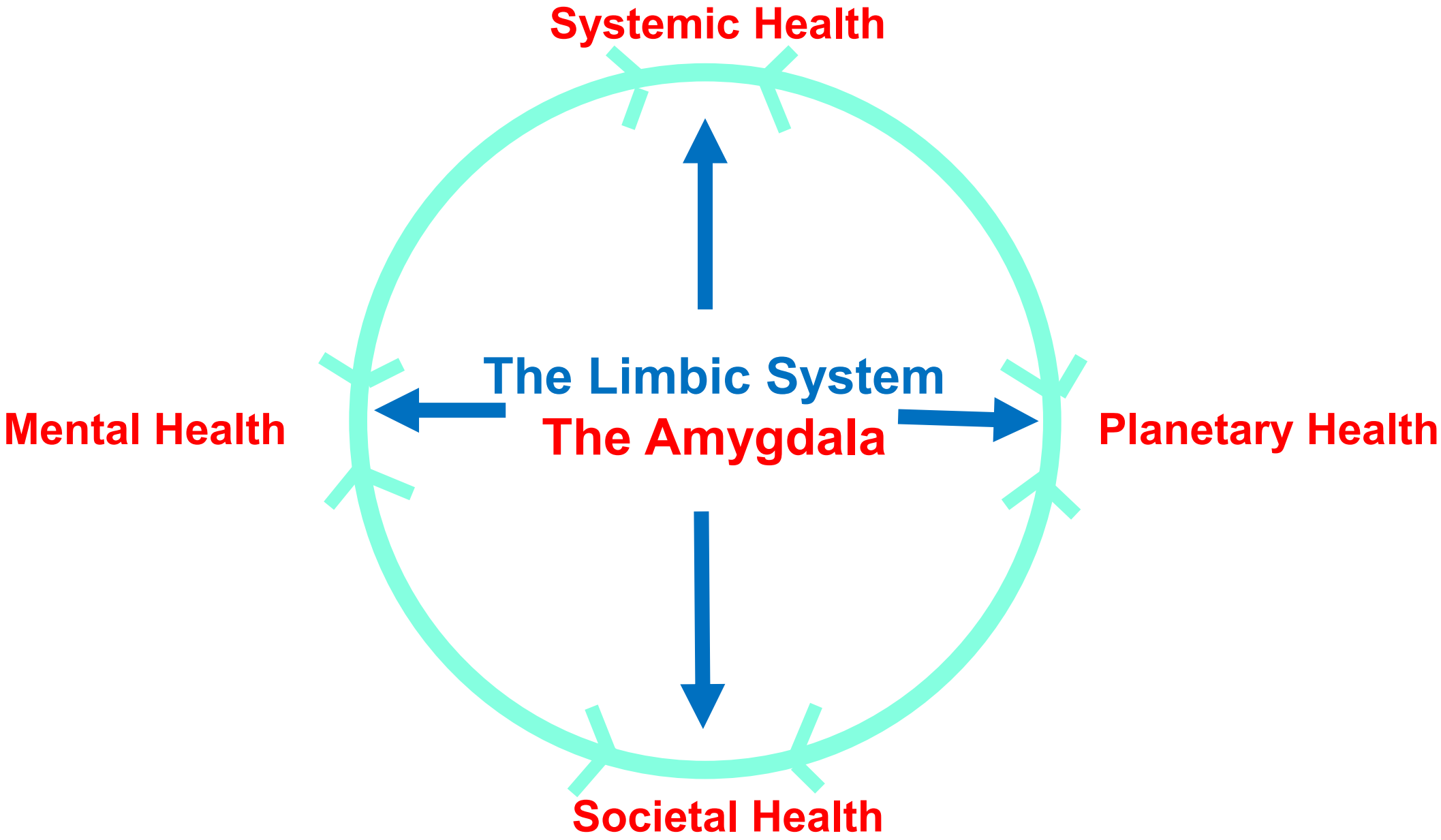
Planetary Health

Climate Change
Toxins
Pollutants
Soil Erosion/Degradation
Nitrogen Cycle Disruption
Species Extinction

What’s the causality?



What's the causality?



The evolution of fear

Fear Reinforcement – Basal Lateral Amygdala

The evolution of fear

Fear Reinforcement –
Basal Lateral Amygdala

Chronic Toxic Stress –
Central Amygdala

European Heart Journal (2013) **34**, 2697–2705
doi:10.1093/eurheartj/eht216

CLINICAL RESEARCH
Coronary artery disease

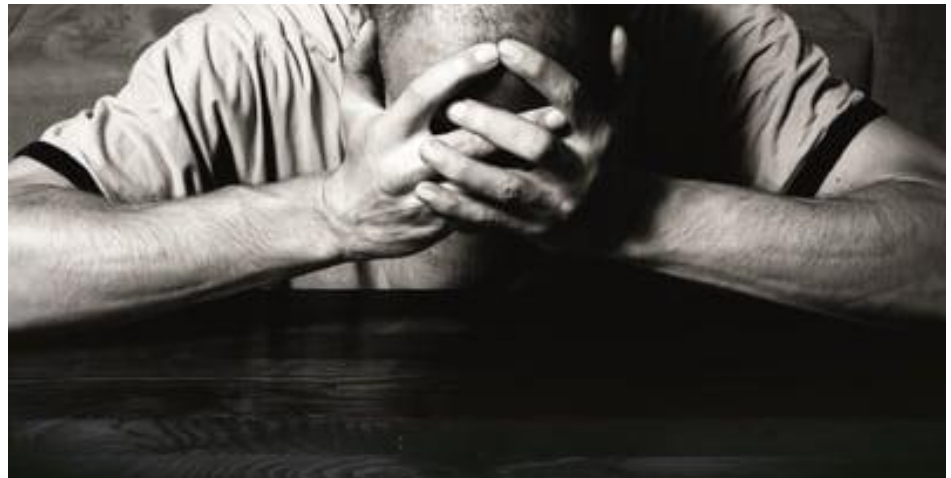
Increased risk of coronary heart disease among individuals reporting adverse impact of stress on their health: the Whitehall II prospective cohort study

Hermann Nabi[1,2*], Mika Kivimäki[3], G. David Batty[3,4], Martin J. Shipley[3], Annie Britton[3], Eric J. Brunner[3], Jussi Vahtera[5,6], Cédric Lemogne[1,7,8,9], Alexis Elbaz[1,2,3], and Archana Singh-Manoux[1,2,3,10]

Occup Environ Med 1999;**56**:302–307

Work characteristics predict psychiatric disorder: prospective results from the Whitehall II study

S A Stansfeld, R Fuhrer, M J Shipley, M G Marmot



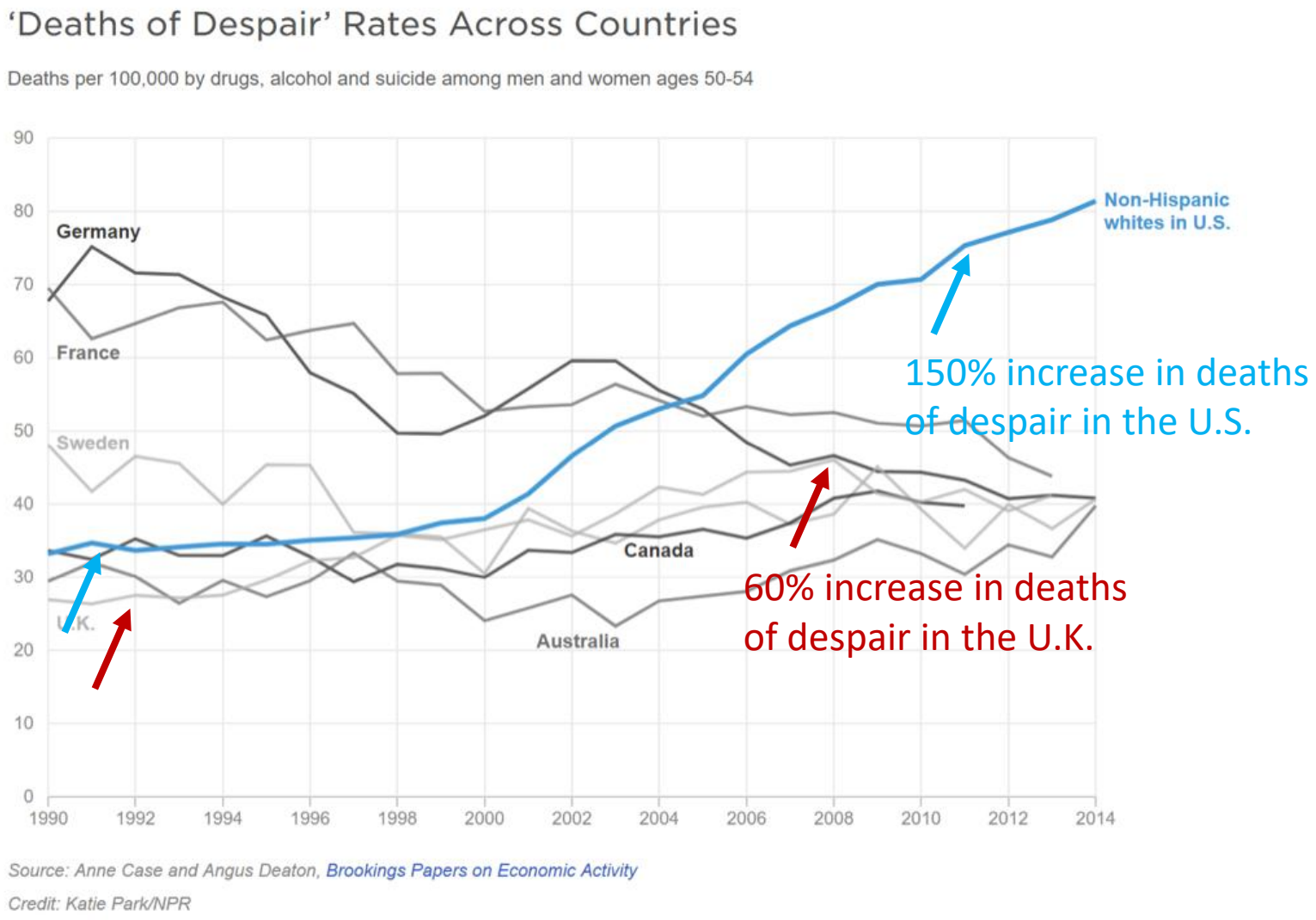
DEATHS OF DESPAIR

AND THE FUTURE OF CAPITALISM

ANNE CASE & ANGUS DEATON

Deaths of Despair

from drugs, alcohol, and suicide



Lindgren-Dwyer et al. JAMA 319:1013, 2018

Does happiness itself directly affect mortality? The prospective UK Million Women Study

Bette Liu, Sarah Floud, Kirstin Pirie, Jane Green, Richard Peto, Valerie Beral, for the Million Women Study Collaborators

Serious illness at baseline	**With illness**	**Without illness**	
Cancer	44481/9579	654583/136797	0·953 (0·924–0·982)
Heart disease	49035/13329	650029/133047	0·784 (0·763–0·806)
Stroke	11703/3501	687361/142875	0·748 (0·710–0·787)
Chronic obstructive lung disease	4924/1902	694140/144474	0·668 (0·621–0·718)
Current treatment at baseline	**Treated**	**Not treated**	
High blood pressure	153825/34249	545239/112127	0·928 (0·911–0·945)
Diabetes	22070/5854	676994/140522	0·863 (0·829–0·898)
Asthma	49919/13104	649145/133272	0·848 (0·825–0·871)
Arthritis	79848/22729	619216/123647	0·763 (0·747–0·780)
Depression or anxiety	29285/25628	669779/120748	0·224 (0·218–0·229)
Self-rated health at baseline	**Fair or poor**	**Excellent or good**	
Fair or poor	125393/62859	541004/76505	0·298 (0·293–0·303)

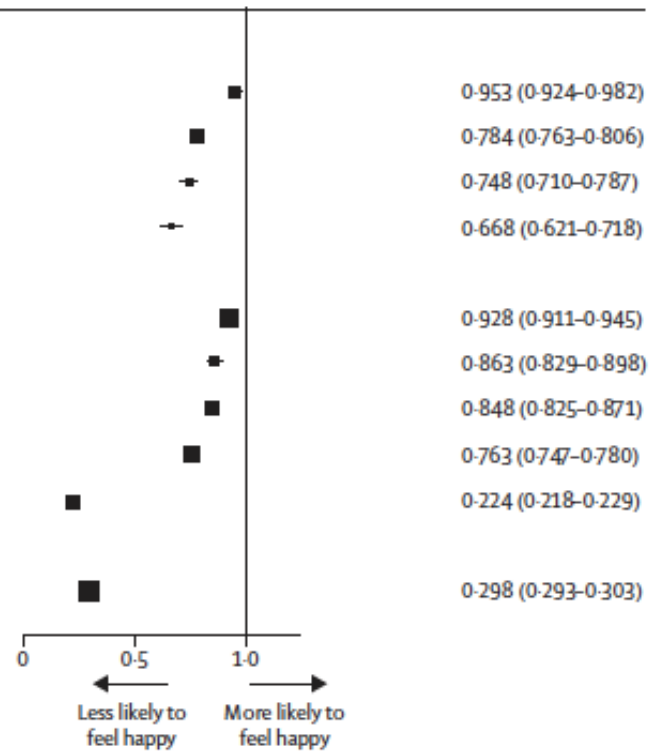


Figure 2: **Correlates of being generally happy—relevance of various indices of health at baseline**
Analysis for whole population (N=845 440), including women later excluded for life-threatening health disorders. ORs are adjusted for age, region, area deprivation, body-mass index, qualifications, strenuous exercise, smoking, alcohol, living with a partner, parity, participation in group activities, and sleep duration. OR=odds ratio.

Liu et al. Lancet 387:874, 2016

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Findings Of 719 671 women in the main analyses (median age 59 years [IQR 55–63]), 39% (282 619) reported being happy most of the time, 44% (315 874) usually happy, and 17% (121 178) unhappy. During 10 years (SD 2) follow-up, 4% (31 531) of participants died. Self-rated poor health at baseline was strongly associated with unhappiness. But after adjustment for self-rated health, treatment for hypertension, diabetes, asthma, arthritis, depression, or anxiety, and several sociodemographic and lifestyle factors (including smoking, deprivation, and body-mass index), unhappiness was not associated with mortality from all causes (adjusted RR for unhappy *vs* happy most of the time 0·98, 95% CI 0·94–1·01), from ischaemic heart disease (0·97, 0·87–1·10), or from cancer (0·98, 0·93–1·02). Findings were similarly null for related measures such as stress or lack of control.

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Liu et al. Lancet 387:874, 2016

The How — The Amygdala

What is the amygdala?

What is the amygdala?

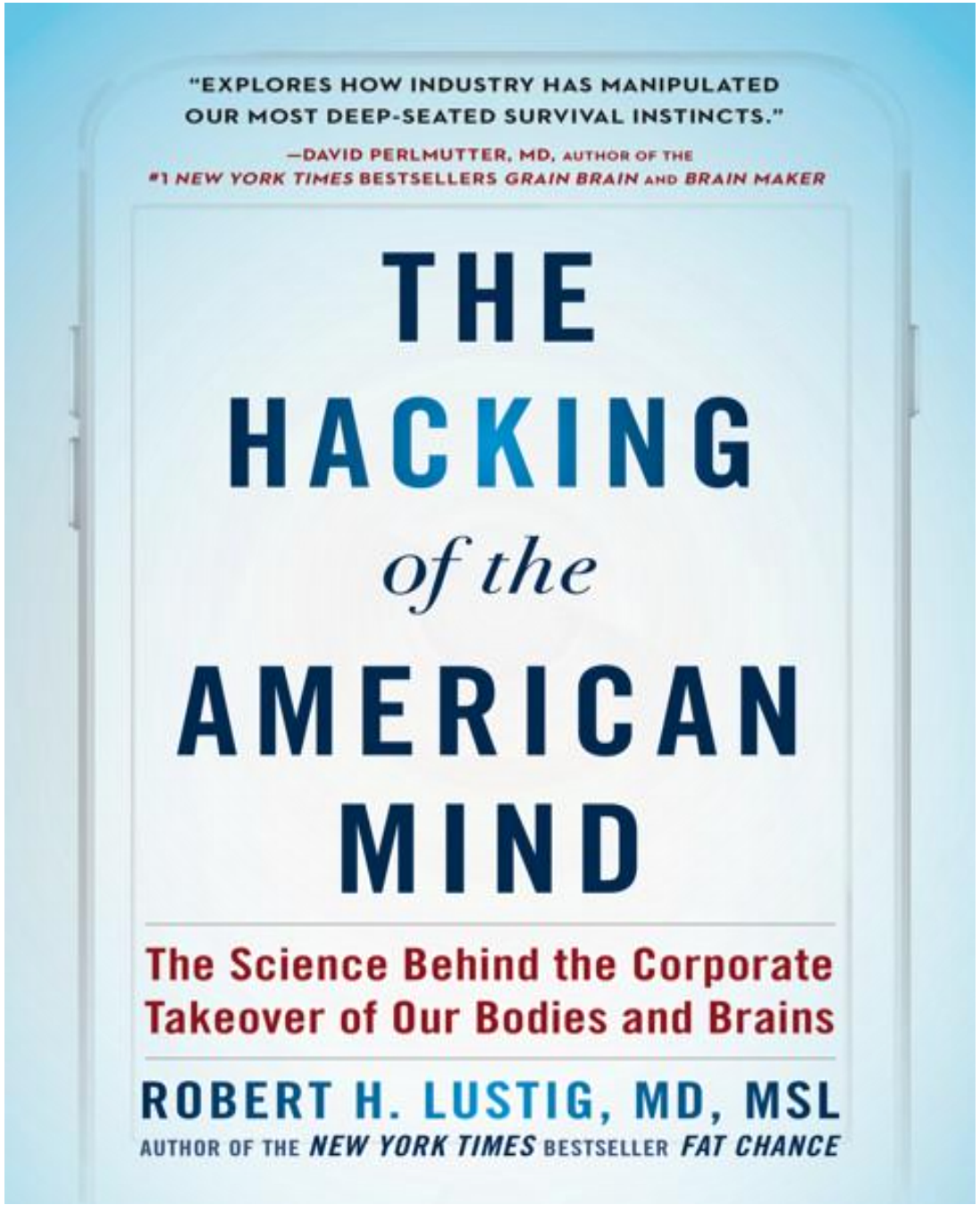
What is the amygdala?

What is the amygdala?

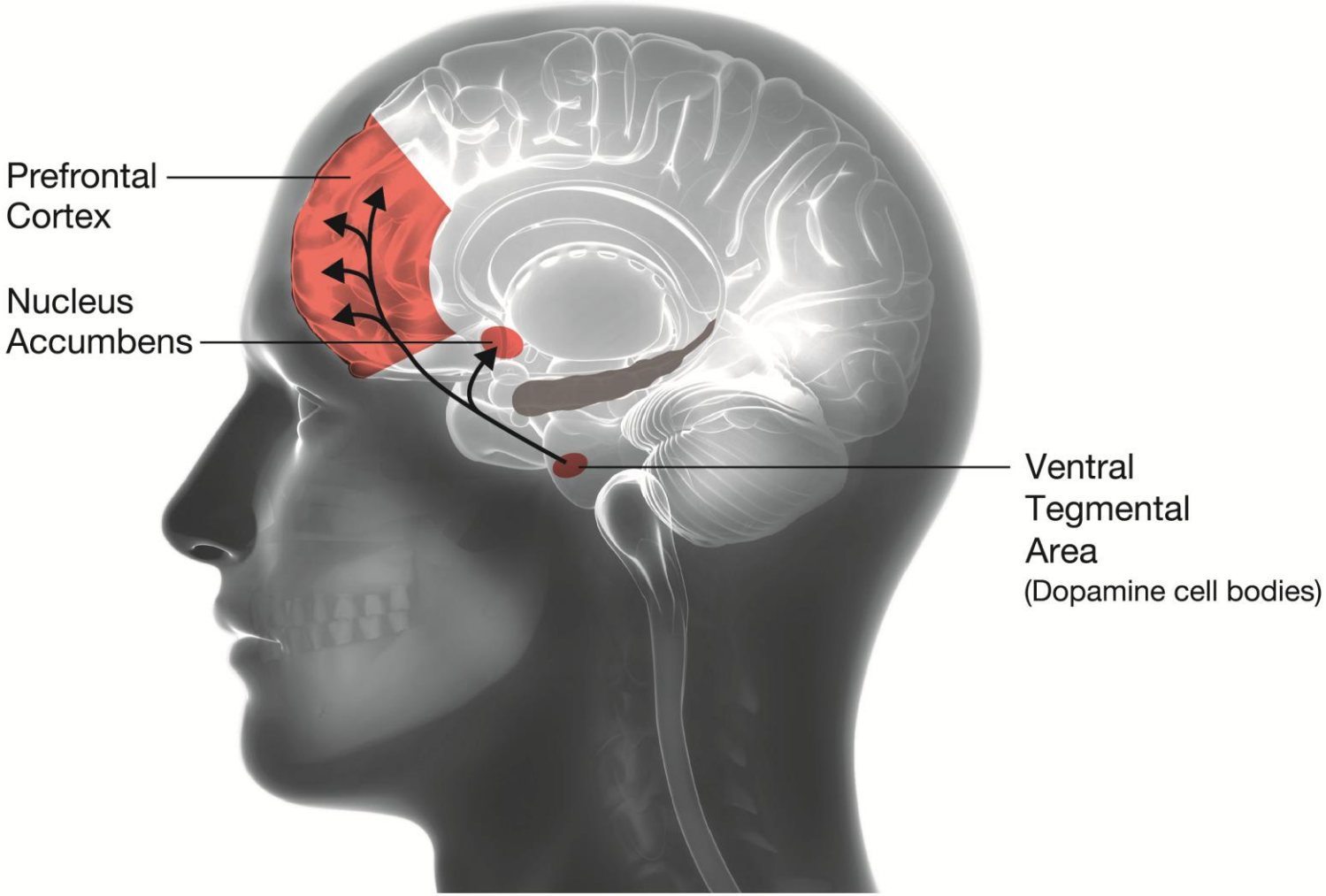
What is the amygdala?

What is the amygdala?

