



Our Exponential Healthcare Future: Navigating Uncertainty

Dr. Tiffany Vora
September 18, 2024

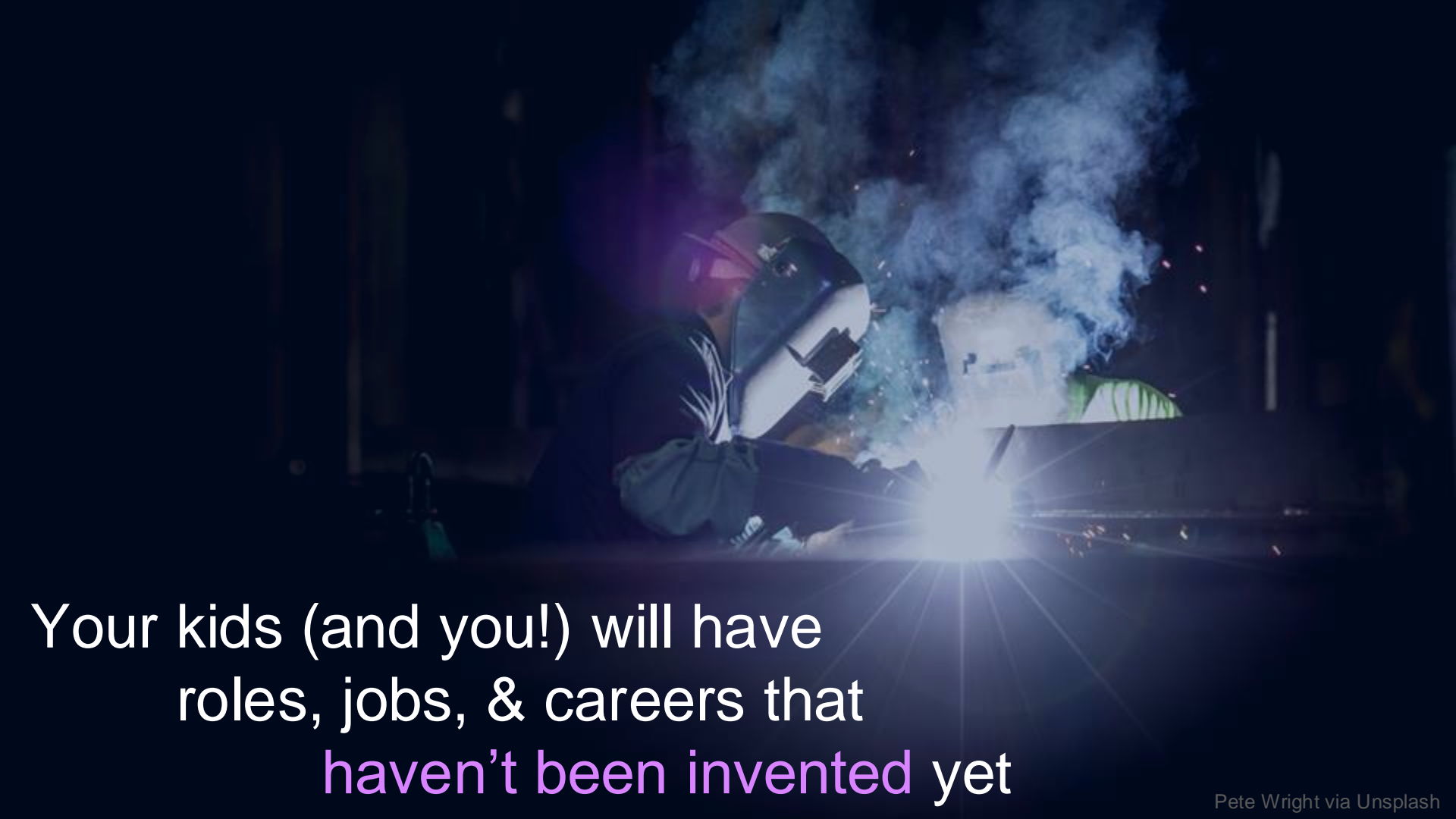
How long will **you** live?