1. Sort mundane from novel
2. For novel: sort negative stimulus (pain) from positive (reward)
3. Site of new synapse formation for reinforcement learning (by dopamine)

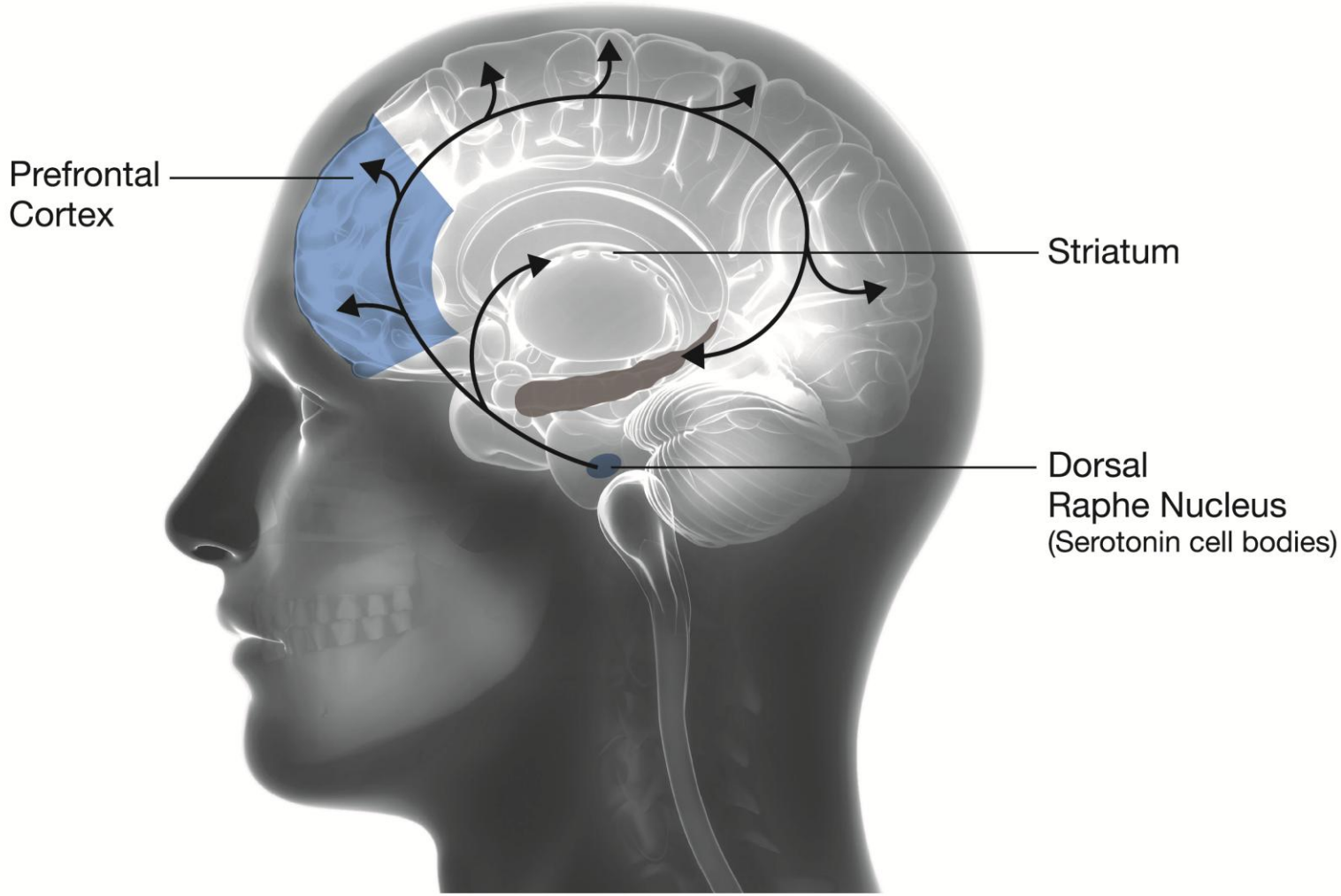

"EXPLORES HOW INDUSTRY HAS MANIPULATED
OUR MOST DEEP-SEATED SURVIVAL INSTINCTS."
—DAVID PERLMUTTER, MD, AUTHOR OF THE
#1 NEW YORK TIMES BESTSELLERS GRAIN BRAIN AND BRAIN MAKER
THE
HACKING
of the
AMERICAN
MIND
The Science Behind the Corporate
Takeover of Our Bodies and Brains
ROBERT H. LUSTIG, MD, MSL
AUTHOR OF THE NEW YORK TIMES BESTSELLER FAT CHANCE

Reward Pathway
Dopamine



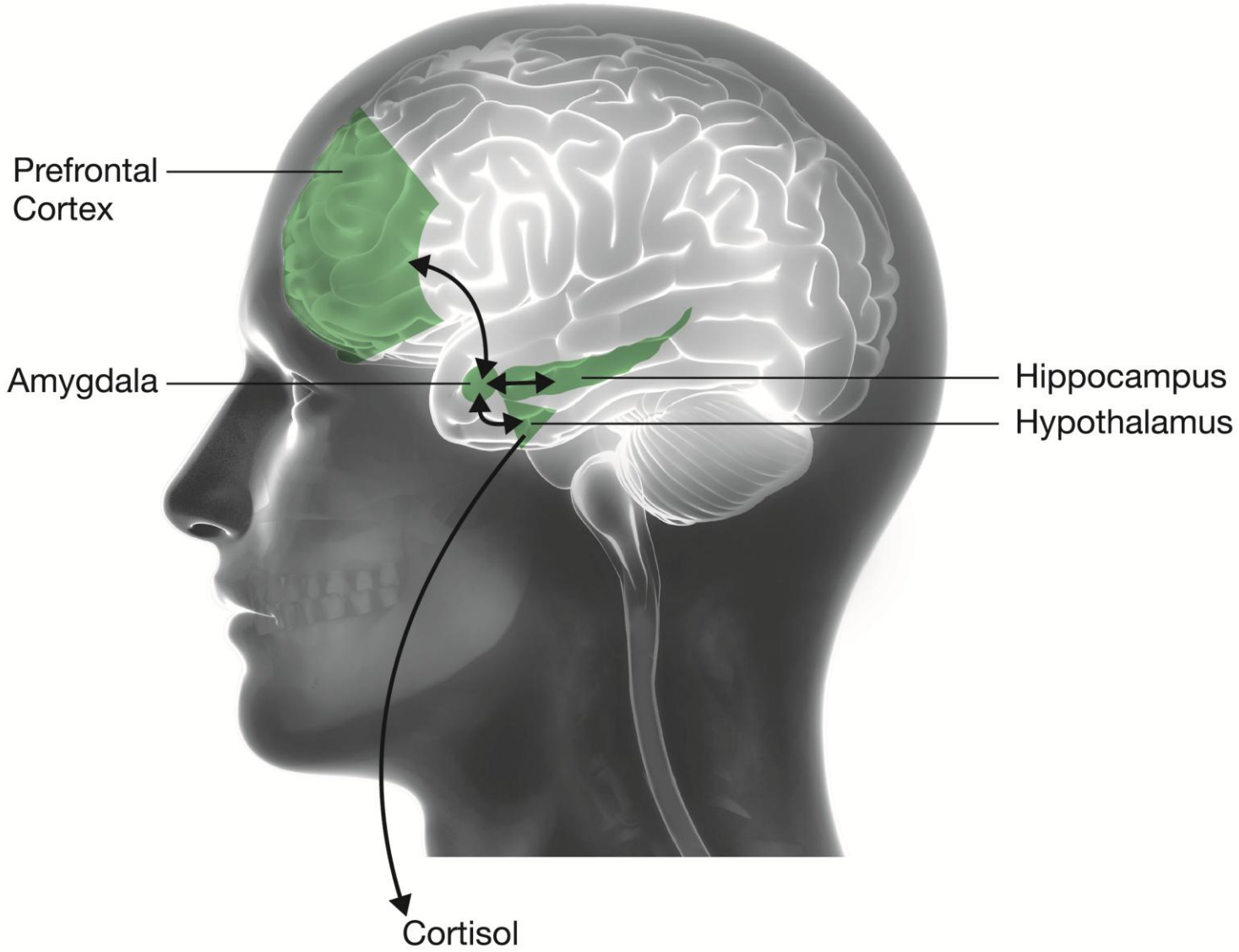
Lustig, The Hacking of the American Mind, Avery Press, 2017

Contentment Pathway
Serotonin



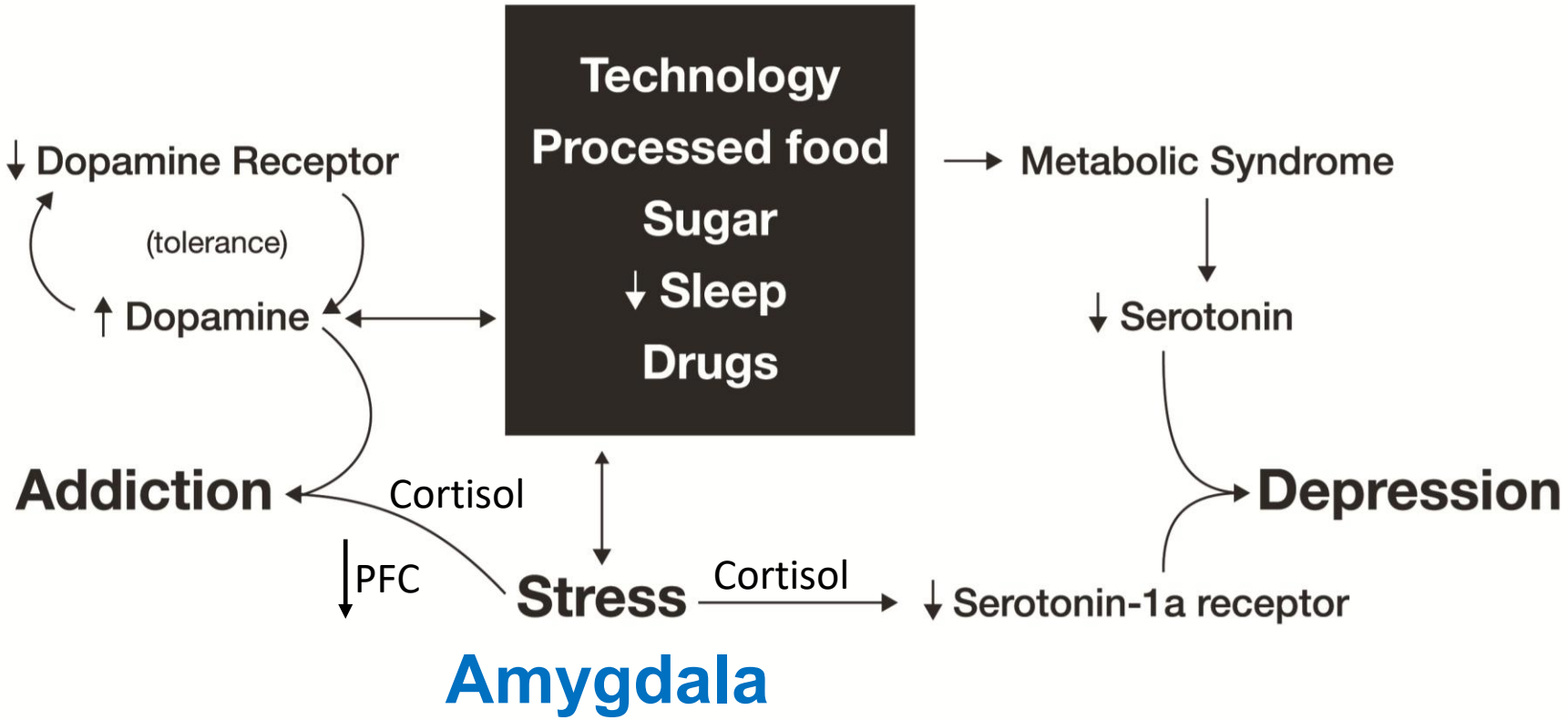
Lustig, The Hacking of the American Mind, Avery Press, 2017

Stress-Fear-Memory Pathway
Cortisol



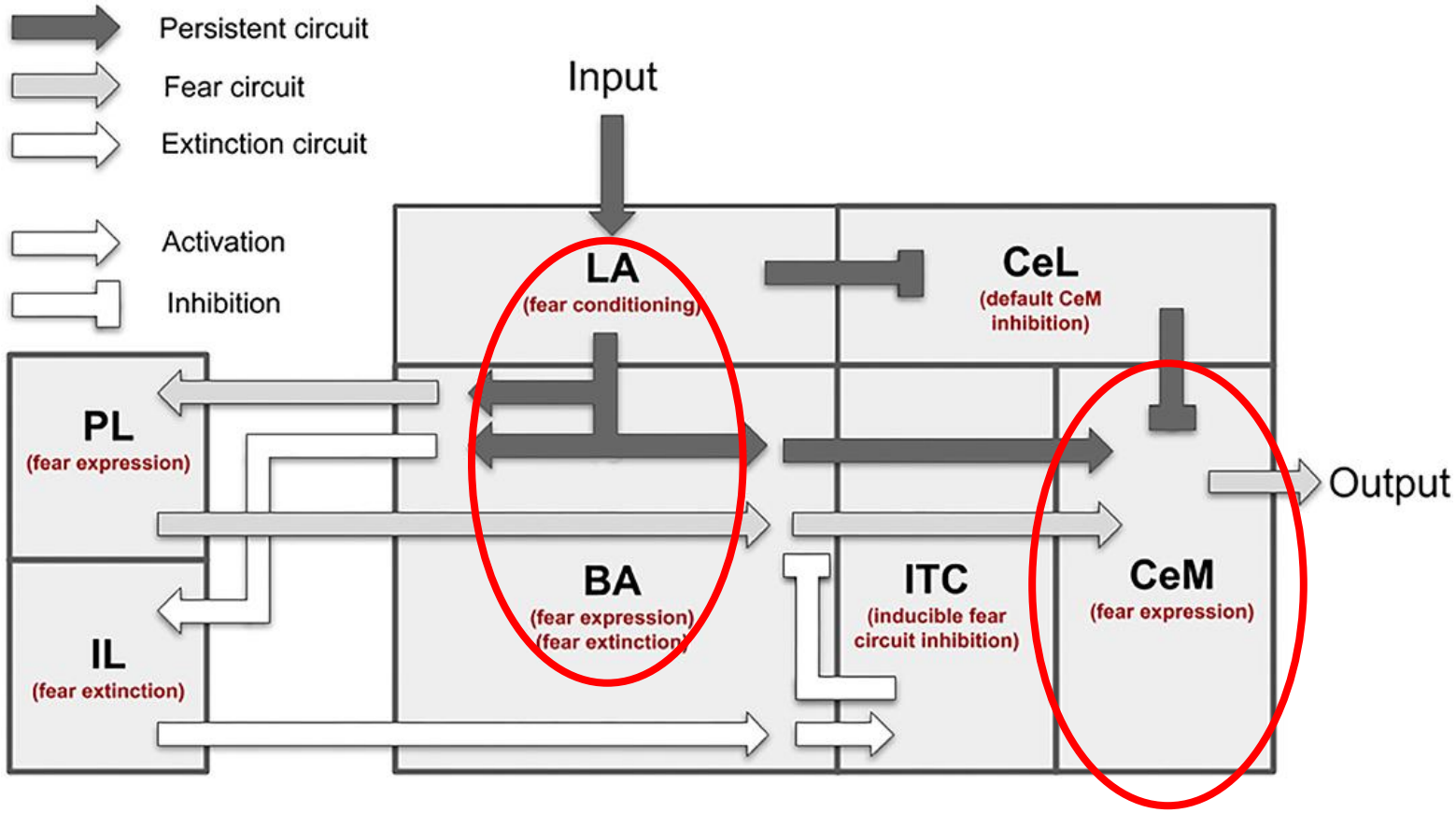
Lustig, The Hacking of the American Mind, Avery Press, 2017

The dopamine-cortisol-serotonin interaction



Lustig, The Hacking of the American Mind, Avery Press, 2017

Fear Conditioning in the Amygdala



Input (CS, US) is conveyed from LA to CeL through three main circuits:
a persistent circuit (LA-BA-CeM and LA-CeL-CeM),
a fear circuit (LA-BA-PL-BA-CeM),
an extinction circuit (BA-IL-BA-ITC-BA-CeM),

Mattera et al. Front. Syst. Neurosci. 14:65, 2020

Doesn't explain what's changed in last 60 years

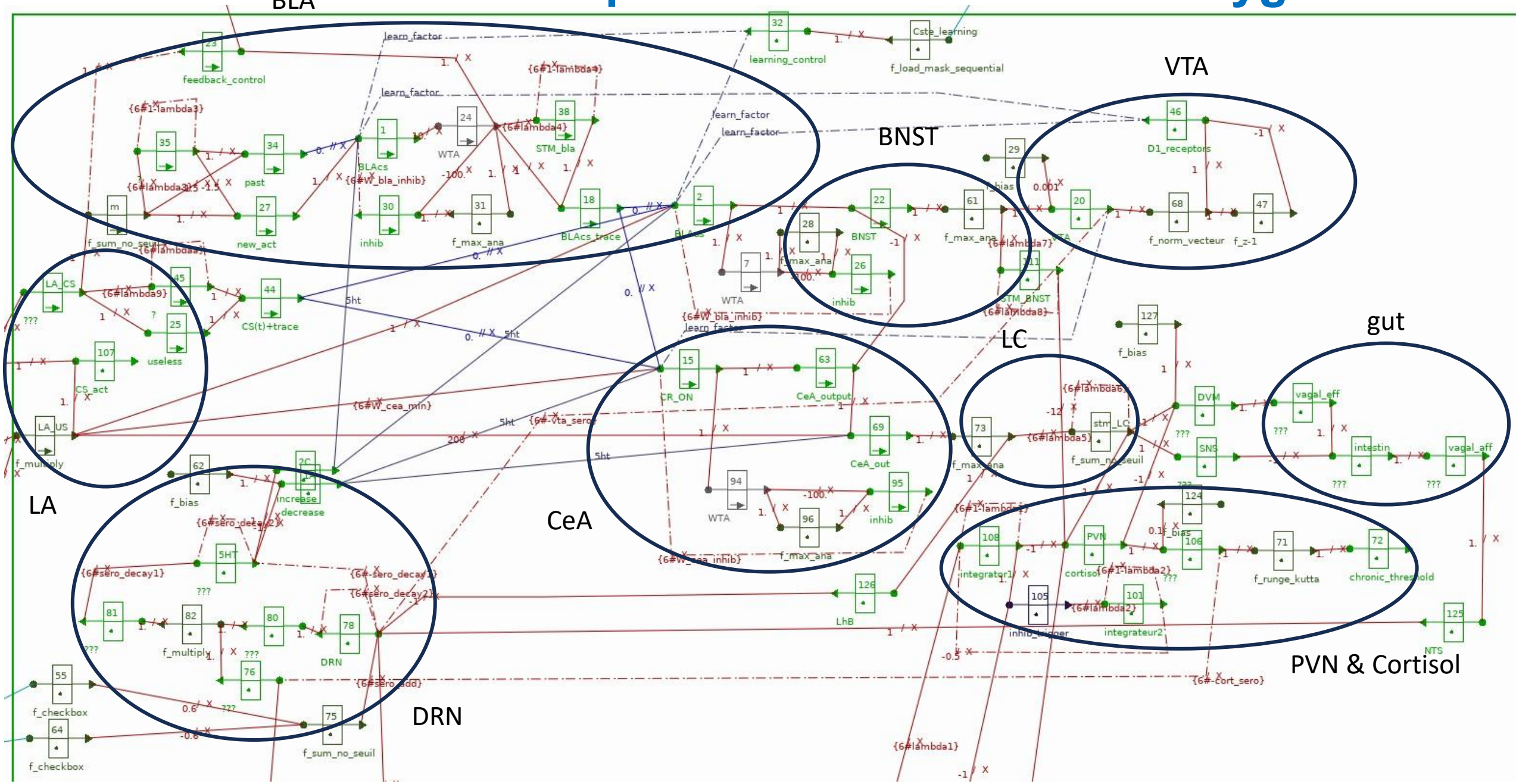
FULBRIGHT
COMMISSION FRANCO-AMÉRICAINE
& Université / / Paris Seine

etis
Cergy-Pontoise

iea institut d'études avancées
université de Cergy-Pontoise

Prof. Philippe Gaussier
ETIS (Equipe Traitement de l'Information et Systèmes)
CY Cergy Université, Paris, France

Computational model of the amygdala



Four Brakes on the Amygdala

Four Brakes on the Amygdala

Four Brakes on the Amygdala

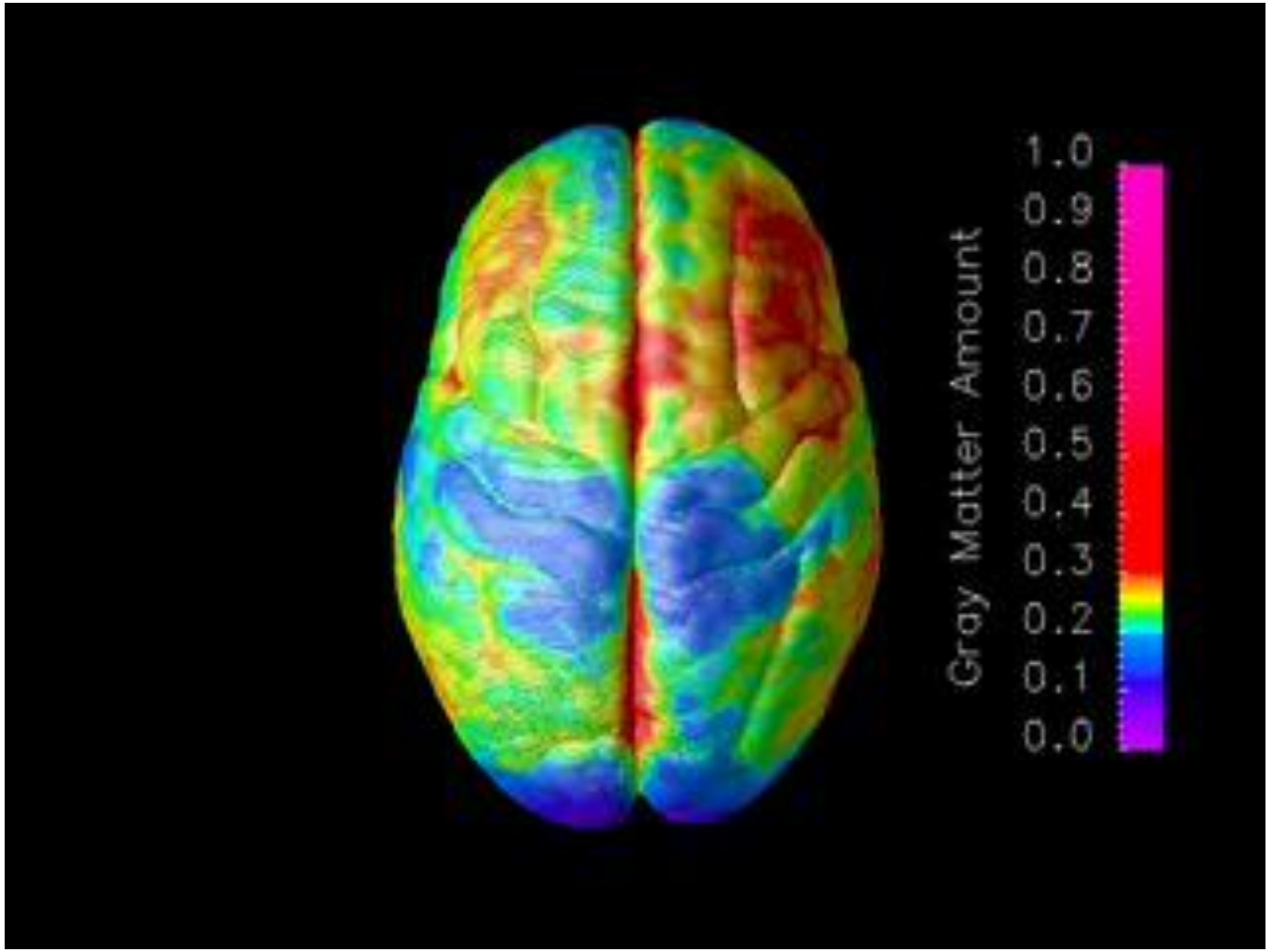
Four Brakes on the Amygdala

Four Brakes on the Amygdala

Four Brakes on the Amygdala

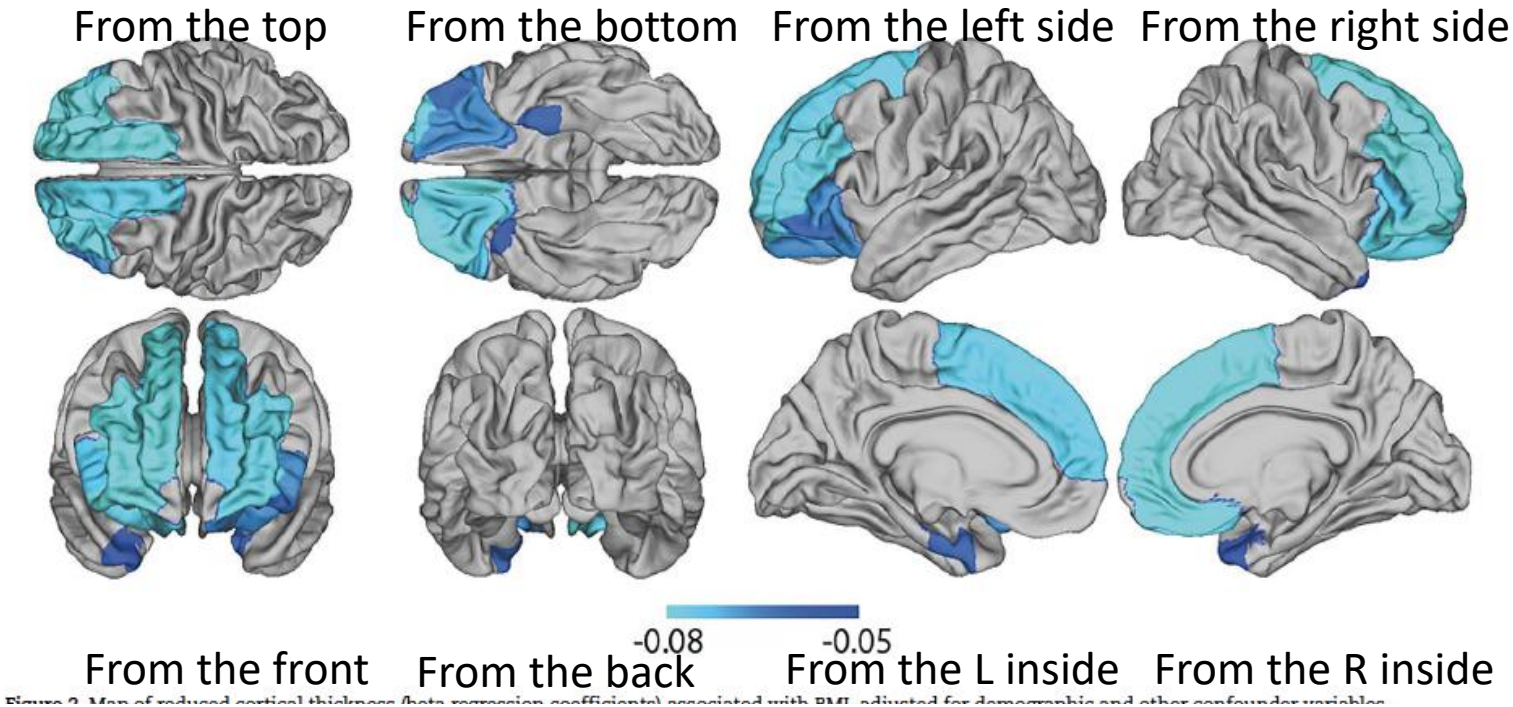
- 1. Prefrontal Cortex (reasoning)

Ontogeny recapitulates phylogeny: The PFC is the last area to develop, and the last to myelinate



Gogtay et al, Proc Natl Acad Sci 101:8174, 2004

Cortical thickness and BMI



Cortical thickness and executive function

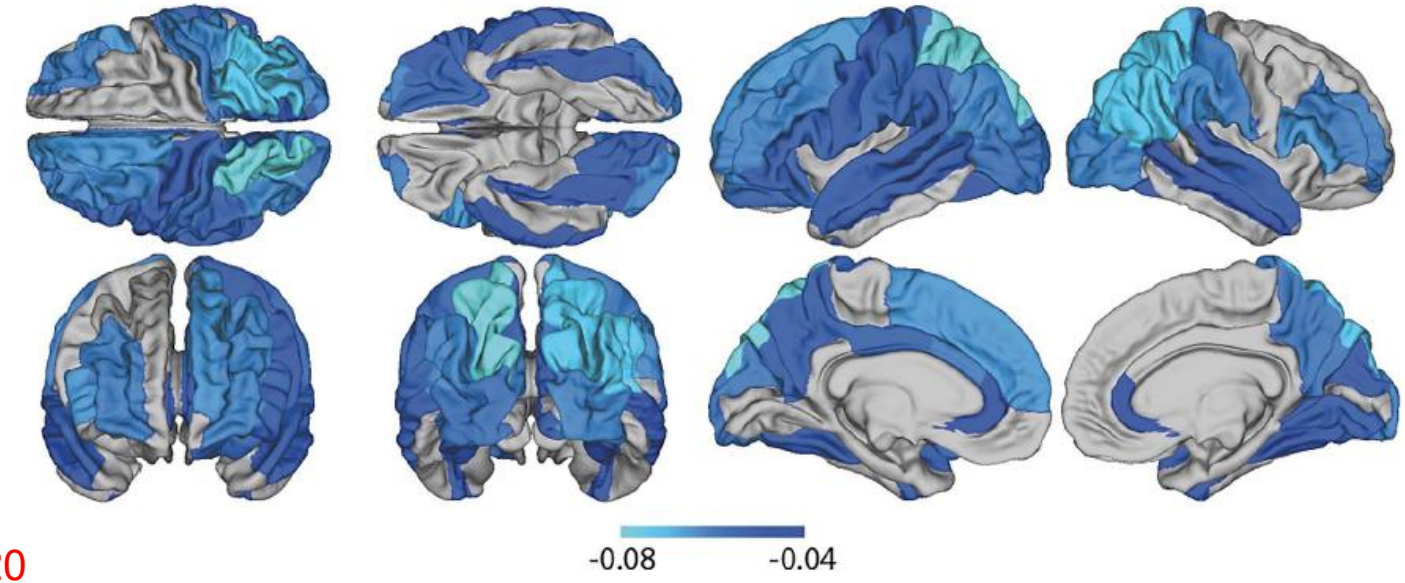


Figure 3. Map of reduced cortical thickness (beta regression coefficients) associated with executive function adjusted for demographic and other confounder variables.

Ronan et al.
Cerebral Cortex, 30:2519, 2020

Reduced PFC function in adolescents with metabolic syndrome

Table 2. Domain scores by MetS classification group.

	No MetS ($n = 204$)	MetS ($n = 84$)	p	Effect Size (r)
Memory	100.88 (13.86)	97.94 (15.55)	0.195	0.08
Processing Speed	100.57 (13.46)	100.64 (13.14)	0.774	0.03
Executive Function	101.47 (14.34)	96.97 (15.43)	0.020	0.15
Reaction Time	100.39 (13.69)	101.03 (12.81)	0.790	0.02
Complex Attention	103.93 (10.17)	101.32 (11.25)	0.109	0.11
Cognitive Flexibility	101.61 (14.20)	96.53 (16.00)	0.020	0.15
Verbal Memory	100.68 (14.07)	98.18 (15.19)	0.225	0.07
Visual Memory	100.18 (14.92)	99.21 (14.41)	0.674	0.03

Yau et al. Pediatrics 130:e856, 2012

Four Brakes on the Amygdala

- 1. Prefrontal Cortex (reasoning)
- 2. Hippocampus (memory)

Hippocampus and Stress

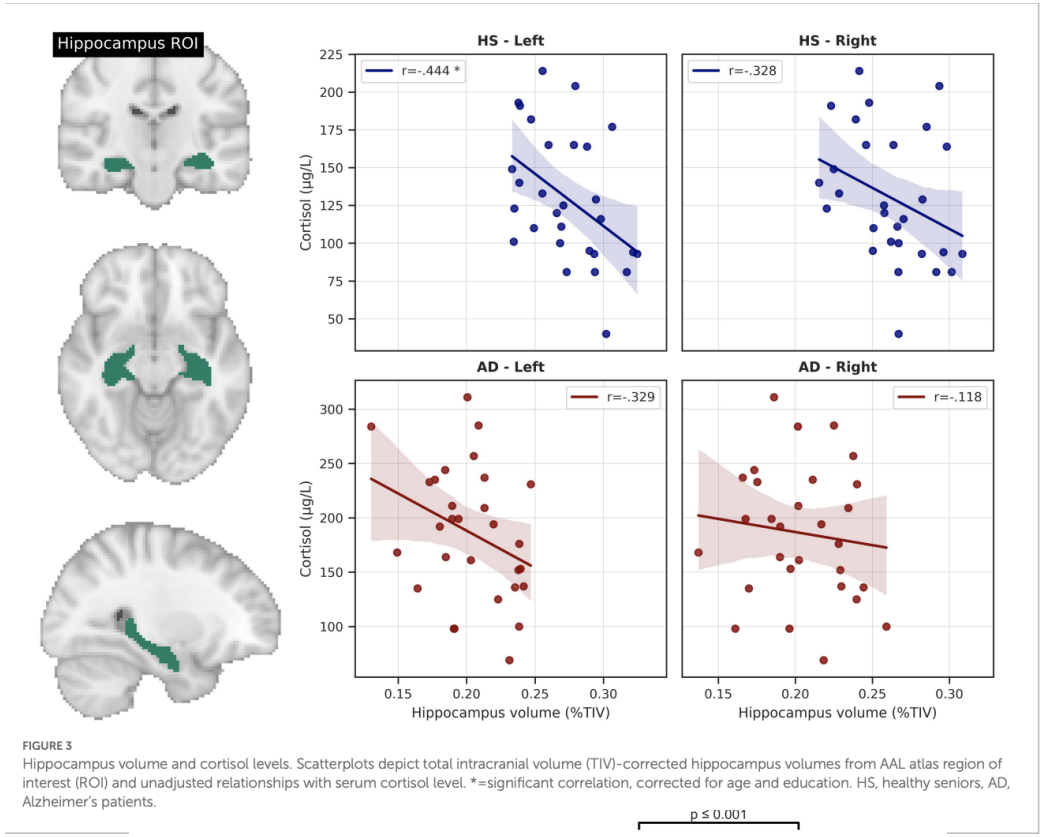
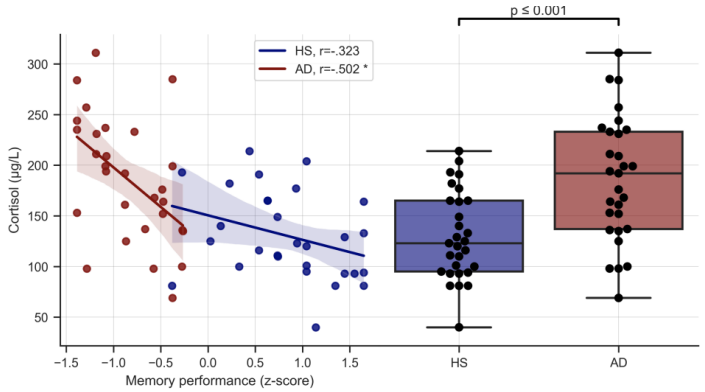


FIGURE 3
Hippocampus volume and cortisol levels. Scatterplots depict total intracranial volume (TIV)-corrected hippocampus volumes from AAL atlas region of interest (ROI) and unadjusted relationships with serum cortisol level. *=significant correlation, corrected for age and education. HS, healthy seniors, AD, Alzheimer's patients.



Dronse et al. Front Aging Neurosci. 15:1154112, 2023

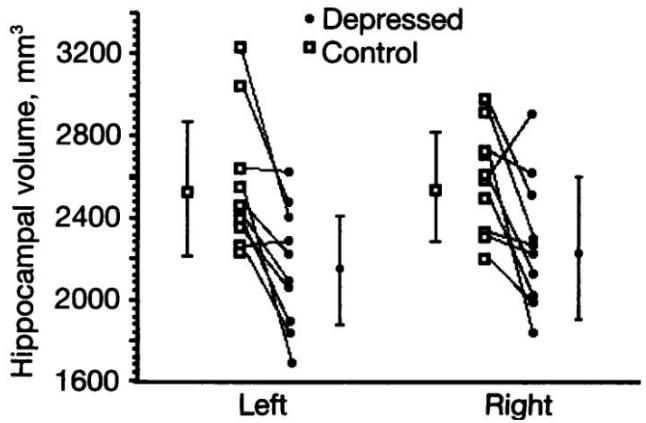


FIG. 2. Left and right hippocampal volumes for each subject pair of depressed subject and the age, gender, education, and height-matched case control; the mean and SD for each group are also shown.

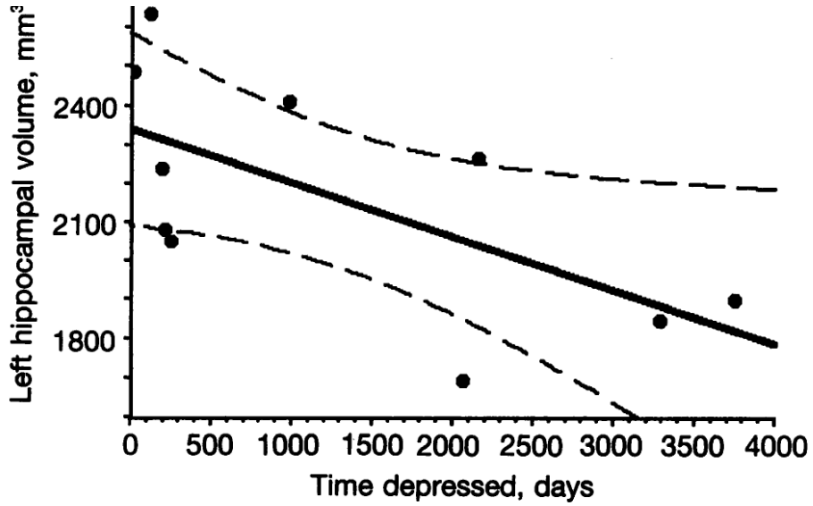


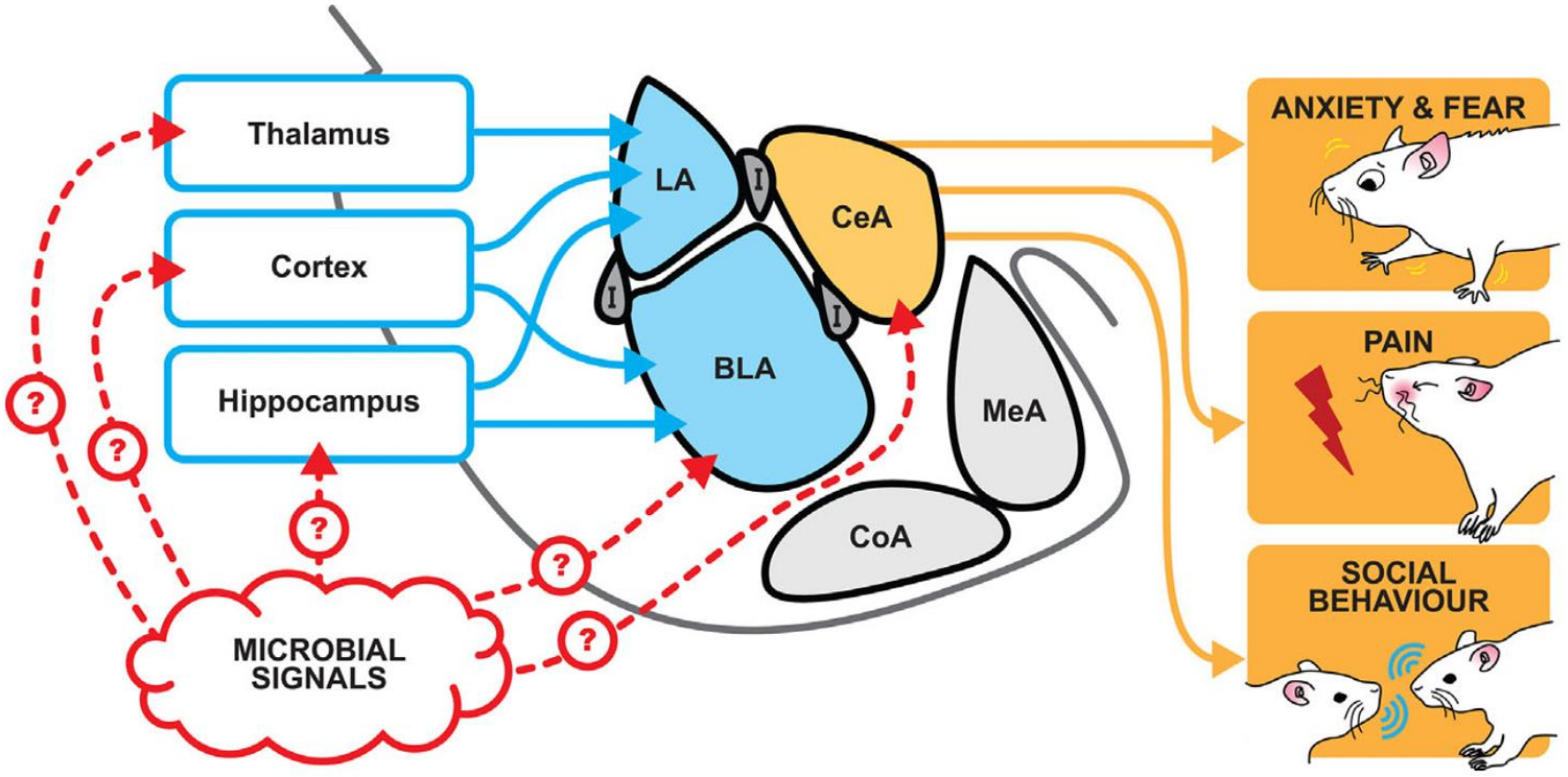
FIG. 3. Correlation between left hippocampal gray matter volumes and total days of major depression.

Sheline et al. Proc Natl Acad Sci. 93(9):3908, 1996

Four Brakes on the Amygdala

- 1. Prefrontal Cortex (reasoning)
- 2. Hippocampus (memory)
- 3. Afferent Vagus (interoception)

The amygdala is one of the mediators of the effects of the microbiome on behavior

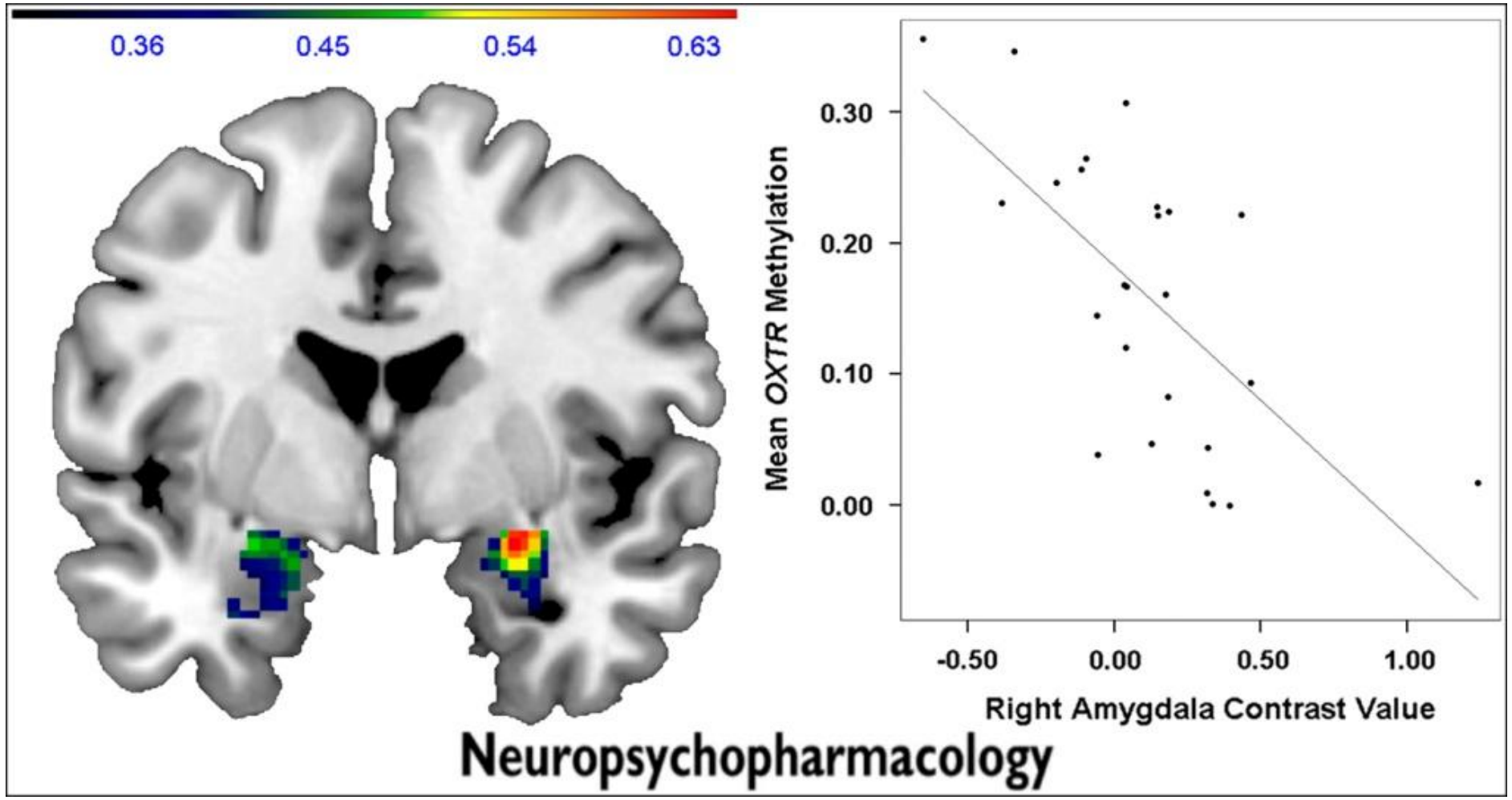


Cowan et al. Bioessays 40(1), doi: 10.1002/bies.201700172, 2017

Four Brakes on the Amygdala

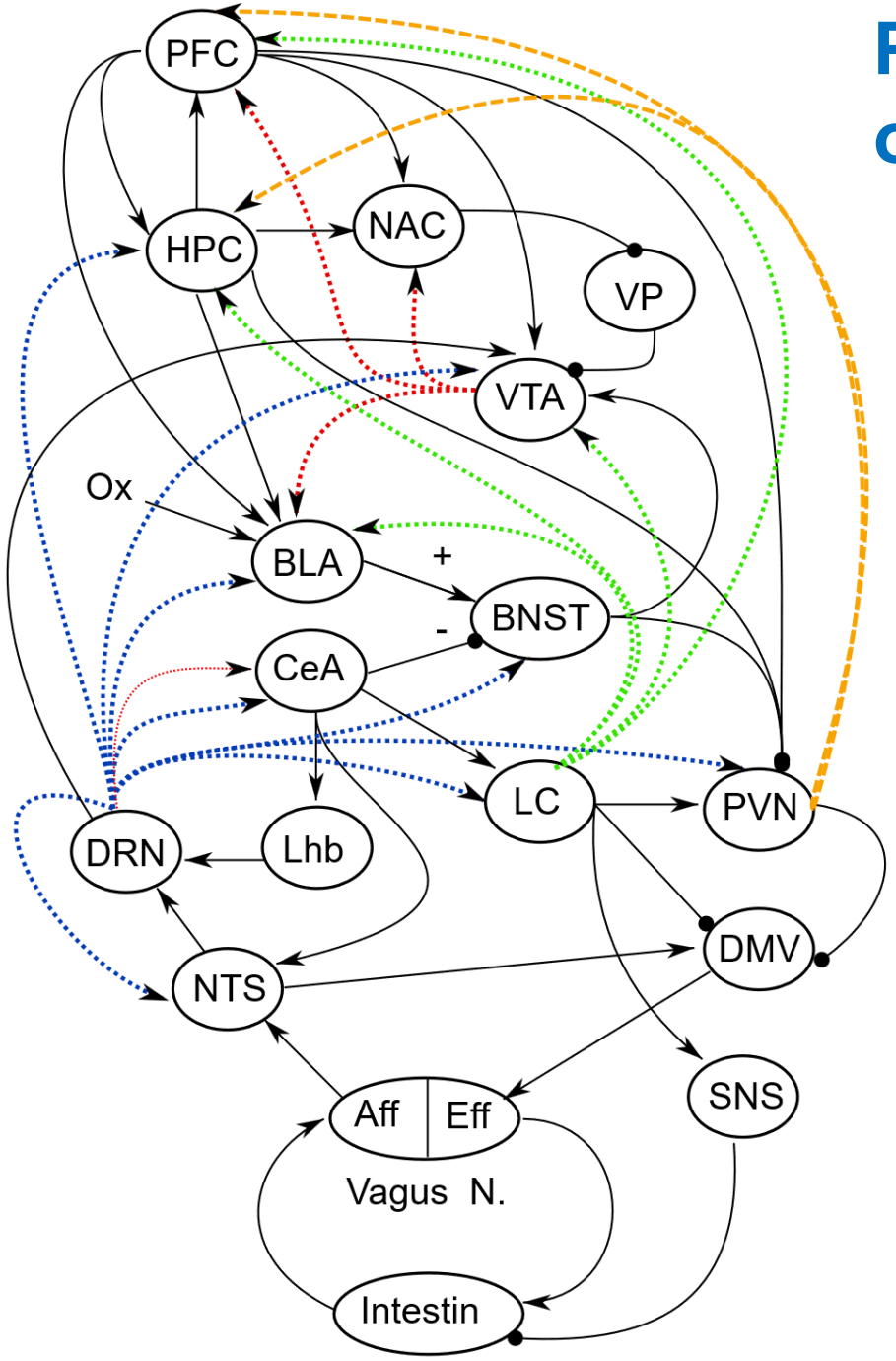
- 1. Prefrontal Cortex (reasoning)
- 2. Hippocampus (memory)
- 3. Afferent Vagus (interoception)
- 4. Oxytocin (safety)

Oxytocin Receptor Gene Methylation: Converging Multilevel Evidence for a Role in Social Anxiety