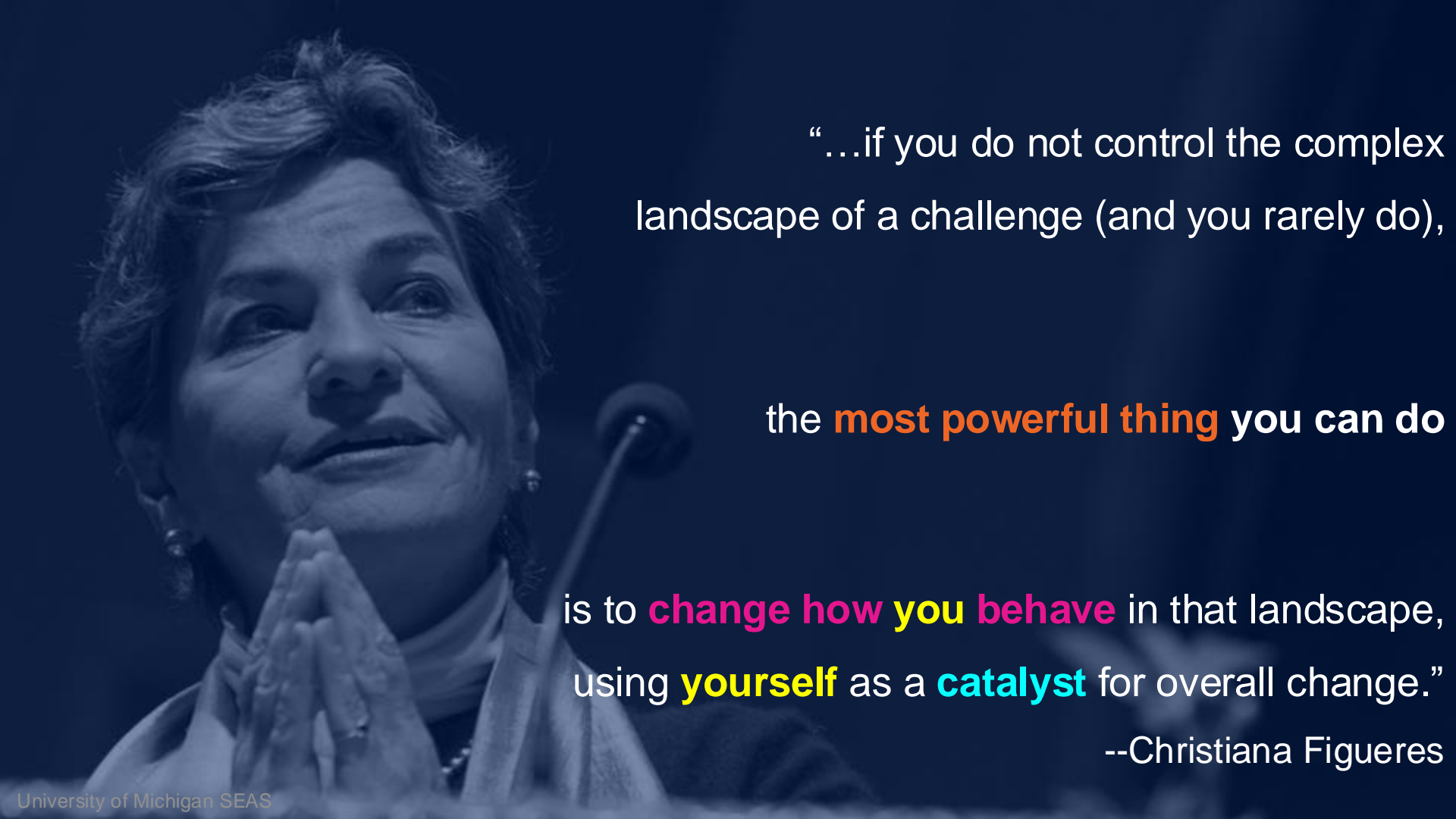


How do you **feel** about the future?

The future is **yet to be written**



Your kids (and you!) will have
roles, jobs, & careers that
haven't been invented yet



“...if you do not control the complex landscape of a challenge (and you rarely do),

the **most powerful thing** you can do

is to **change how you behave** in that landscape, using **yourself** as a **catalyst** for overall change.”