Ziegler et al., Neuropsychopharmacology 40:1528, 2015

Philippe and Rob's Computational Model of the Limbic System



excitatory connectionx

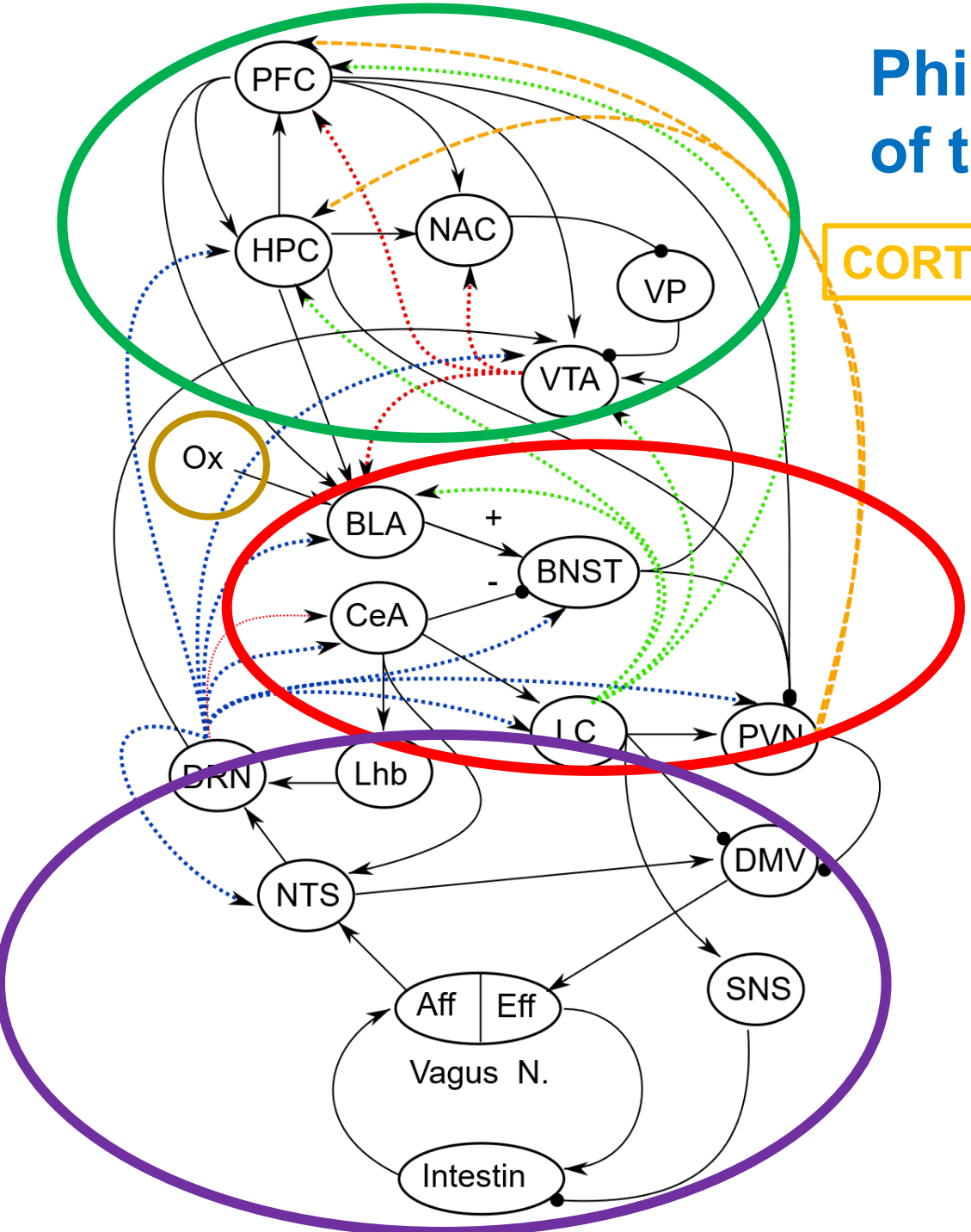
inhibitory connections

5HT

DA

NE

Philippe and Rob's Computational Model of the Limbic System



CORTISOL

excitatory connectionx

inhibitory connections

5HT

DA

NE

The Cerebral Control Brakes (PFC, HPC)

The Amygdala

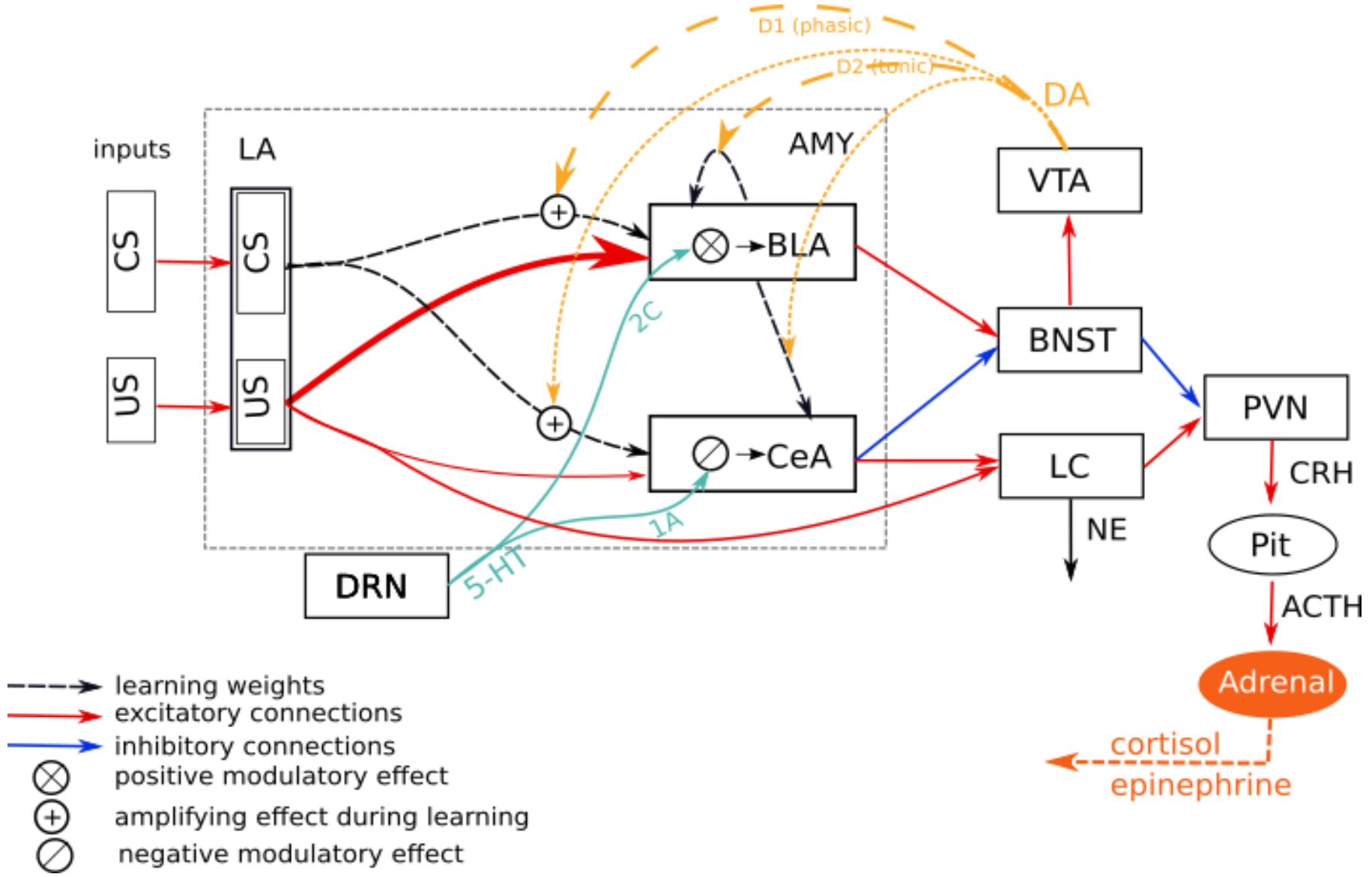
The Visceral Control Brakes (Afferent Vagus)

*Polyvagal Theory, Stephen Porges

Setting the Amplitude

*Oxytocin Imprinting, Sue Carter

Philippe and Rob's Computational Model of the Amygdala



All Four Brakes on the Basolateral Amygdala are Now Defective

- 1. Prefrontal Cortex (reasoning) — dopamine, cortisol, toxins
- 2. Hippocampus (memory) — cortisol, toxins
- 3. Afferent Vagus (interoception) — tryptophan/serotonin def., microbiome
- 4. Oxytocin (safety) — cortisol (methylation of OXTR)

- PLUS: Cortisol increases CRF, hypersensitizes the Central Nucleus of the Amygdala (CeA)
  - causes **hyperkatifeia** (emotional pain, mediated through the Spino-Parabracheo-Amygdaloid (SPA) Pathway)

The Why — Bioenergetics

Reactive Oxygen Species (ROS)

Mitochondrial Dysfunction / Energy Diversion

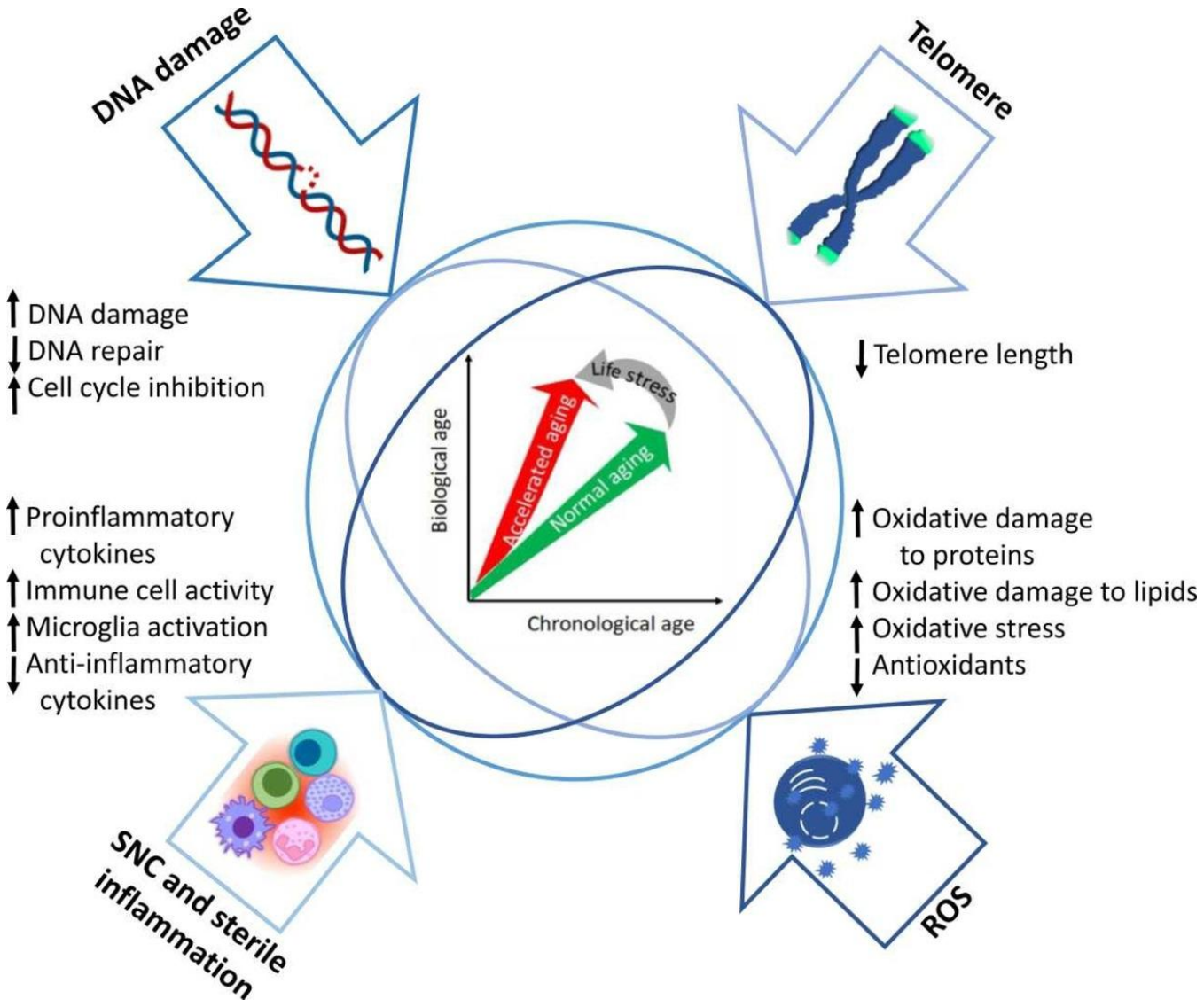
Adenosine Triphosphate (ATP) Depletion

Why neurons are such “gas-guzzlers”

- **Malate-aspartate shuttle**
  - *gets NAD^+ inside the mitochondria*
- **Glutamate/glutamine cycle**
  - *converts glutamate (excitatory) into GABA (inhibitory)*
- **Axonal transport**
  - *powers microtubules and molecular motors (myosins, kinesins, and dyneins)*
- **Synaptic plasticity**
  - *synthesis, remodelling, and recycling of phospholipids*
- **Synaptic transmission**
  - *restoring ionic equilibrium after action potential*

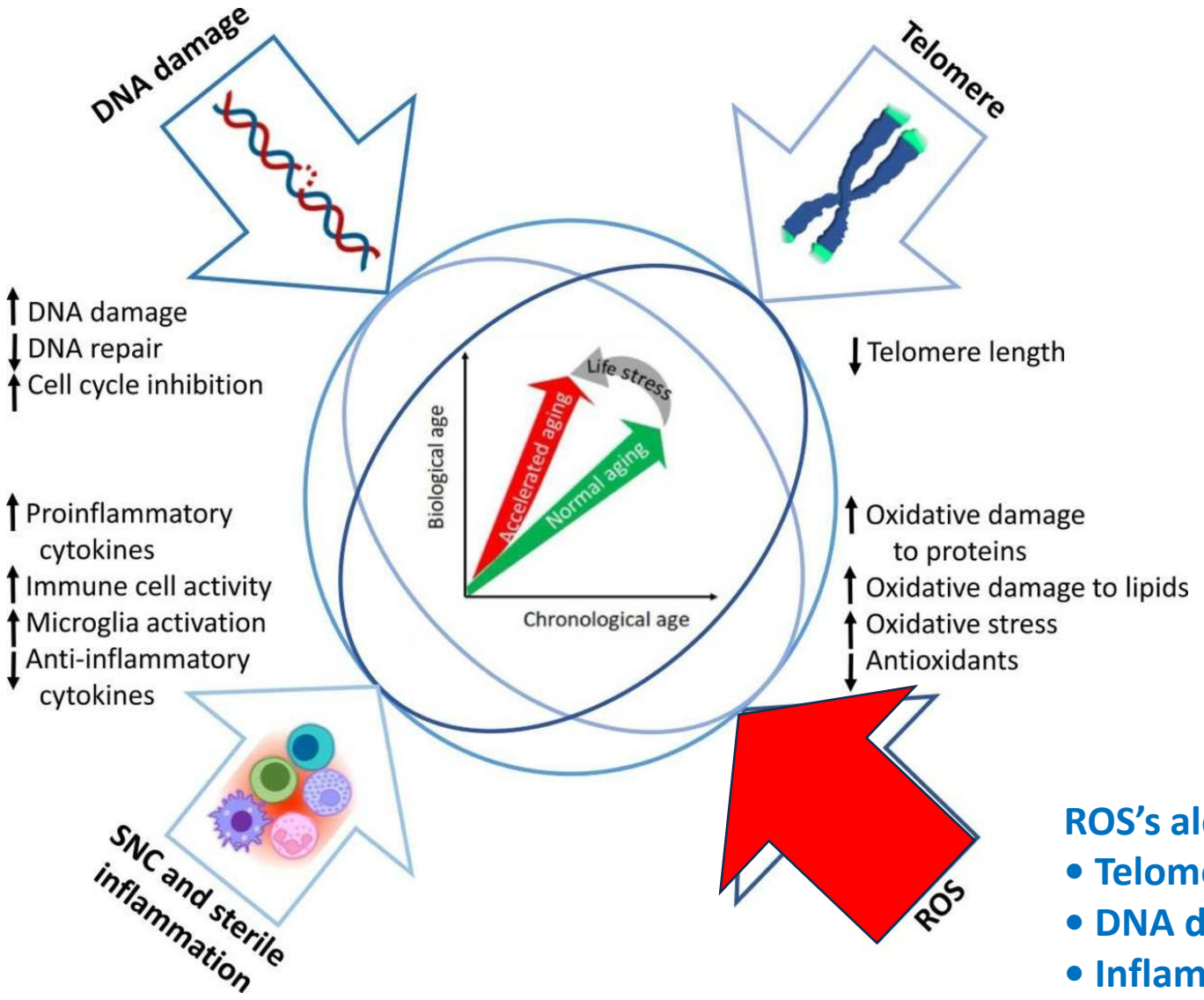
Walker, Int. J. Mol. Sci. 2025, 26, 7328

Stress is a Primary Driver of Chronic Disease



Lyons et al. Neurosci Biobehav Rev 153:105359, 2023

Stress is a Primary Driver of Chronic Disease
ROS's are a primary intermediate



ROS's alone cause

- **Telomere shortening**
- **DNA damage**
- **Inflammation**
- **Most importantly, mitochondrial dysfunction**

Lyons et al. Neurosci Biobehav Rev 153:105359, 2023

Reactive Oxygen Species (ROS):

Superoxide Anion (O_2• —)
Hydrogen Peroxide (H_2O_2)
Hydroxyl Radical (OH•)

High Dose — Toxic ions

Low Dose — Signaling ions

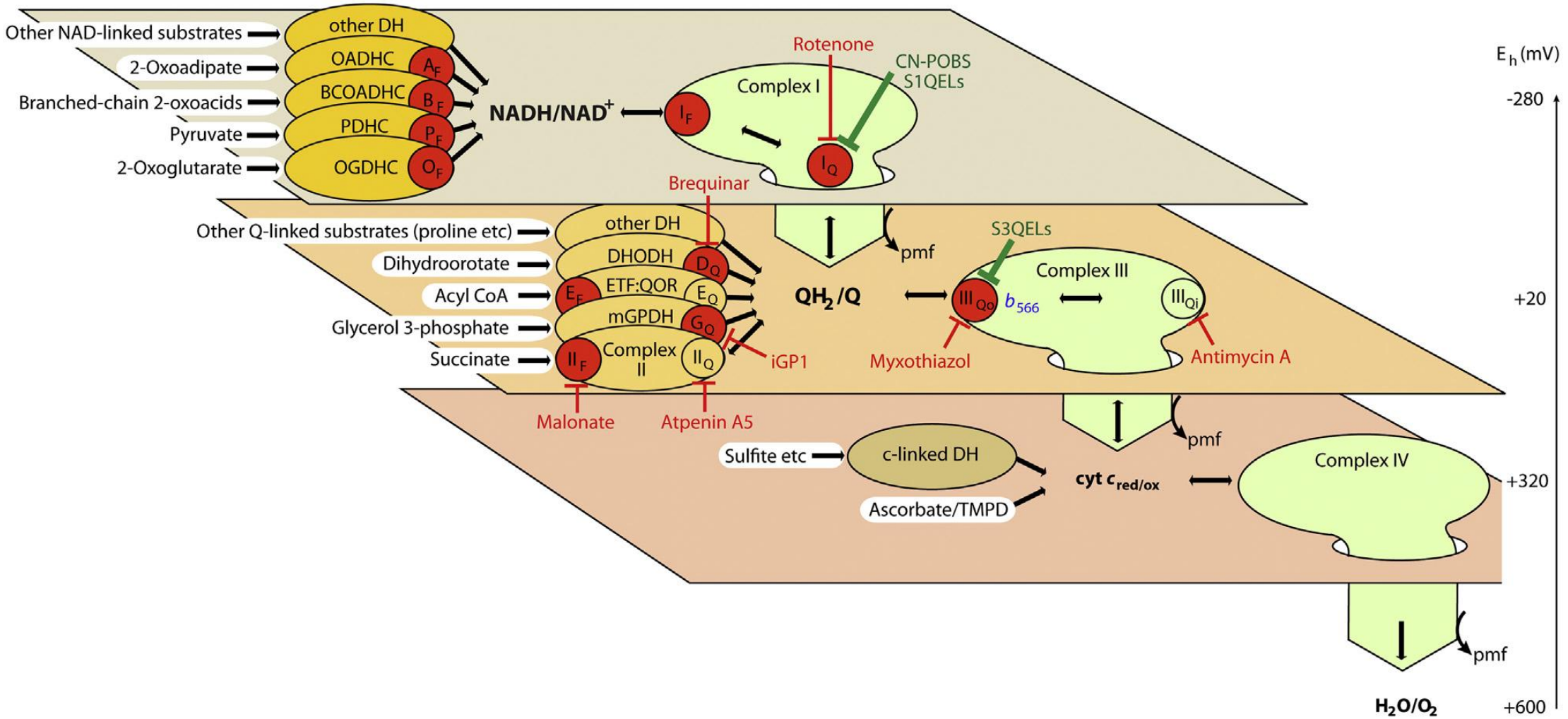
ROS is a signaling molecule, as well as a pathologic molecule

- *ROS and PI3K-Akt Signaling Pathway (metabolism)*
- *ROS and NF-κB Signaling Pathway (inflammation)*
- *ROS and Keap1-Nrf2-ARE Signaling Pathway (growth, cancer)*
- *Cross Talk between ROS and Ca^{2+} (neurotransmission)*
- ***ROS inhibits mitochondrial ATP production, while mitochondria make ROS***

- *ROS without quenching (peroxisome) – oxidative damage*

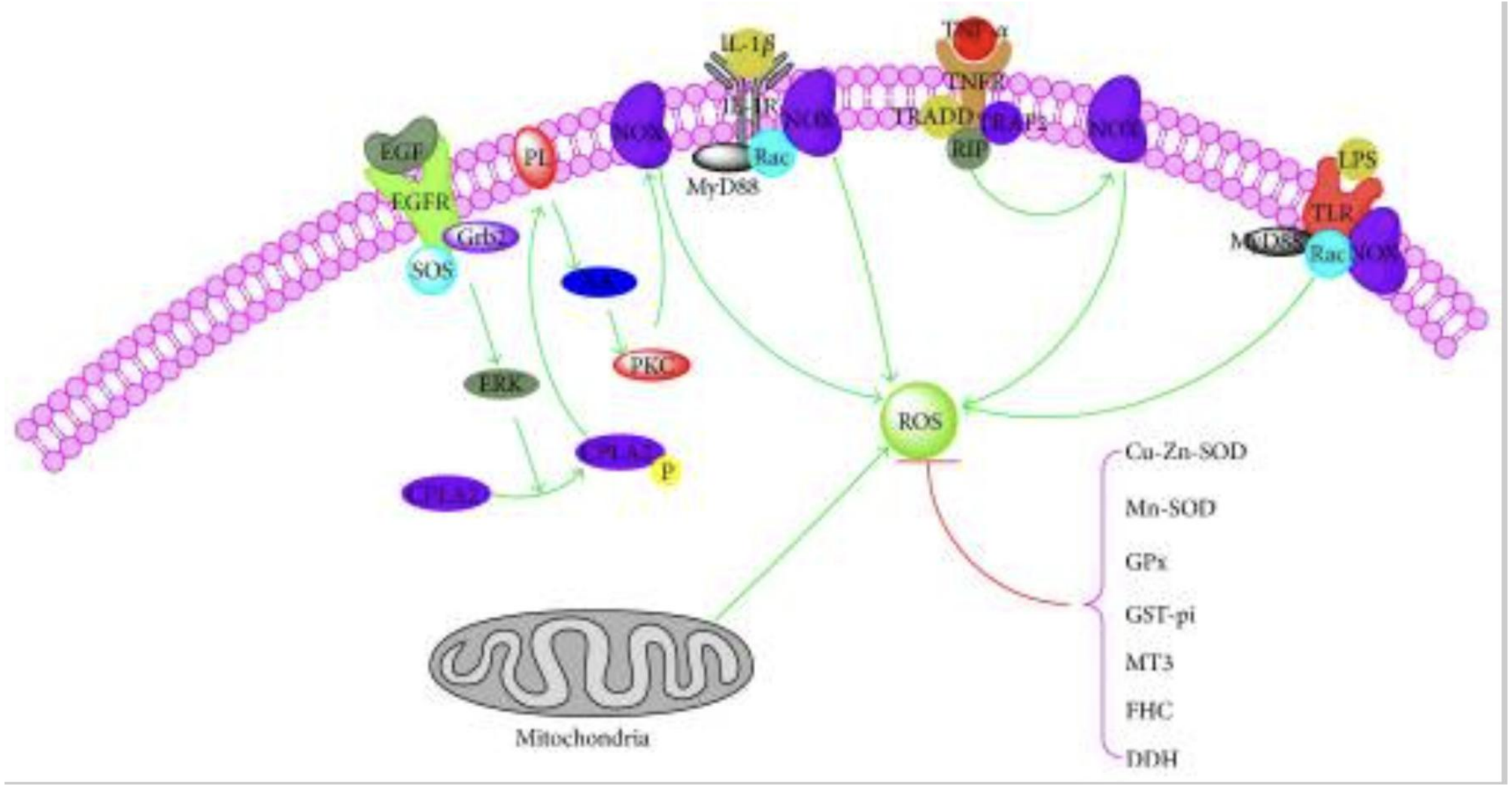
Zhang et al. Oxid Med Cell Longev 2016:4350965.

11 separate mitochondrial enzymes give off ROS's



Brand M, Free Radical Biol Med 100:14, 2016

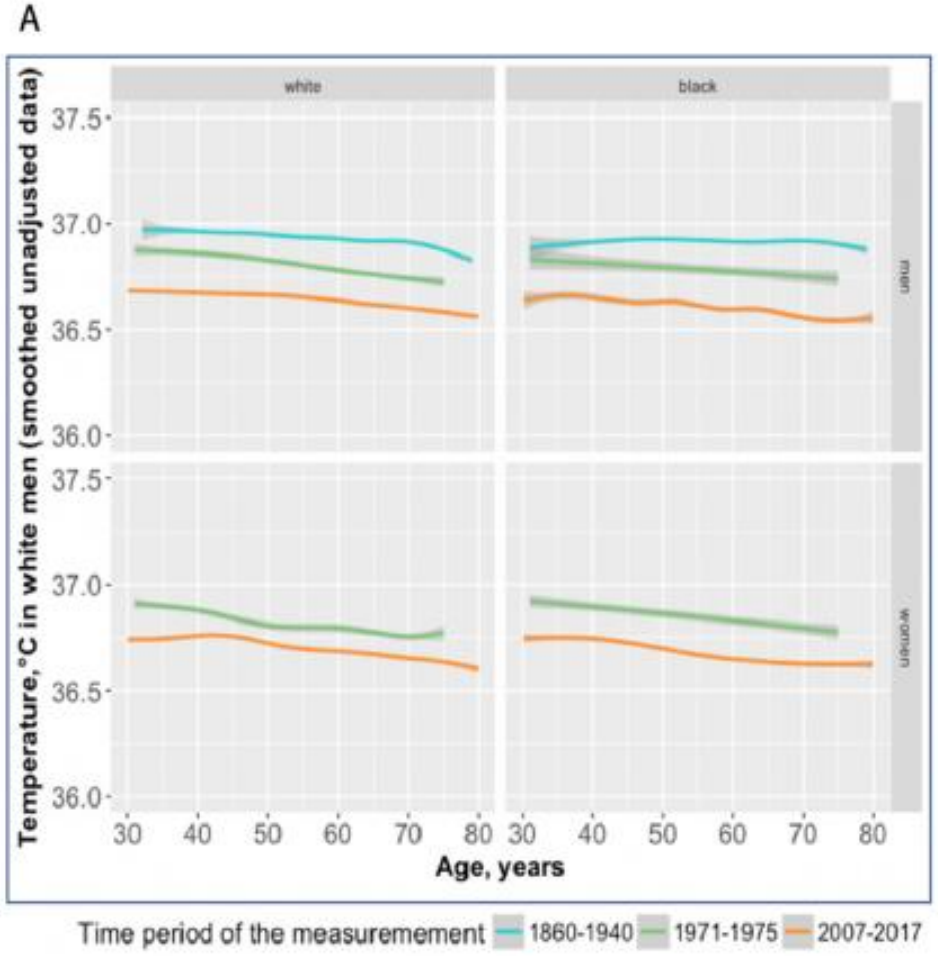
Mitochondria make ROS's from "within", while environmental toxins make ROS's from "without"



Zhang et al. Oxid Med Cell Longev 2016:4350965.

Empiric Evidence for Mitochondrial Dysfunction

Declining human body temperature in the last 150 years



Protsiv et al. eLife 9:e49555, 2020

Lab animals in captivity are getting obese too

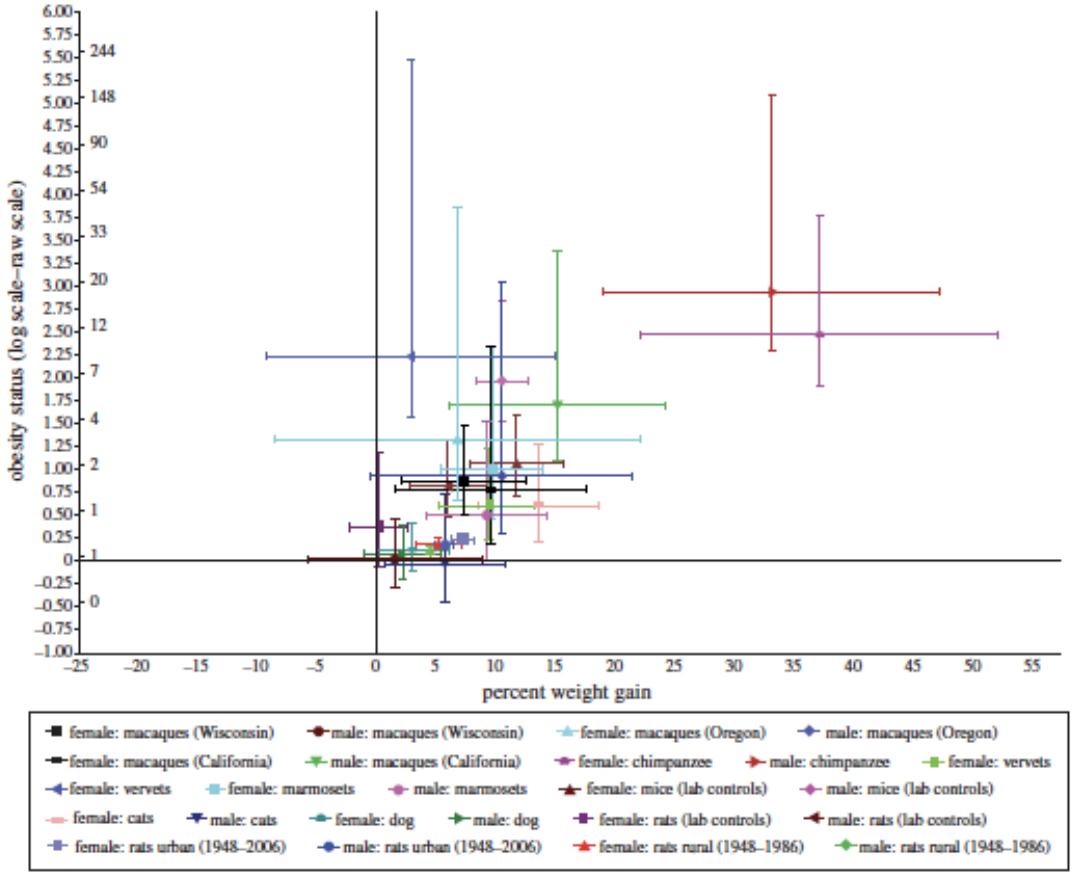
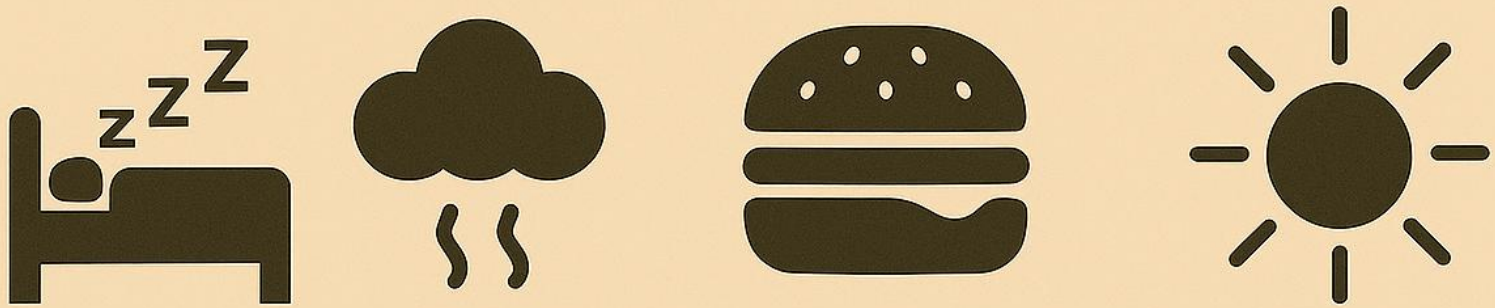


Figure 1. Mean and ±1 s.e. of per cent weight gain and obesity status by decade. The left side of the *y*-axis refers to the raw scale of obesity status, and the right side refers to the log scale of obesity status.

Klimentidis et al. Proc Royal Soc 278:1626, 2011

Mitochondrial dysfunction vs. a coal burning factory/mill

Environmental Causes Disrupting Mitochondrial Function



Sleep

Air Pollution

Ultra-Processed Food

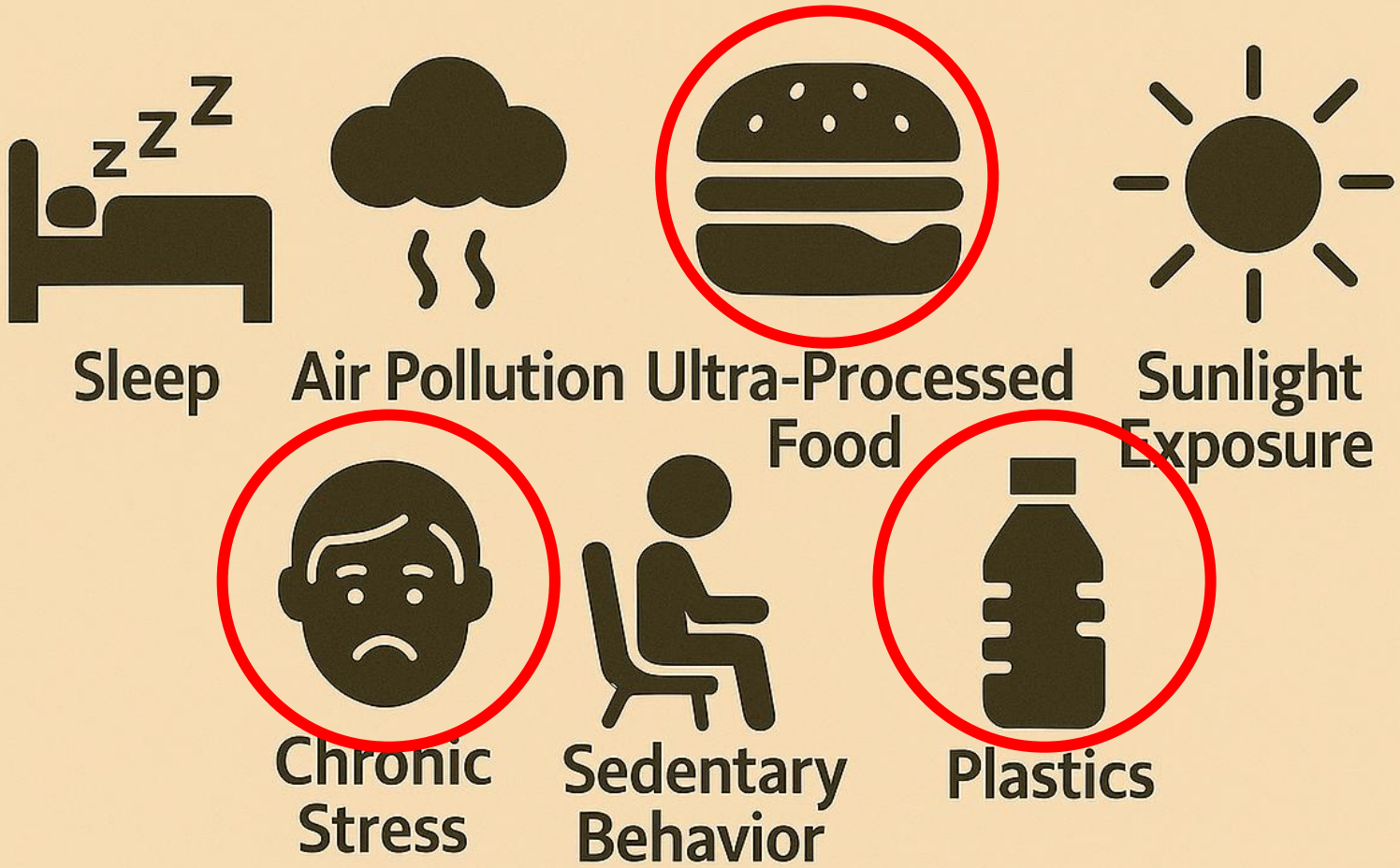
Sunlight Exposure

Chronic Stress

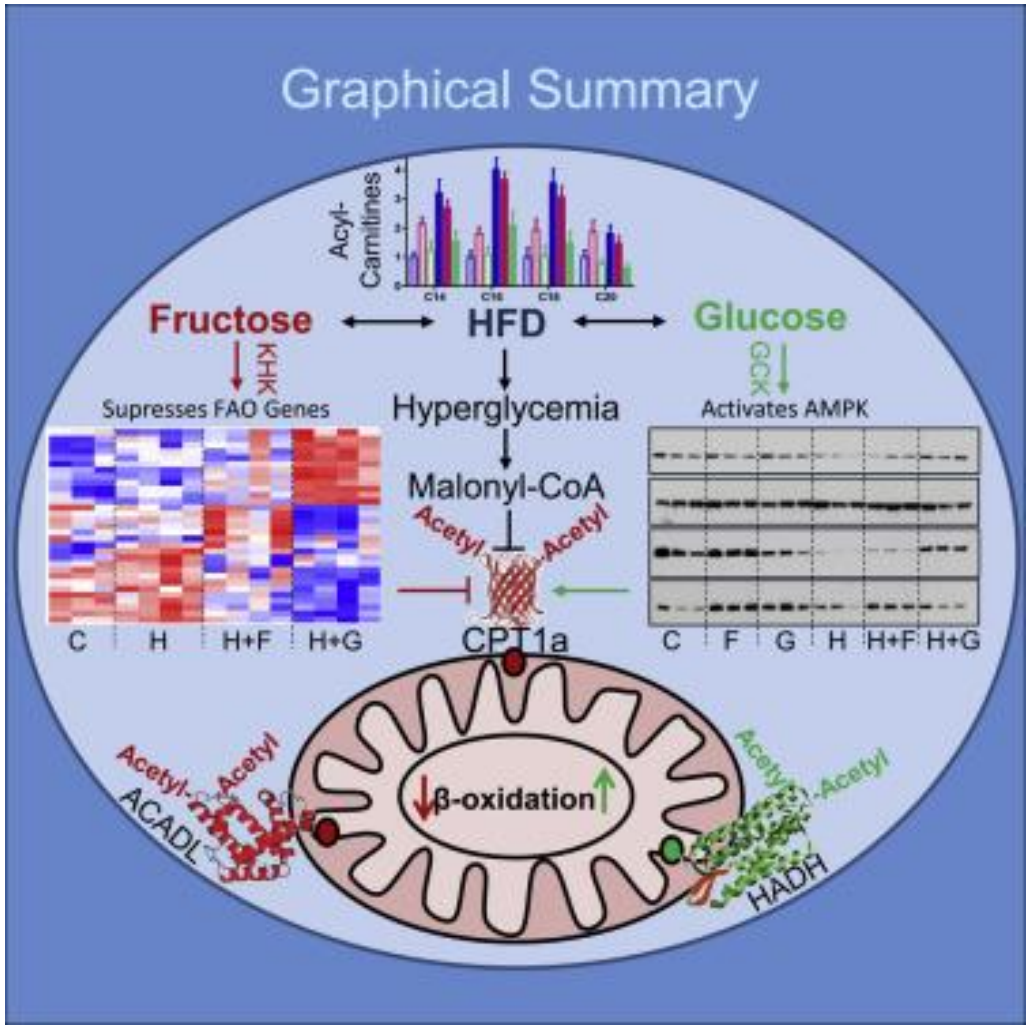
Sedentary Behavior

Plastics

Environmental Causes Disrupting Mitochondrial Function



Fructose reduces liver mitochondrial function, (resulting in energy diversion), while glucose stimulates it



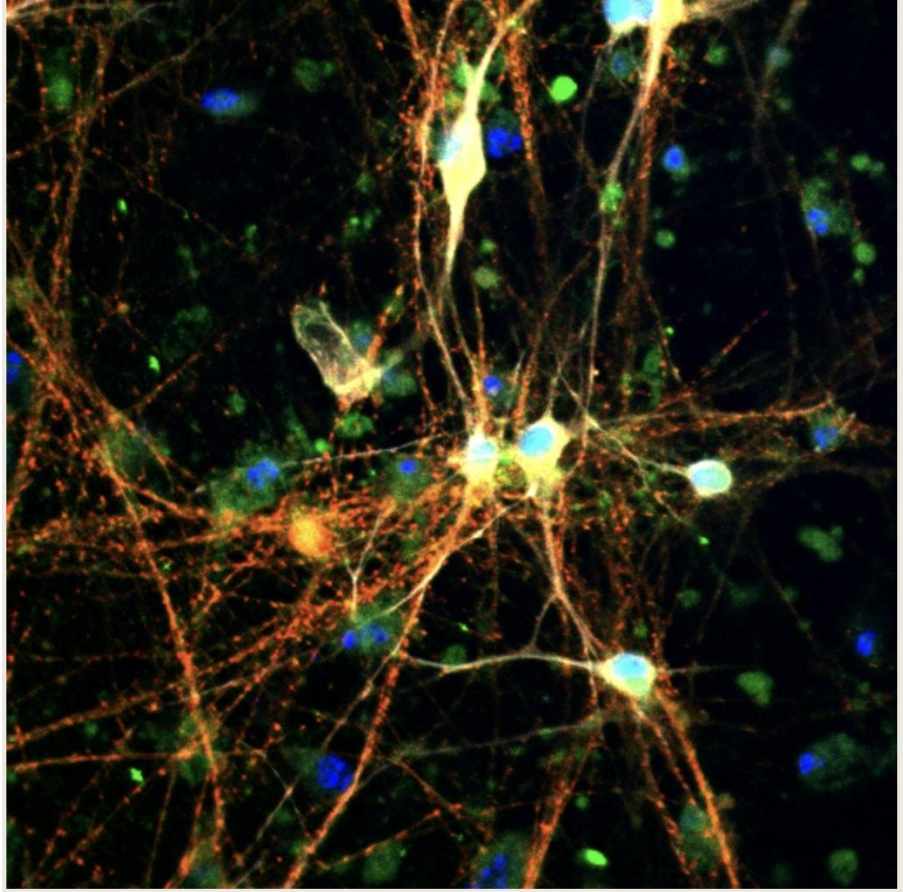
"The most important takeaway of this study is that high fructose in the diet is bad," says Dr. Kahn. "It's not bad because it's more calories, but because it has effects on liver metabolism to make it worse at burning fat. As a result, adding fructose to the diet makes the liver store more fat, and this is bad for the liver and bad for whole body metabolism."

Dr. C. Ronald Kahn,
CEO, Joslin Diabetes Center

Softic et al. Cell Metab 30:735, Oct 1, 2019

Glycogen in Alzheimer's Neurons? How? Why?

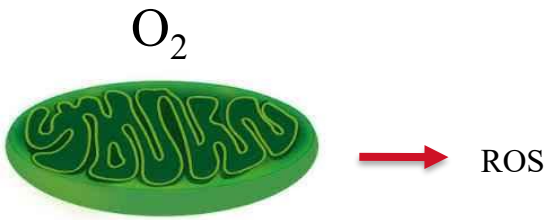
Another example of Energy Diversion



The image shows brain cells (neurons) where two substances are highlighted: tau, appears in red, and glycogen appears in green. Where the two overlap, the color turns yellow or orange, showing they are located close together. Follow-up experiments confirmed that in Alzheimer's disease, glycogen builds up in brain cells and can stick to tau. This discovery suggests that glycogen may play a role in helping tau clump together—a harmful process believed to drive Alzheimer's and similar brain disorders.

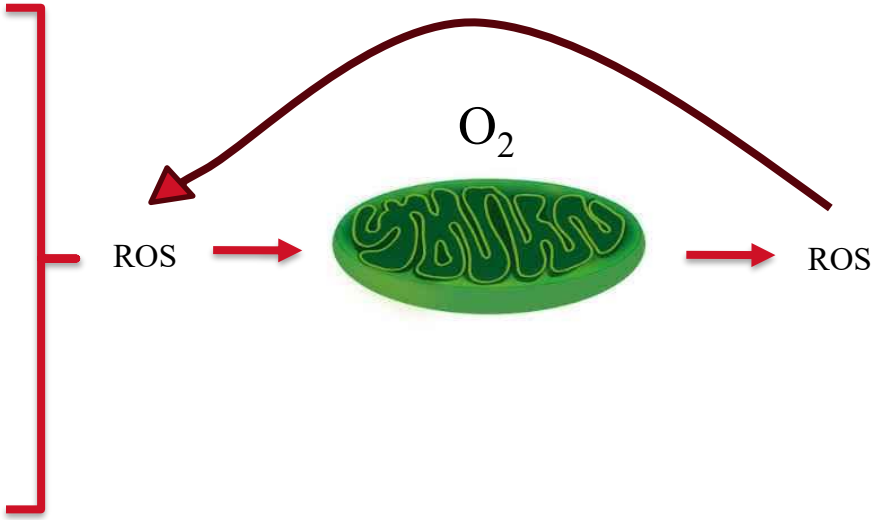
Bar et al. Nature Metabolism 7:1375–1391,2025

An Integrated Mitochondrial Model of Neuropsychiatric Disease



An Integrated Mitochondrial Model of Neuropsychiatric Disease

ApoE4
Ionizing Radiation
Ischemia/Hypoglycemia
Microplastics
SRDB/Sleep Apnea
Environmental Toxins
Insulin Resistance
Cell Senescence
Inflammation
Poor Nutrition:
- Fructose
- Low Omega-3's
- Low B vitamins



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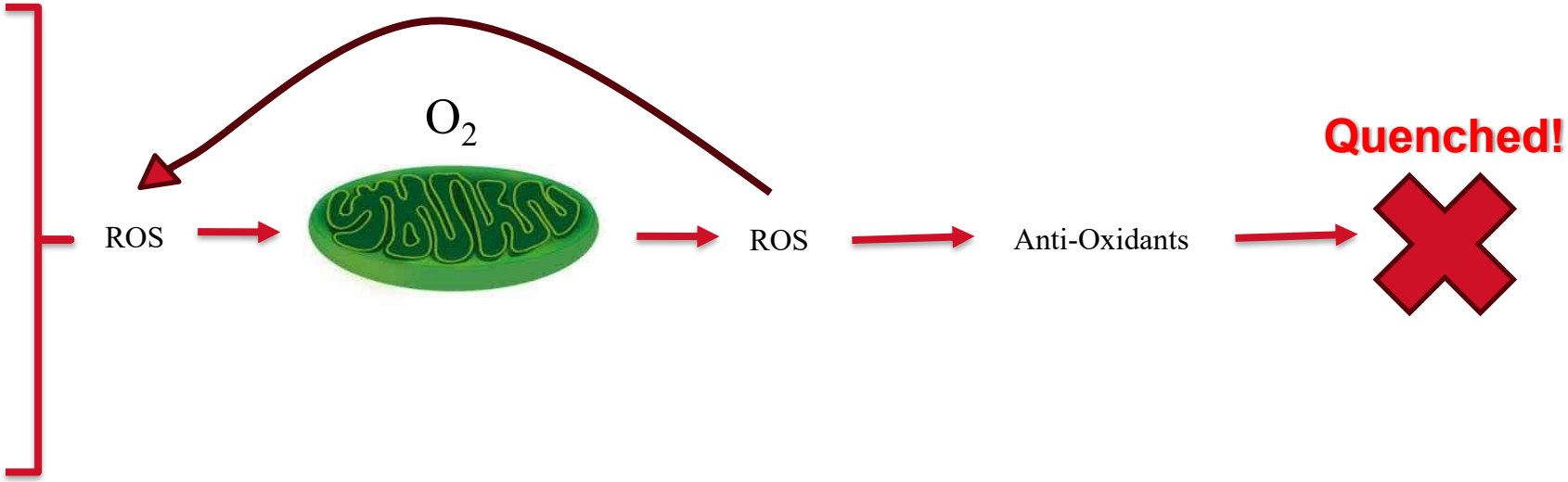

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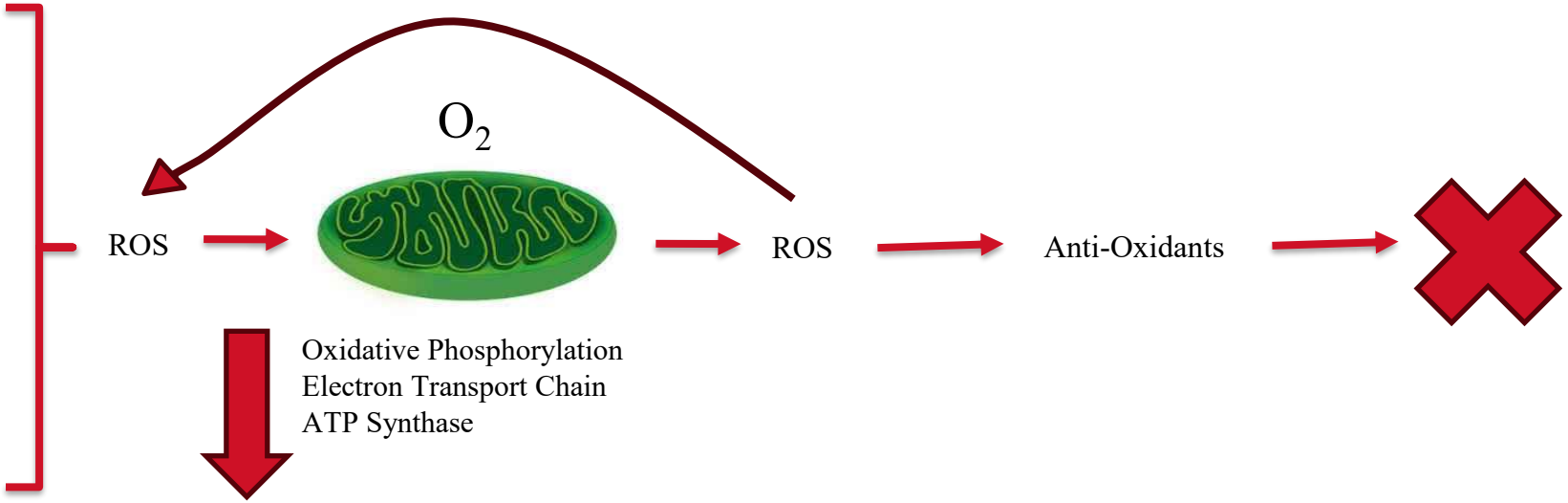