--Christiana Figueres



Simon Berger via Unsplash

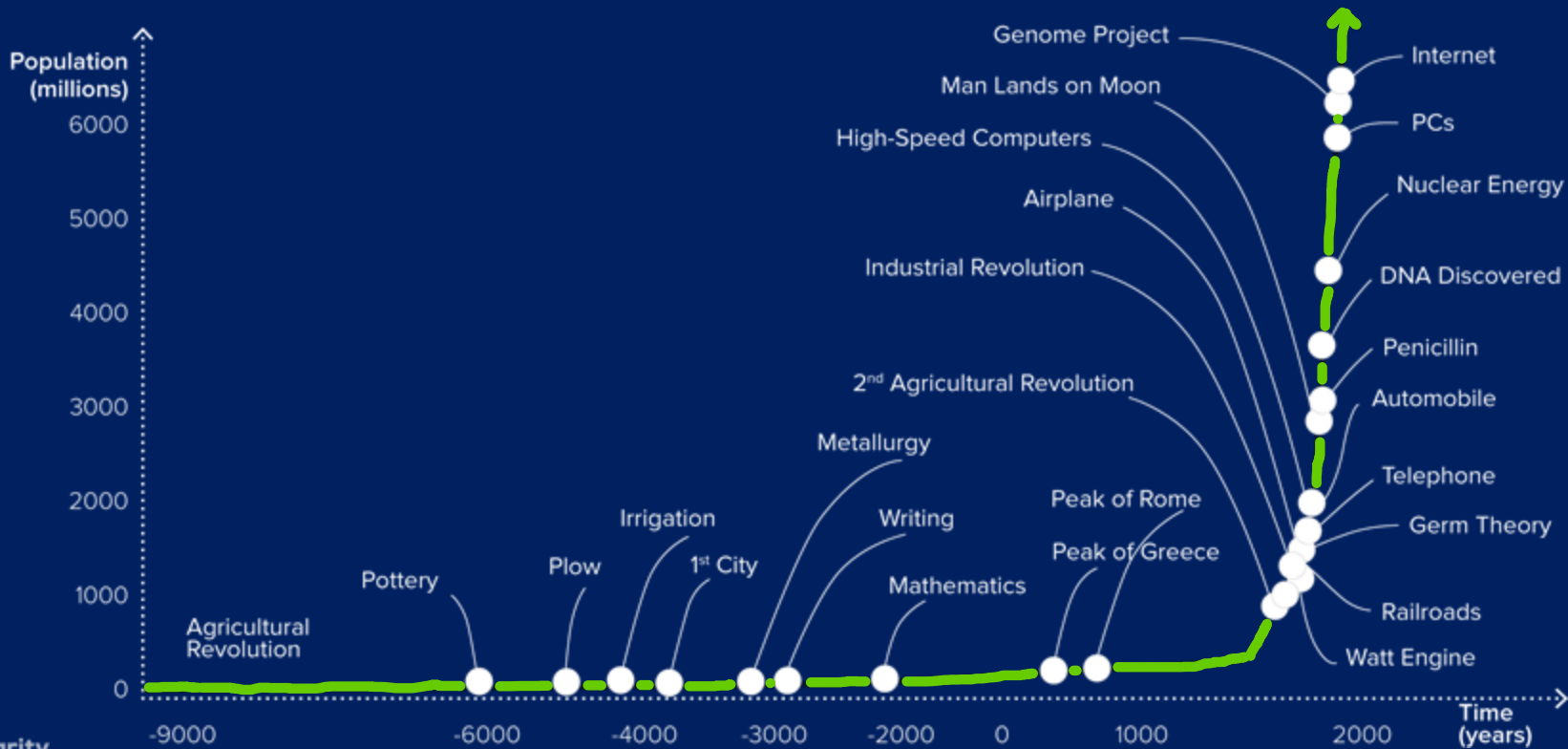


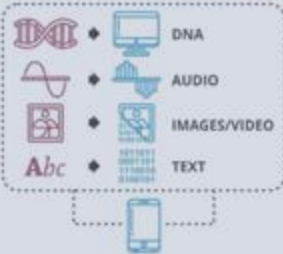
Mindset

Systems change
Radical disruption

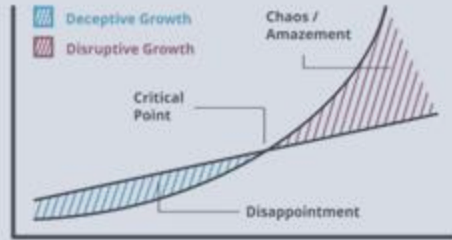
Local + Linear

Global + Exponential





Digitized



Deceptive - Disruptive



Dematerialized

	ENIAC	iPhone 7
YEAR	1946	2016
SPEED	1/1000 Ghz	2.38 Ghz
WEIGHT	30 Tons	138 grams
COST	\$500,000	\$850