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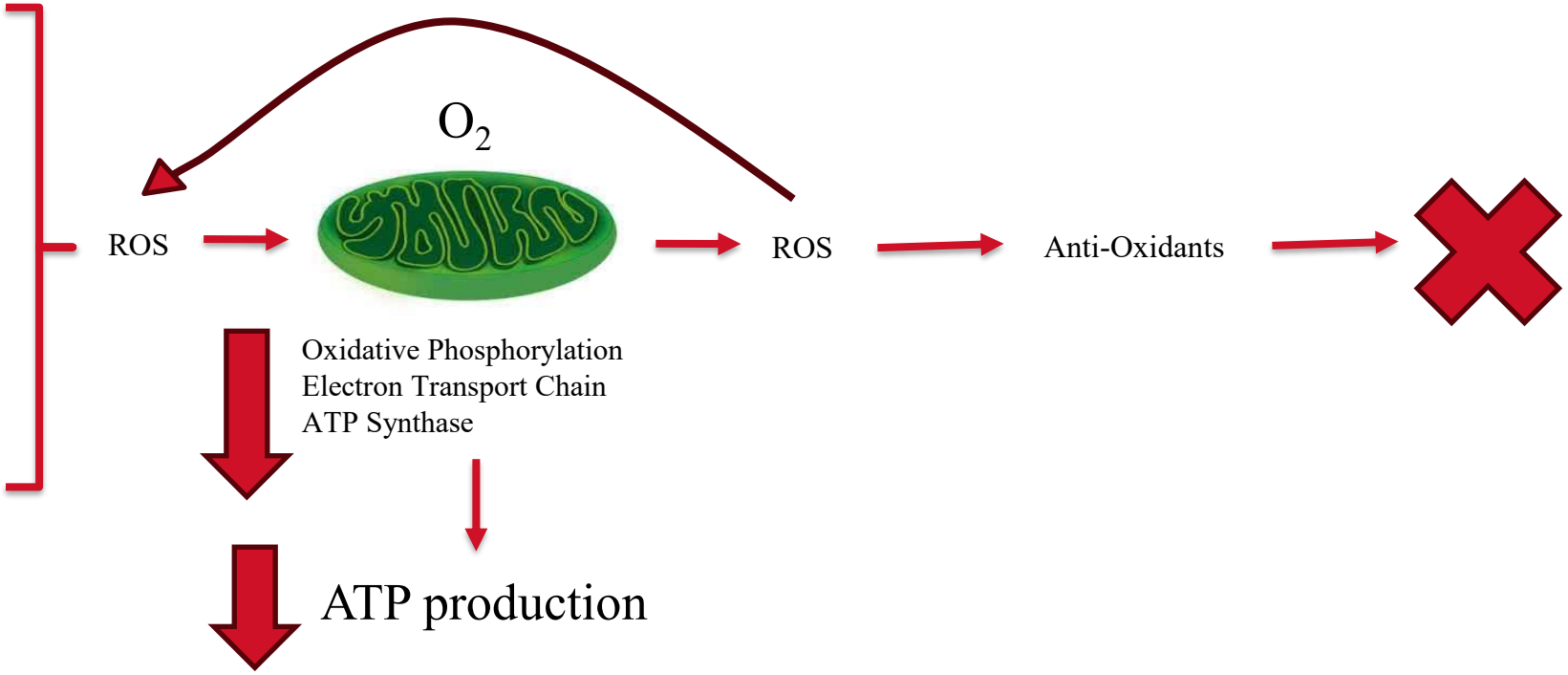

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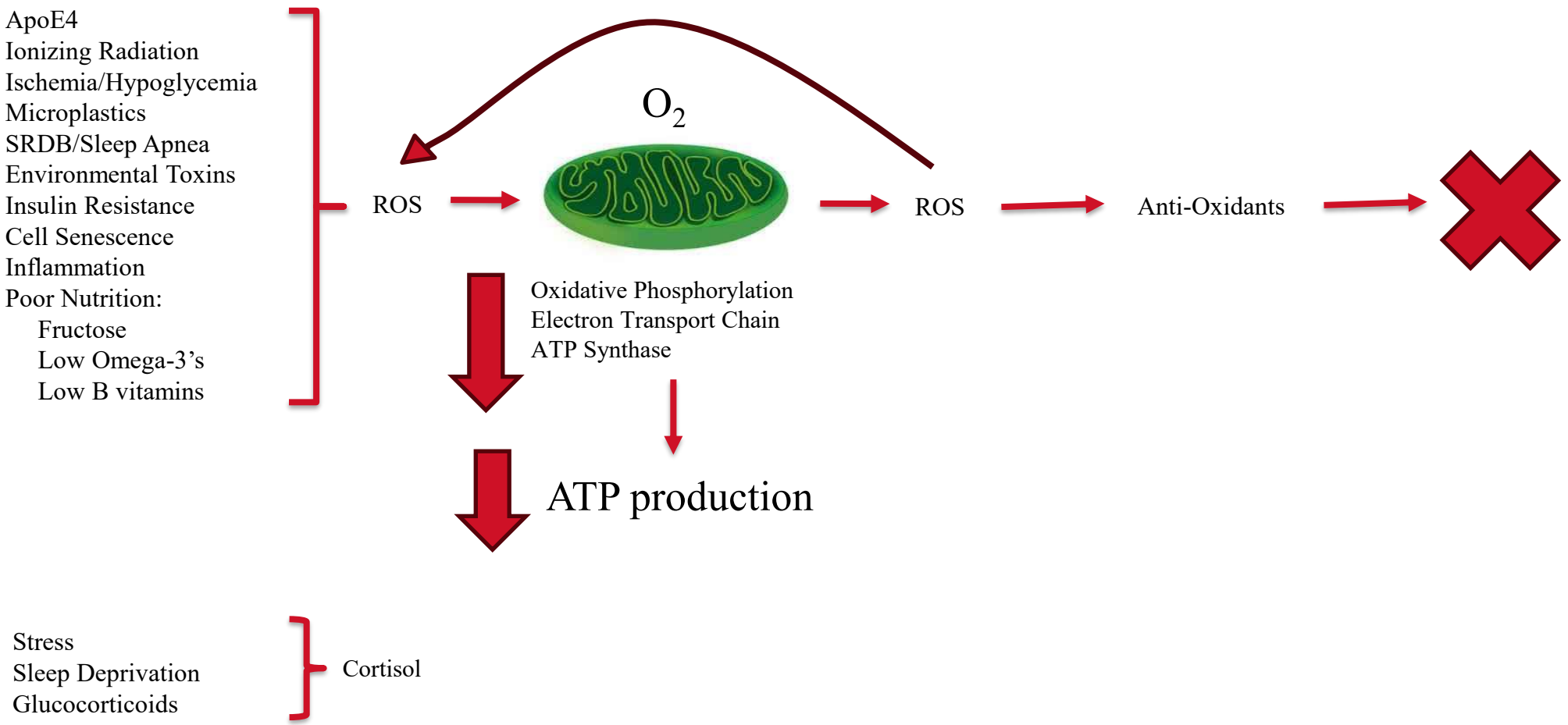


Alzheimer's Research & Therapy

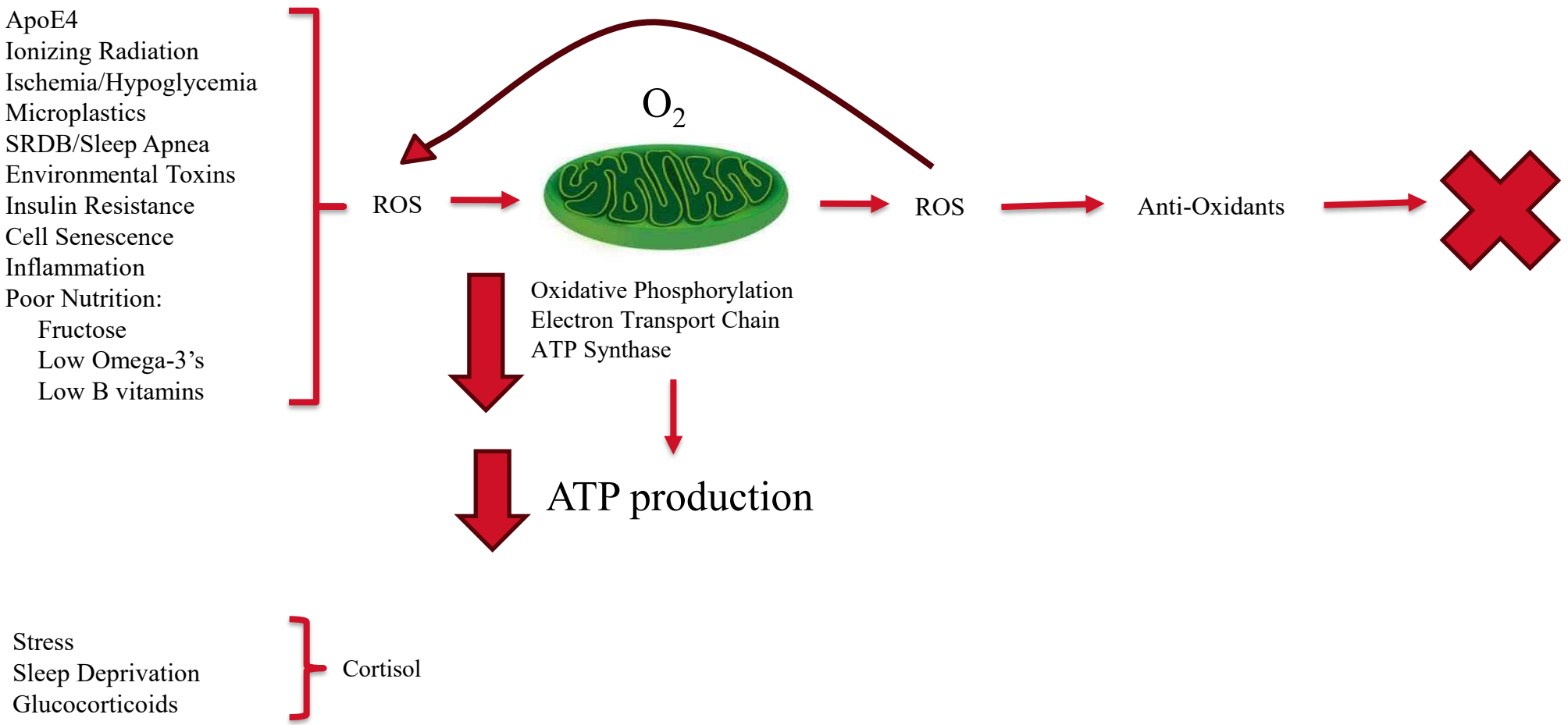
Alzheimers Res Ther. 2023 Oct 2;15:161. doi: 10.1186/s13195-023-01308-4

Stress, depression, and risk of dementia – a cohort study in the total population between 18 and 65 years old in Region Stockholm

Johanna Wallensten [1,2,✉], Gunnar Ljunggren [2,3], Anna Nager [3], Caroline Wachtler [2,3], Nenad Bogdanovic [3], Predrag Petrovic [4,5], Axel C Carlsson [2,3]

1.4M Swedes
Stress to Alzheimer's OR 2.45
Depression to Alzheimer's OR 2.32
Both to Alzeheimer's OR 4.00
Additive effect of both

An Integrated Mitochondrial Model of Neuropsychiatric Disease



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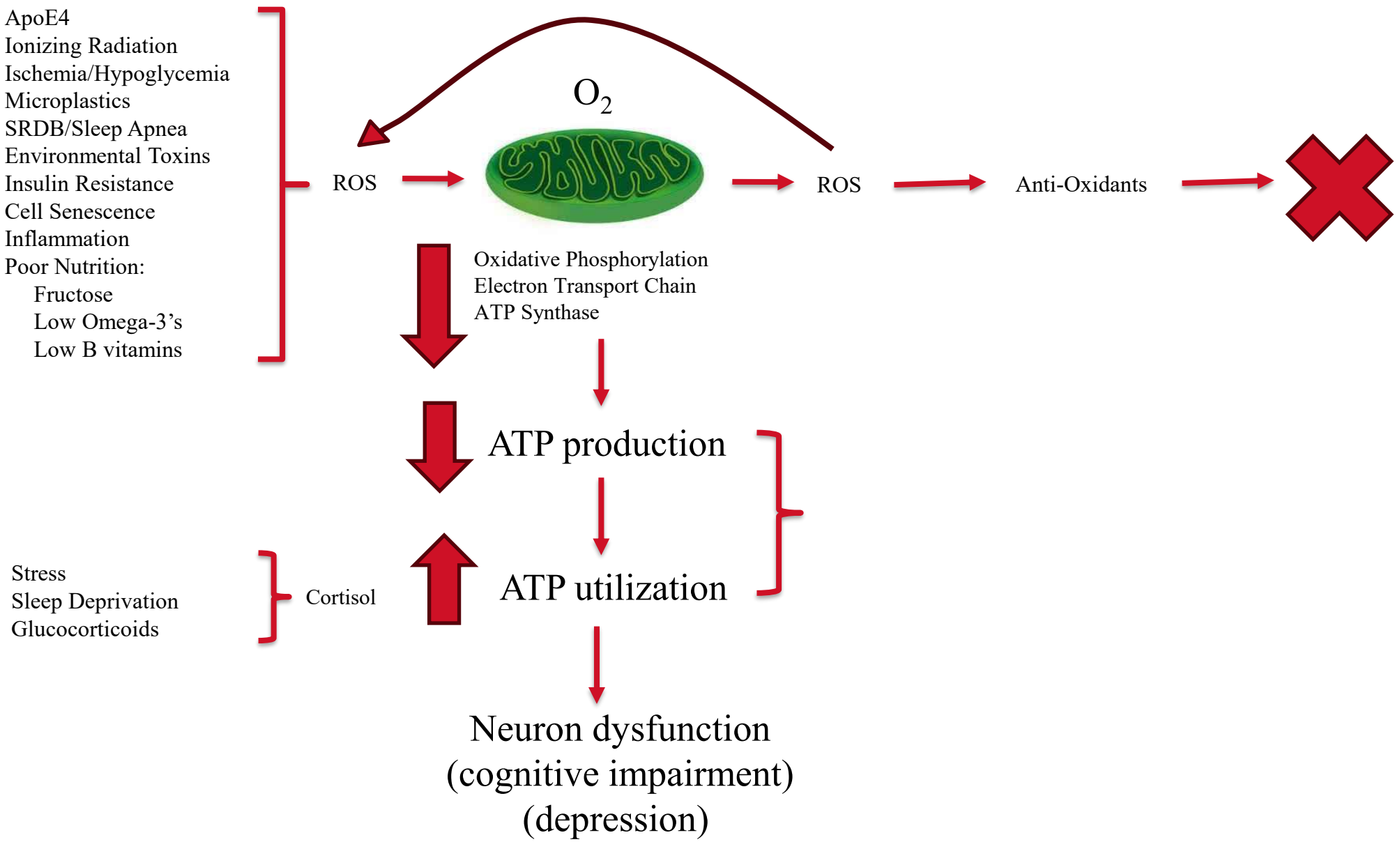
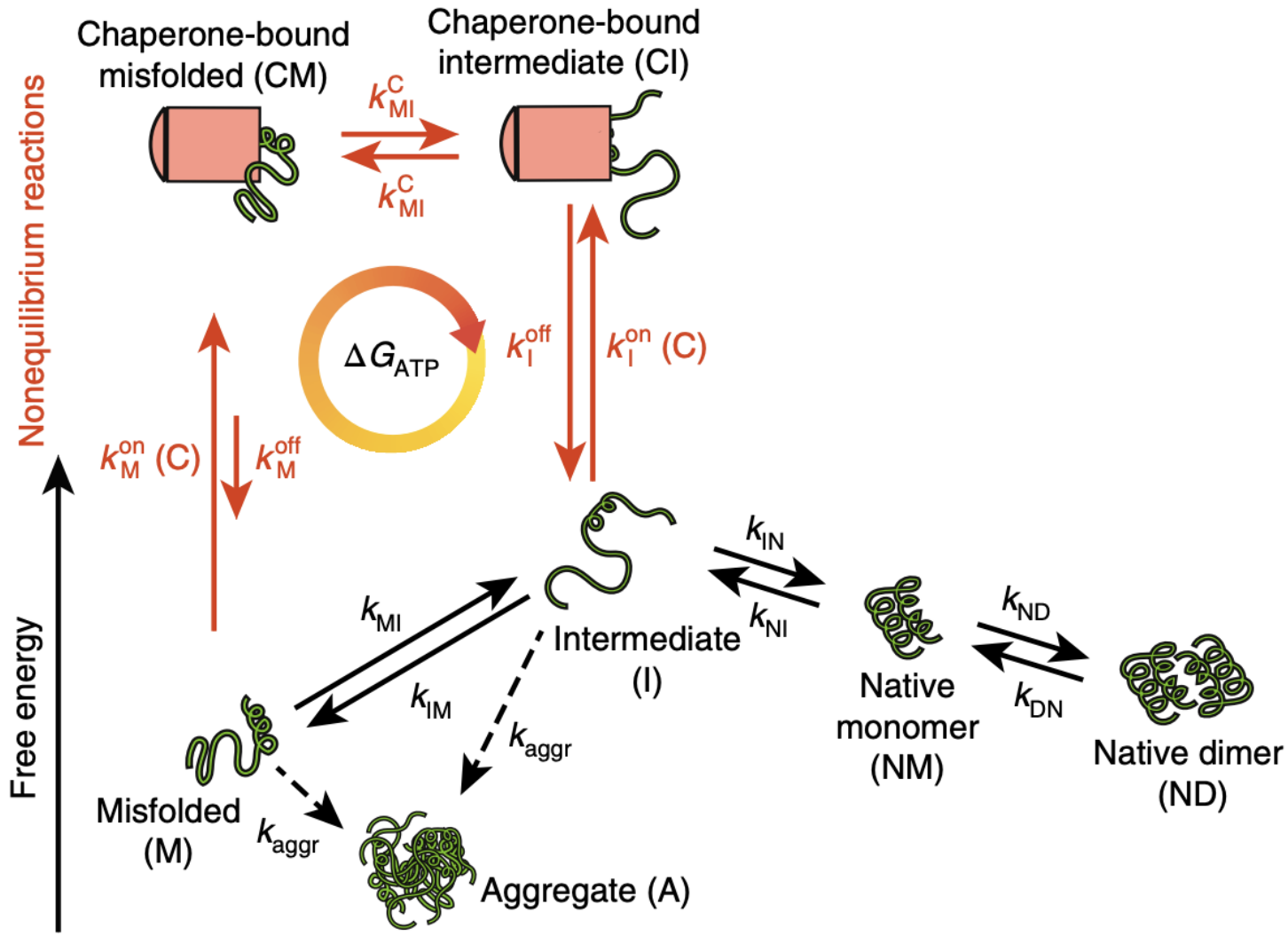


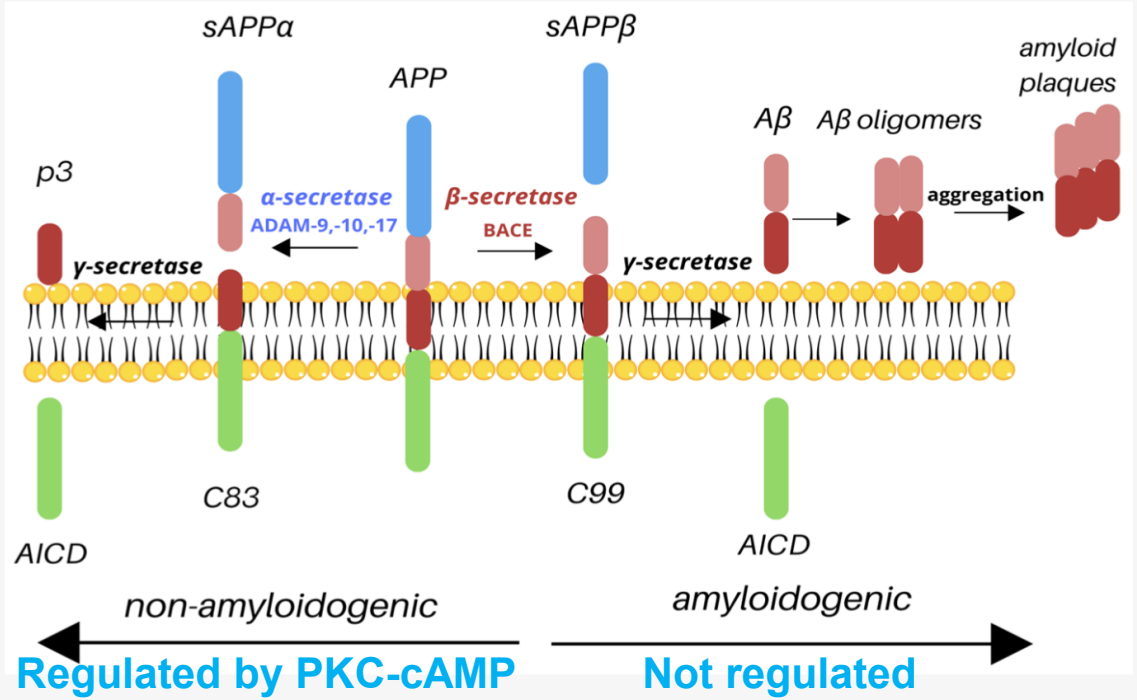
ATP required for chaperone proteins to direct proper folding



Gouloubinoff et al. Nature Chem Biol 14:388. 2018

Cleavage of Amyloid Precursor Protein is dependent on ATP

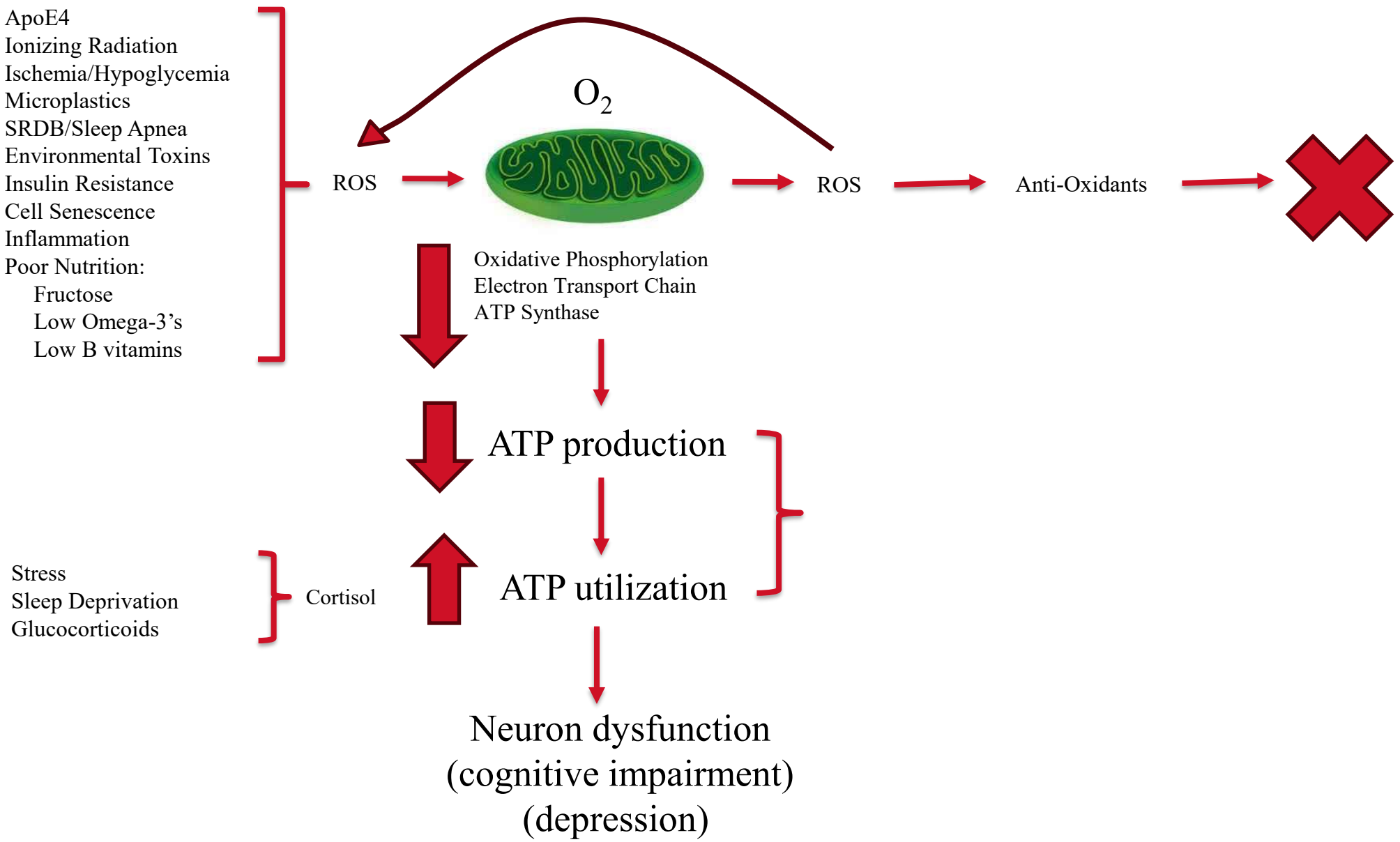
Figure 1. Cleavage of APP. Depending on the secretases involved, APP is processed via the non-amyloidogenic or amyloidogenic pathway. Cleavage by α-secretase (e.g., ADAM-9, -10, -17) results in the release of sAPPα and C83; C83 is then cleaved by γ-secretase to produce nontoxic p3 and AICD. However, under pathological conditions, APP may be processed by β-secretase, resulting in the production of sAPPβ and C99; C99 is then cleaved by γ-secretase. As a result, similarly to the non-amyloidogenic pathway, AICD is released; however, such cleavage also produces toxic Aβ species, which aggregate into amyloid plaques, main hallmark of Alzheimer's disease.



Skovronsky et al. J Biol Chem 275: 2568, 2000
Postina, J Neurochem 120 (Suppl. 1): 46, 2012

Walker, Int J Mol Sci 2025, 26:7328, 2025

An Integrated Mitochondrial Model of Neuropsychiatric Disease



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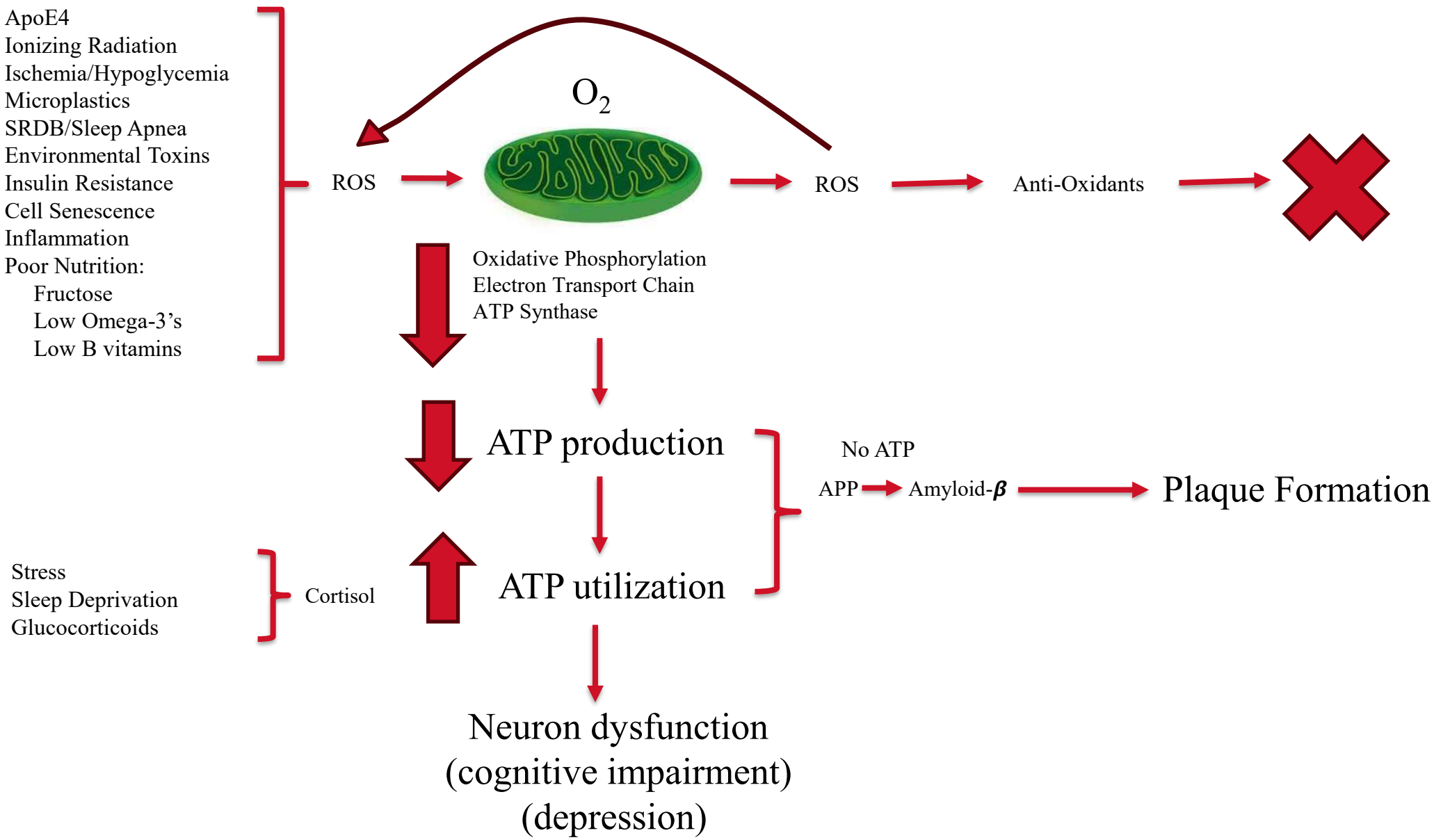
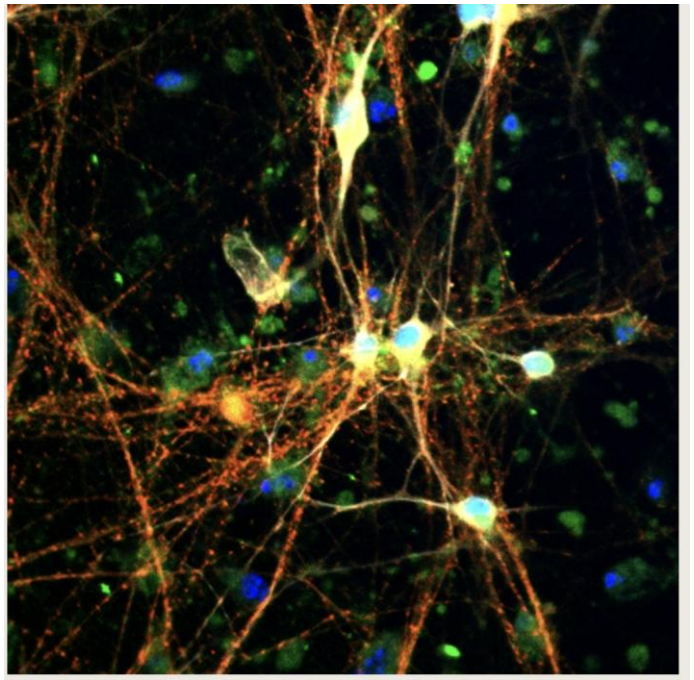
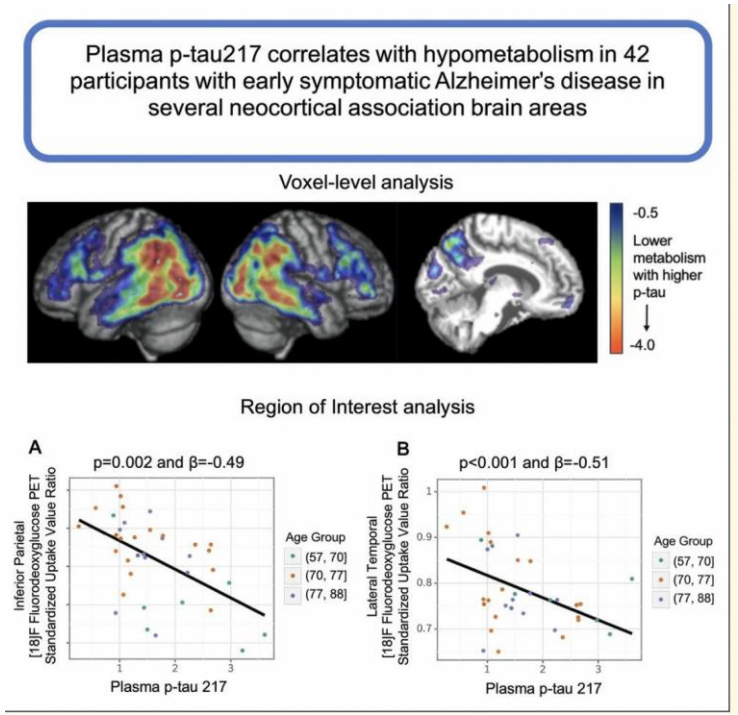


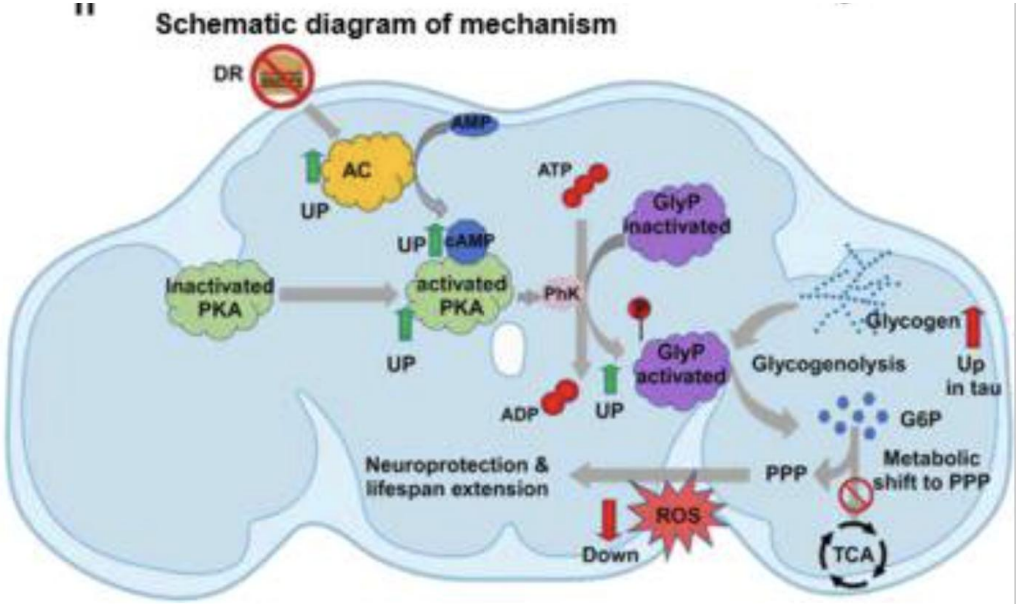
Phosphorylation of Tau is dependent on activation of Glycogen Synthase Kinase-3β
P-Tau-217 is the "cage" that holds the glycogen
P-Tau-217 dissociates from microtubules leading to tangles and neuronal dysfunction



Bar et al. Nature Metabolism 7:1375–1391,2025



Koenig et al. Brain Comm 2026: fcag074



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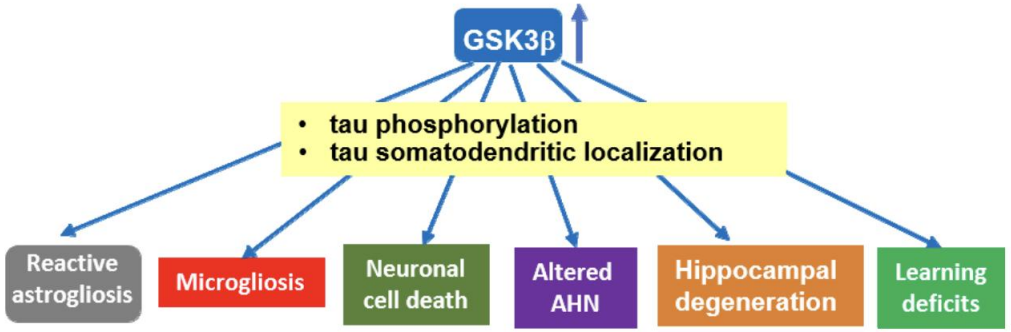

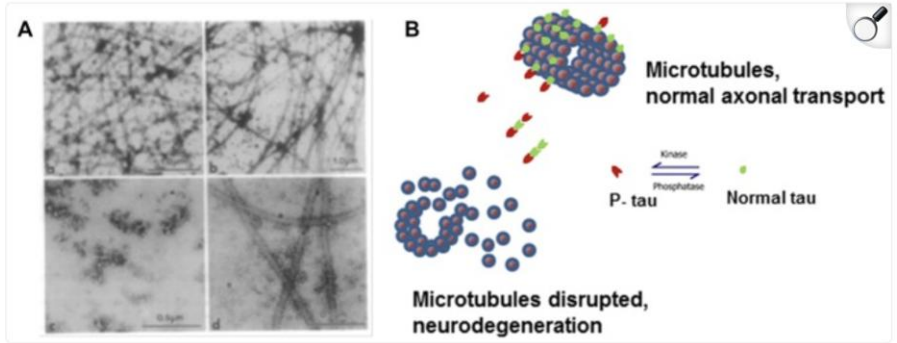

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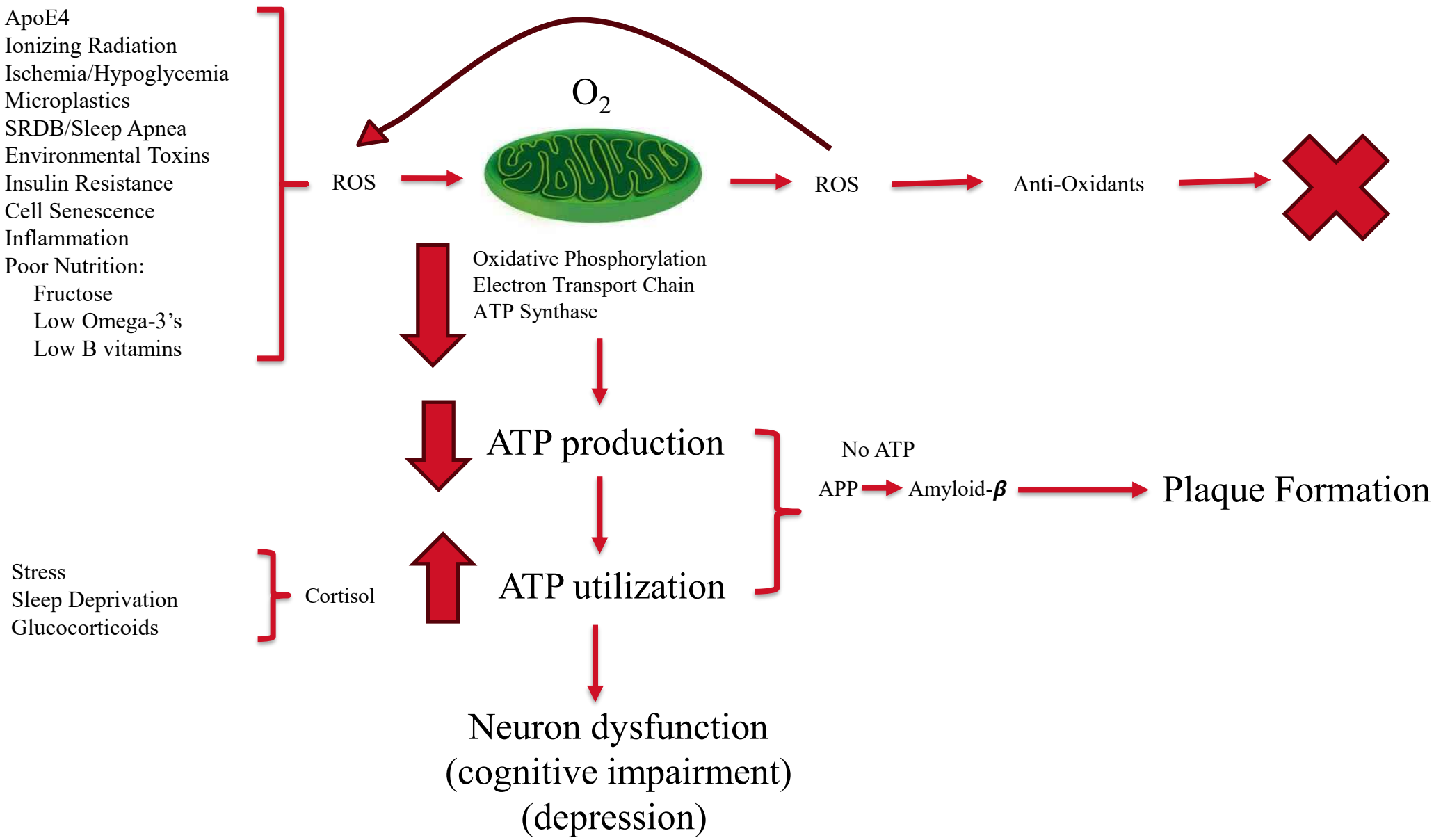

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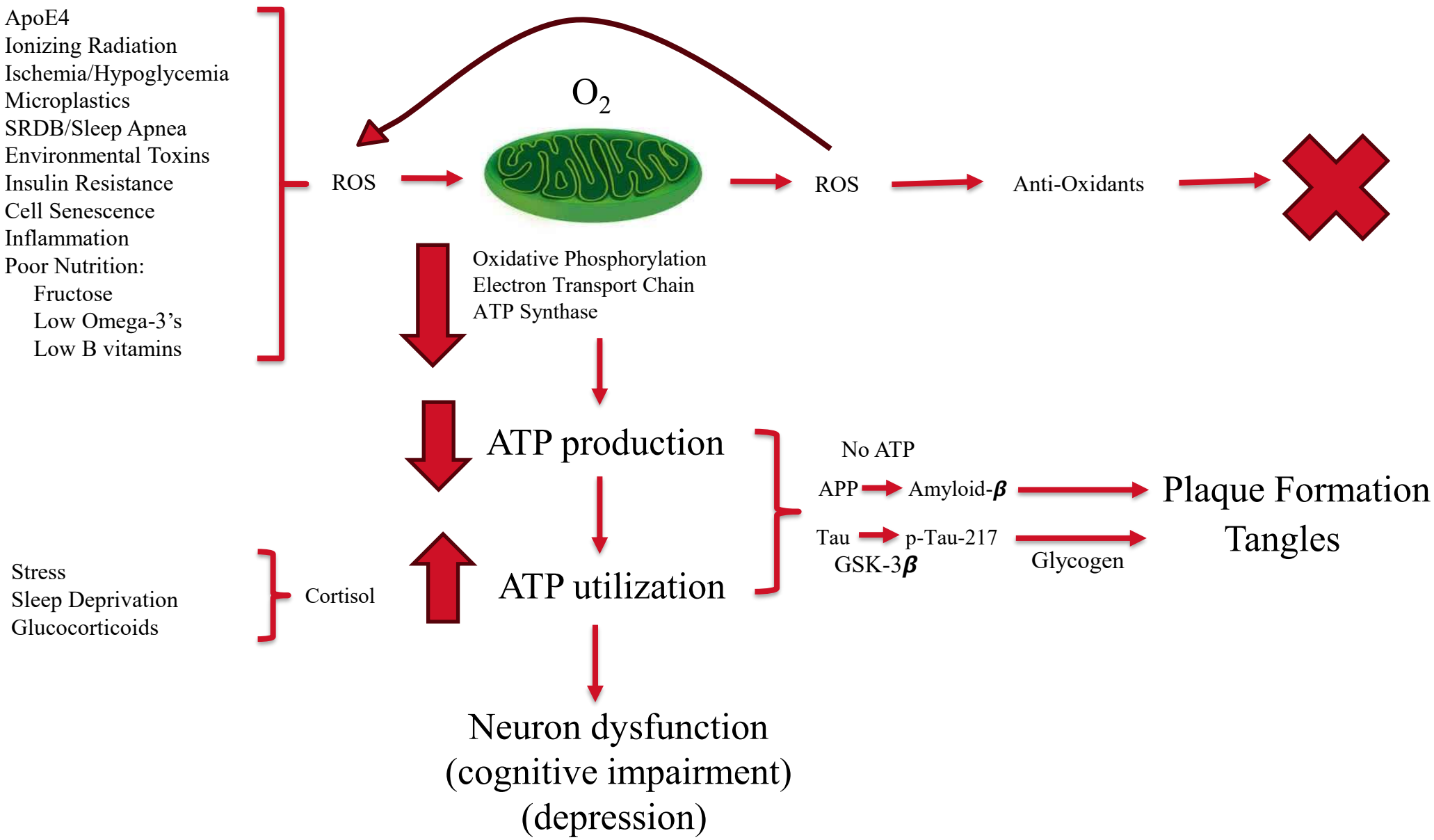


ROS's drive NF-κB, which promotes inflammation

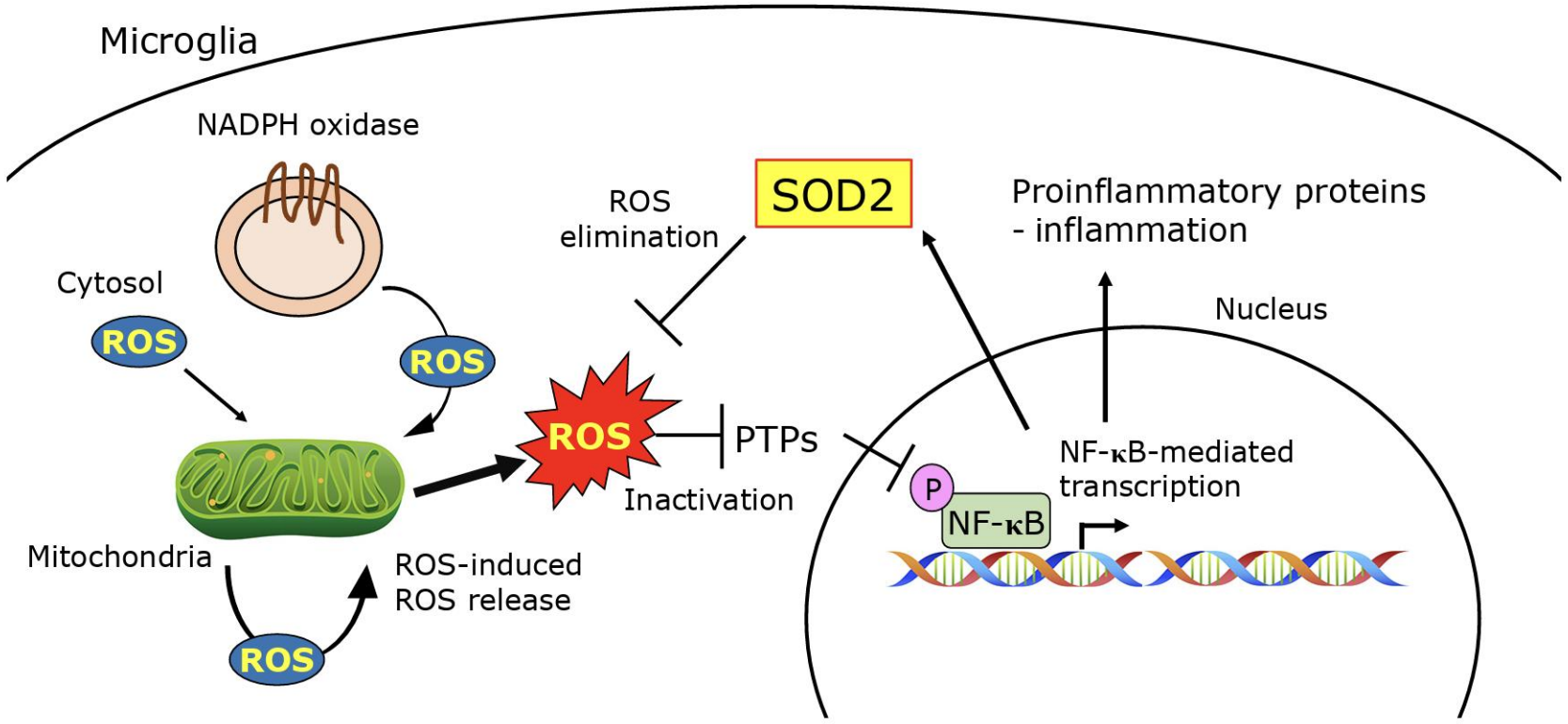
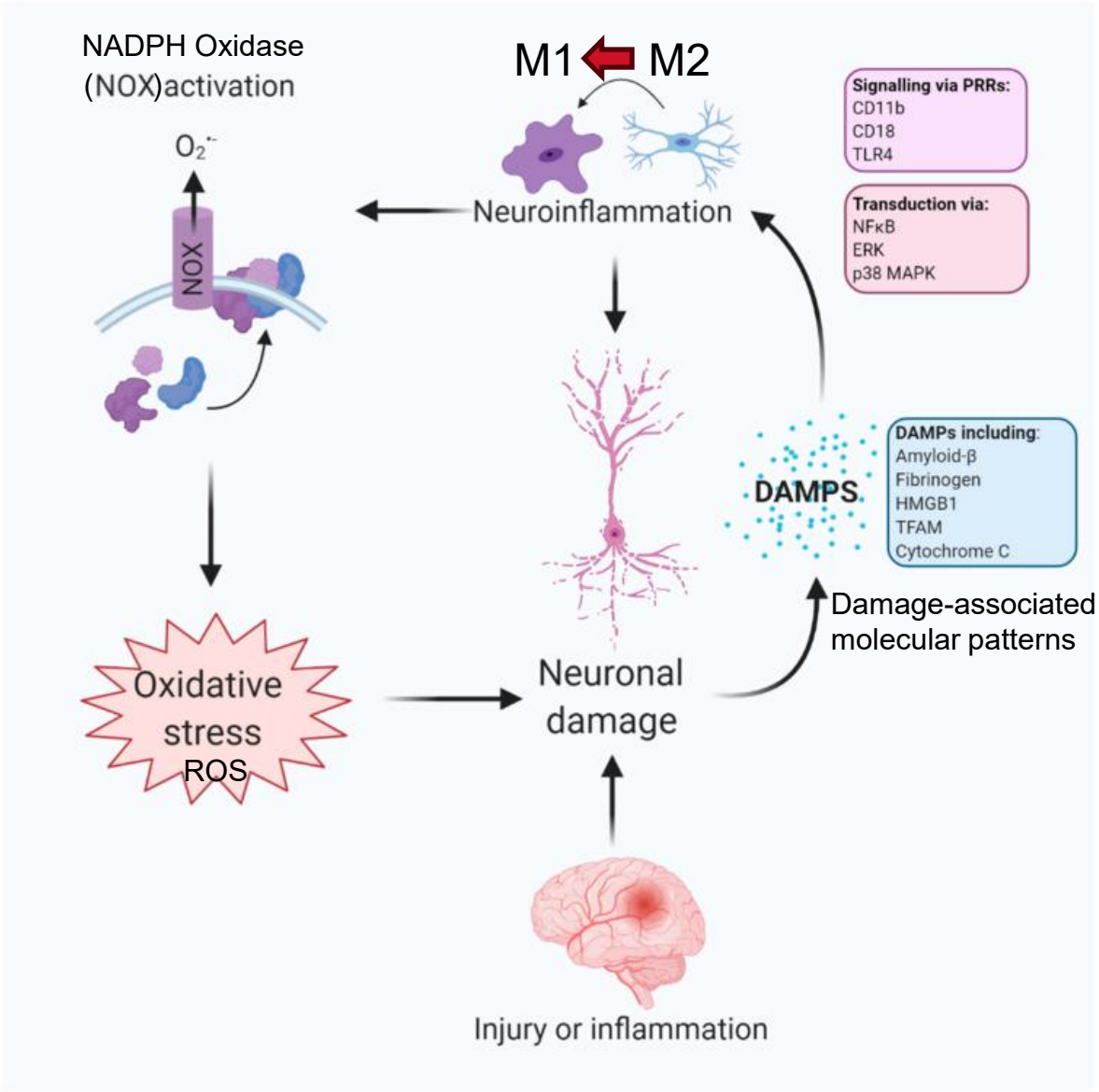