Demonetized



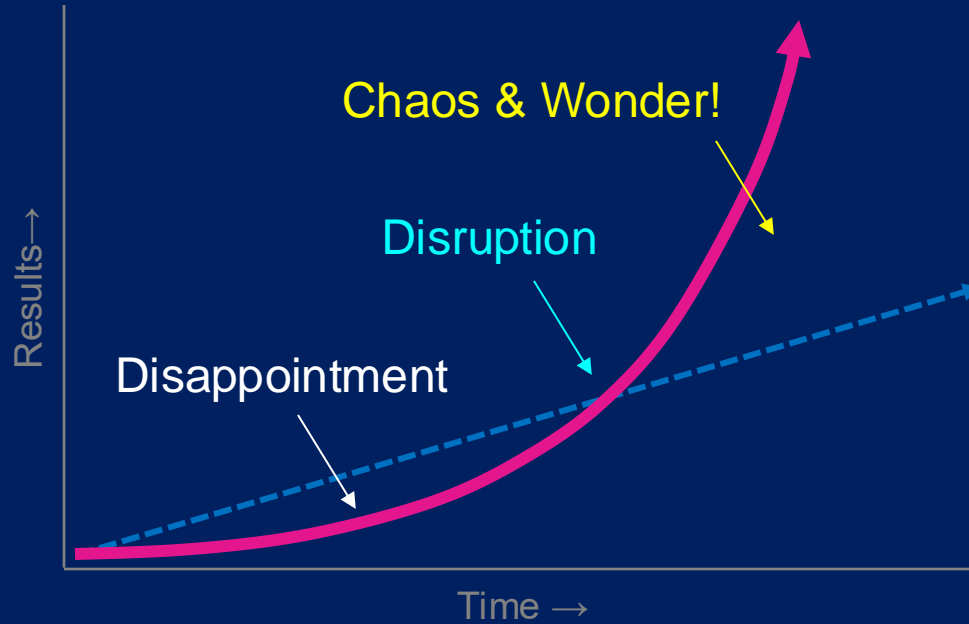
Democratized

Decentralized



Systems change
Radical disruption

Gradually, then suddenly

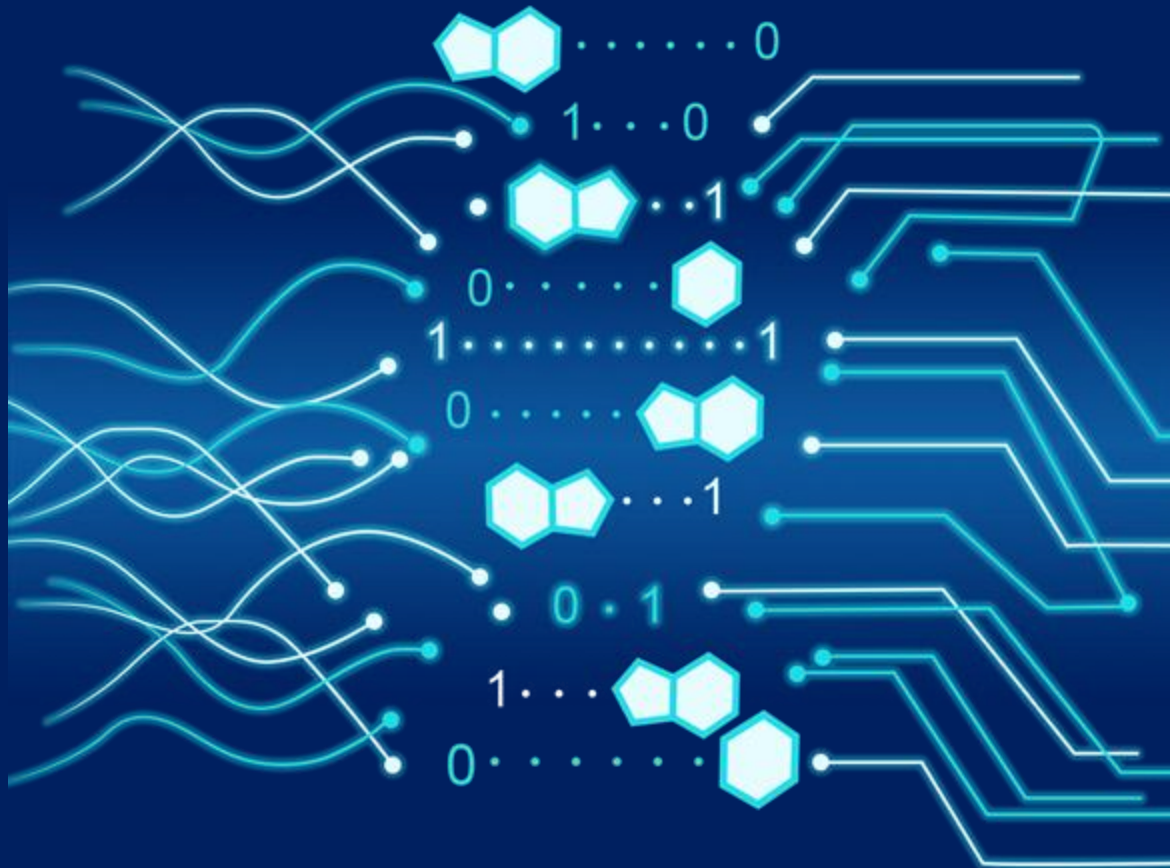
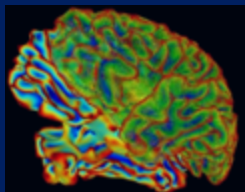