Fig. 1. The role of SOD2 in activated microglia. During inflammation when TLRs are stimulated, ROS are generated from NADPH oxidase and/or mitochondria, which are amplified in the mitochondria, in a process named ROS-induced ROS release. Activated NF-κB upregulates the expression of SOD2 as well as proinflammatory proteins such as cytokines and chemokines. NF-κB activity is regulated by its phosphorylation, including the phosphorylation of the Ser276 residue of the p65 subunit. ROS inactivate protein phosphatases to enhance NF-κB phosphorylation, followed by NF-κB activation. SOD2 eliminates ROS, resulting in the suppression of NF-κB activity. Collectively, transcriptionally activated SOD2 downstream of NF-κB attenuates NF-κB activity. This process might terminate the inflammatory reaction in microglia.

Ishihara and Itoh, J Clin Biochem Nutr 72:23, 2023

ROS's drive neuroinflammation and neuronal damage



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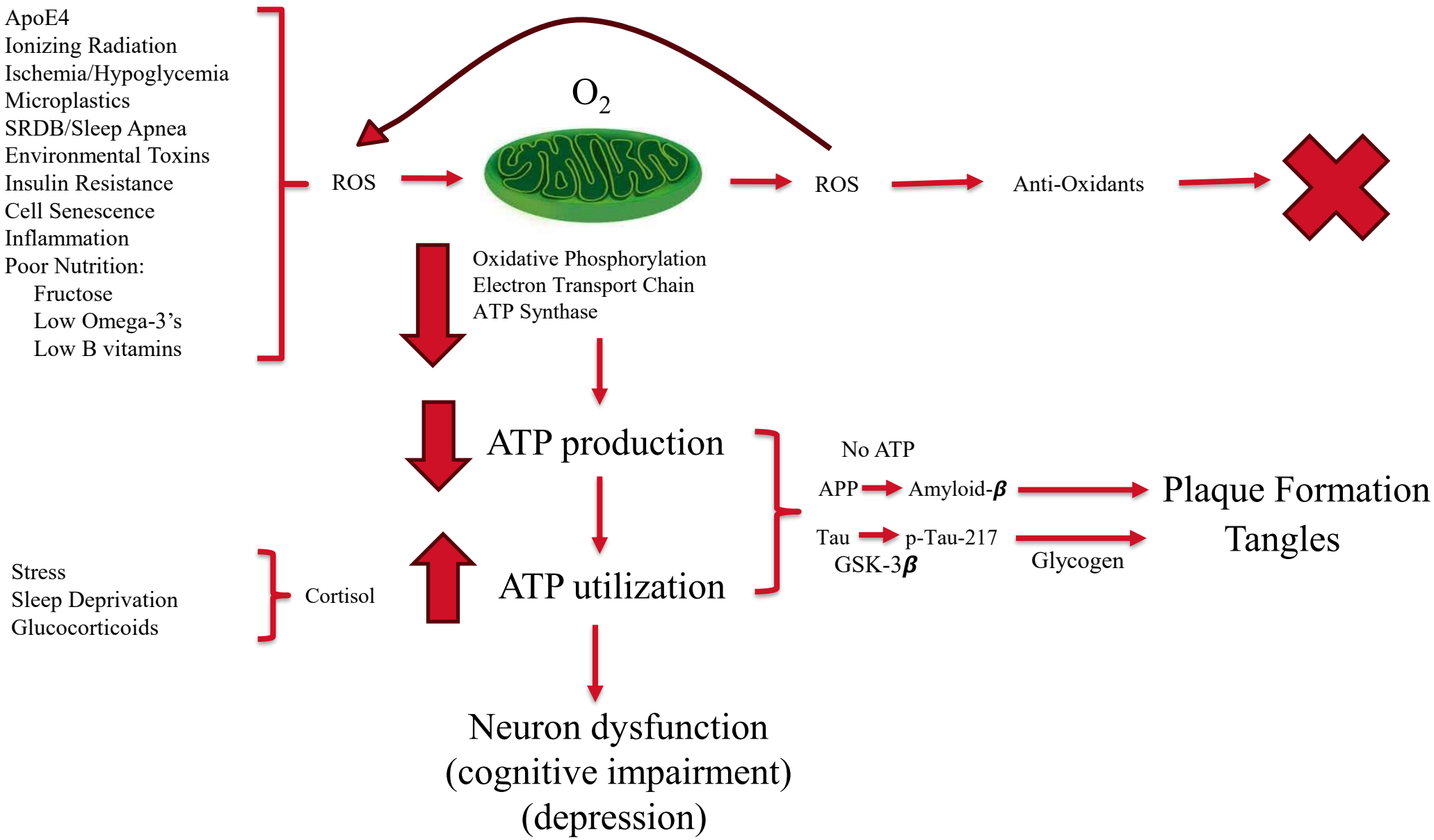

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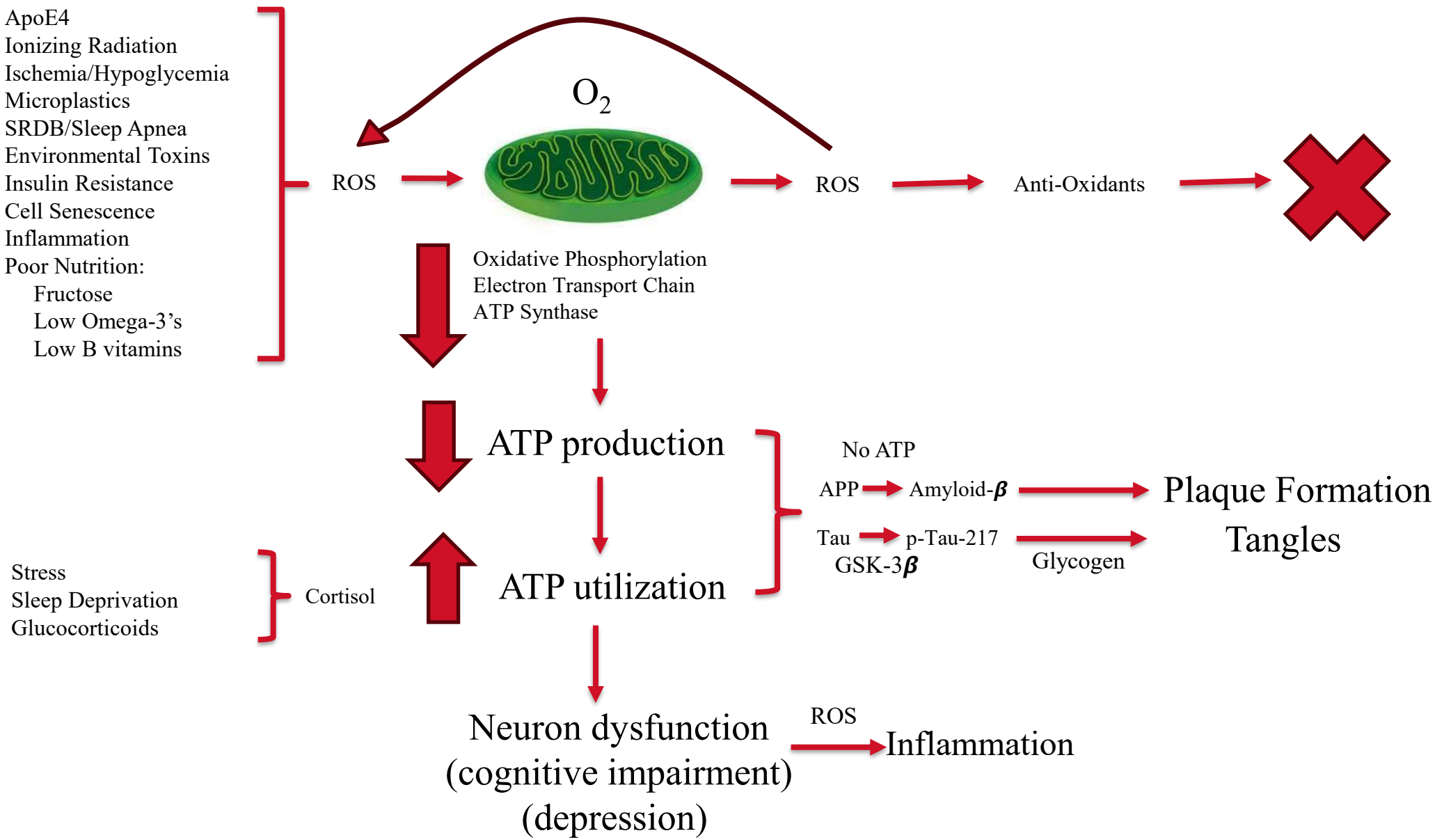

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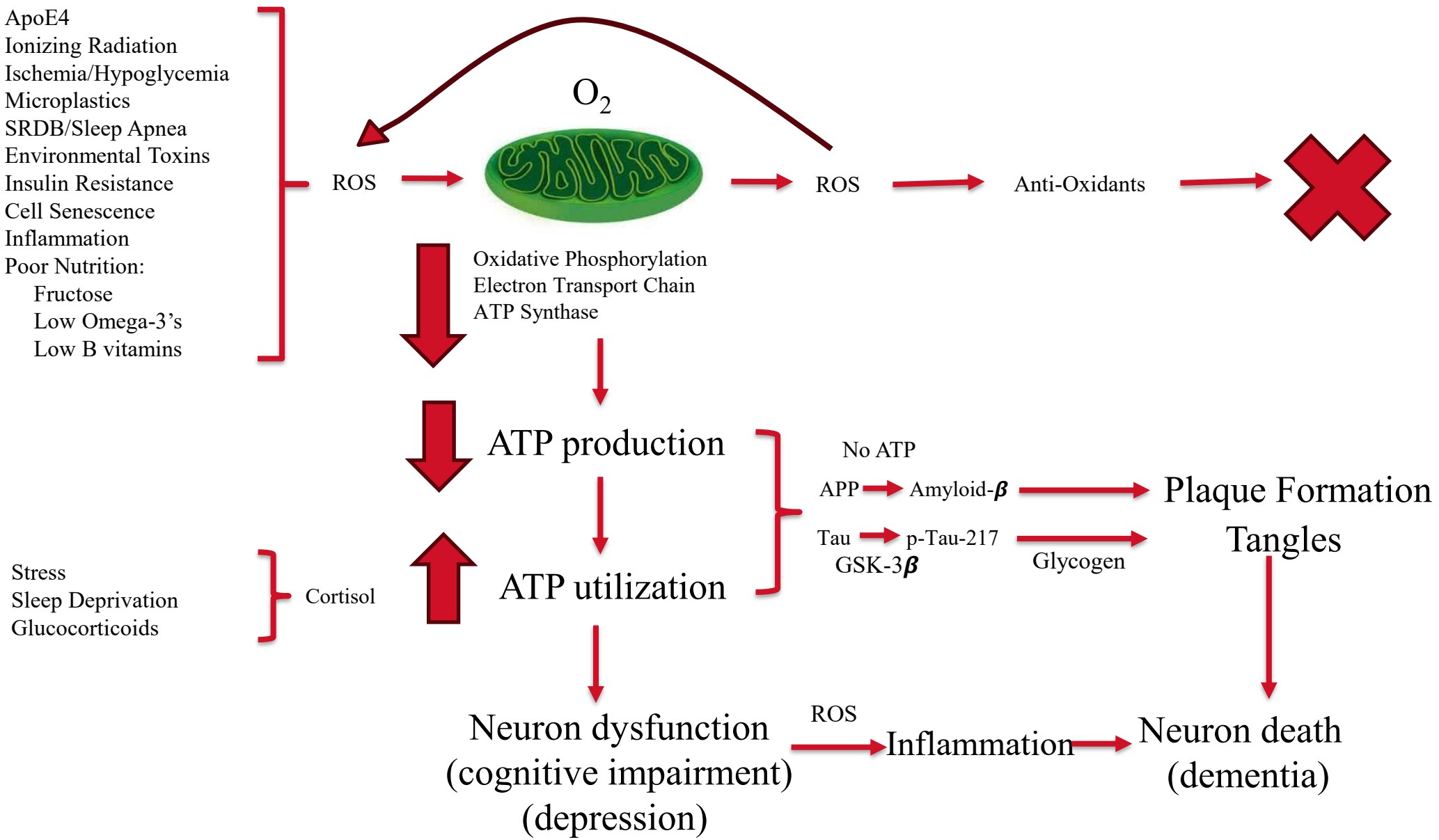


A ROS-reducing diet and Alzheimer's Disease (Low ROS generation, high antioxidant content)

scientific reports

Check for updates

OPEN

The long-term neuroprotective effect of MIND and Mediterranean diet on patients with Alzheimer's disease

Xiaofang Liu✉, Bo Yang, Qiong Liu, Mengge Gao & Miaoqing Luo

antioxidants

MDPI

Review

Anti-Oxidant and Anti-Inflammatory Activity of Ketogenic Diet: New Perspectives for Neuroprotection in Alzheimer's Disease

Alessandro Pinto [1,*], Alessio Bonucci [2], Elisa Maggi [2], Mariangela Corsi [2] and Rita Businaro [2]

nutrients

Review

Mediterranean Diet, Polyphenols, and Neuroprotection: Mechanistic Insights into Resveratrol and Oleuropein

Mónika Fekete [1,2,3,*,†], Tamás Jarecsny [3,4,†], Andrea Lehoczki [1,2,3], Dávid Major [1,2,3], Vince Fazekas-Pongor [1,2,3], Tamás Csípő [1,2], Ágnes Lipécz [1,2], Ágnes Szappanos [5,6], Eszter Melinda Pázmándi [3,7], Péter Varga [1,2,3] and János Tamás Varga [8,*]

JCBFM

Original Article

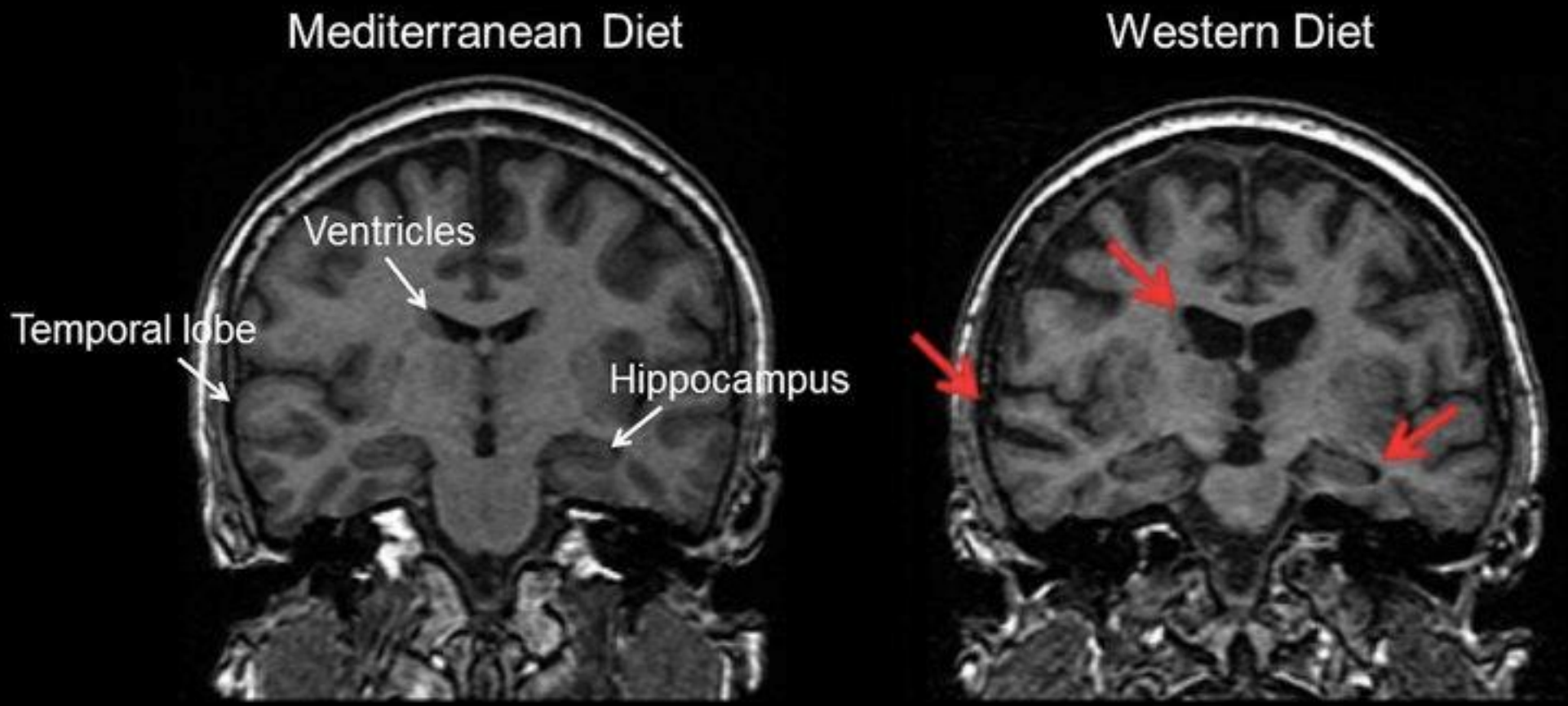
Ketogenic diet decreases oxidative stress and improves mitochondrial respiratory complex activity

Tiffany Greco[1,2], Thomas C Glenn[1,2], David A Hovda[1,2,3,4] and Mayumi L Prins[1,2,3]

Journal of Cerebral Blood Flow & Metabolism
2016, Vol. 36(9) 1603–1613

DOI: 10.1177/0271678X15610584
jcbfm.sagepub.com
SAGE

Your brain on …



Neuropsychiatric disease is the result of dysfunction of neurons…

Dementia is the result of death of neurons…

which is due to either reduced energy (ATP) production…

or increased energy (ATP) utilization… or both.

Risk for dementia is a function of the combination of these factors driving ATP depletion.

ROS's appear to be a common intermediate pathway.

What about the amygdala?

Really, what about the brakes on the Basolateral Amygdala —

(PFC, HPC, Aff Vagus, OXTR)?

The Who — The “Saboteurs”

The Saboteurs

Dopamine

- Money
- Power
- Pleasure
  - Cocaine
  - Heroin
  - Nicotine
  - Ethanol
  - Caffeine
  - Fructose/UPF
  - Shopping
  - Gambling
  - Internet Gaming
  - Social Media
  - Pornography

Cortisol

- Inequality
- Poverty
- Multitasking
- Acculturation
- Adverse Childhood Experiences
- Chronic Health Issues
- Major Life Changes
- Environment
- Work
- Computers
  - Internet
  - Chatbots
  - AI

Dopamine AND Cortisol

- Demagogues
- Othering/Xenophobia
- Cellphones

Which rainbow?…

The Hostage Brain

The substitution of secondary wants…

Power
Money
Pleasure
DOPAMINE
(excitatory, neurotoxiciity)

for primary needs…

Connection
Purpose
Safety
SEROTONIN
(inhibitory, neuroplasticity)

With a dose of fear for good measure

CORTISOL
(neurotoxiciity)

The Solution — Freeing the Hostage Brain

- **First — Increase the ATP**

  Down the ROS (environmental toxins, diet (sugar), antioxidants)
  Down the insulin (diet, exercise)
  Down the dopamine (hedonic limitation)
  Down the cortisol (cellphone detox, meditation, sleep)

The Solution — Freeing the Hostage Brain

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- **Second — Use that ATP to increase the neuroplasticity**

  Up the serotonin (connection, purpose, grief-joy, psychedelics)
  Up the BDNF (exercise)
  Down the cortisol (Turn off the TV! Delete your newsfeed!)
  Amygdala Insula Retraining

The Solution — Freeing the Hostage Brain

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  - Down the ROS (environmental toxins, diet (sugar), antioxidants)
  - Down the insulin (diet, exercise)
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  - Down the cortisol (cellphone detox, meditation, sleep)

- **Second — Use that ATP to increase the neuroplasticity**
  - Up the serotonin (connection, purpose, grief-joy, psychedelics)
  - Up the BDNF (exercise)
  - Down the cortisol (Turn off the TV! Delete your newsfeed!)
  - Amygdala Insula Retraining

- **The easy answer — f**k the saboteurs**

Summary

➔ Dysfunction of the amygdala is at the source of health and societal devolution

➔ Fear used to be a reinforcement for learning by the amygdala, now it is a toxic stimulus

➔ The **hippocampus** and **prefrontal cortex** are the cerebral brakes on the amygdala, but both are damaged due to chronic overstimulation by dopamine and cortisol

➔ Serotonin from the **afferent vagus nerve** is the visceral brake on the amygdala, but it is scarce due to ultraprocessed food and changes in the microbiome

➔**Oxytocin** sets the amplitude for the amygdala response, but methylation of its receptor reduces its action

➔ Cortisol decreases neuroplasticity; Serotonin increases neuroplasticity

➔ ROS's are normal products of mitochondrial metabolism, but feedback to divert energy and reduce ATP generation; must be quenched by anti-oxidants.

➔ **Hypothesis:** a. Exposures ⟶ brain ROS's ⟶ reduced mitochondrial ATP generation.

➔ b. Stress and cortisol ⟶ increased ATP utilization.

➔ c. ATP depletion ⟶ misfolding and plaques; Energy diversion ⟶ glycogen and tangles.

➔ d. ROS's promote inflammation ⟶ microglial activation ⟶ neuron loss and dementia.

➔ Reduce ROS's (exposures, diet, anti-oxidants) to increase ATP, stress reduction to increase neuroplasticity and serotonin, **CHANGE YOUR ENVIRONMENT TO CHANGE YOUR BRAIN**

Summary

➔ Dysfunction of the amygdala is at the source of health and societal devolution

➔ Reduce ROS's (exposures, diet, anti-oxidants) to increase ATP, stress reduction to increase neuroplasticity and serotonin, **CHANGE YOUR ENVIRONMENT TO CHANGE YOUR BRAIN**

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