“We tend to **overestimate** the effect
of a technology in **the short run**

and **underestimate** the effect
in **the long run.**”

--Dr. Roy Amara, Institute for the Future



CASE STUDY

DNA Sequencing and Digital Biology



2000

2010

Genetic Code of Human Life Is Cracked by Scientists

JUSTICES REAFFIRM MIRANDA RULE, 7-2; A PART OF 'CULTURE'

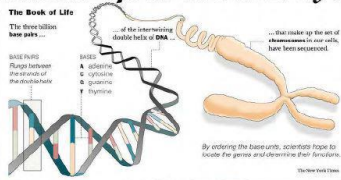
By LINDA GREENHOUSE

WASHINGTON, June 26 — The Supreme Court reaffirmed its 1966 Miranda decision today by a 7-2 vote that ruled to strike over the side of the high court's rulings of earlier times and acknowledged that the Miranda warnings have become part of our national culture.

The case led to an opinion by Chief Justice William H. Rehnquist that because the 1966 Miranda decision "announced a constitutional rule," a statute by which Congress had sought to override the decision was itself unconstitutional.

Miranda had appeared to be in jeopardy, both because of that long-ignored but recently redoubled law. So while Congress had tried to override Miranda 33 years ago, and because of the court's perceived hostility to the original decision.

The court never said though, that it had to do so. It could have struck down the statute without the Miranda warnings with a case-by-case basis of whether confusion and ambiguity would be settled only if the Supreme Court decided to overturn Miranda. But with Miranda having become embedded in routine police practice "without causing any measurable difficulty for government," there was no justification for doing



Science Times
 A SOURCE OF
 ■ Funding for genome research
 ■ Some researchers have already said research is done
 ■ Inevitably, the results will be mixed
 ■ From Monday to Wednesday
 ■ More articles, charts and photos of the genome project
 Section 2

Francis S. Collins, head of the Human Genome Project, left, with J. Craig Venter, head of Celera Genomics, after the announcement yesterday that they had finished the first survey of the human genome.



A SHARED SUCCESS

2 Rivals' Announcement Marks New Medical Era, Risks and All

By NICHOLAS WADE

WASHINGTON, June 26 — In an achievement that represents a decade of human self-knowledge, two rival groups of scientists said today that they had sequenced the hereditary script, the set of instructions that defines the human organism.

Today we are starting the language in which God created life," said Francis S. Collins, head of the Human Genome Project, in a ceremony attended by members of the two teams. Dr. James Watson, co-discoverer of the structure of DNA, and Viscountess Priscilla Beaulieu, Baroness of Britain, (Express, Page 10).

The project leader, Dr. J. Craig Venter, president of Celera Genomics, and Dr. Francis S. Collins, director of the National Human Genome Research Institute, greeted each other's congratulations and agreement to share the data.

The human genome, the actual content of two sets of 23 giant DNA molecules, or chromosomes, with each set — one inherited from each parent — containing more than three billion chemical units.

A Pearl and a Hodgépodge: Human DNA

2020

The New York Times

Pfizer's Early Data Shows Vaccine Is More Than 90% Effective

Pfizer announced positive early results from its coronavirus vaccine trial, cementing the lead in a frenzied global race that has unfolded at record-breaking speed.

By Katie Thomas, David Soltis and Carl Zimmer
 Published Nov. 9, 2020
 Copyright © 2020 The New York Times Company

Revolution Postponed: Why the Human Genome Project Has Been Disappointing

The Human Genome Project has failed so far to produce the medical miracles that scientists promised. Biologists are now divided over what, if anything, went wrong—and what needs to happen next

By Stephen S. Hall on October 1, 2010



Early Data Show Moderna's Coronavirus Vaccine Is 94.5% Effective

The New York Times

Moderna is the second company to report preliminary results from a large trial testing a vaccine. But there are still months to go before it will be widely available to the public.

By Denise Grady
 Nov. 16, 2020 Updated 1:49 p.m. ET

2001
USD \$2.7B

Cost



EXCLUSIVE

STAT+

Ultima Genomics launching high-end DNA sequencers that can read genome for \$100



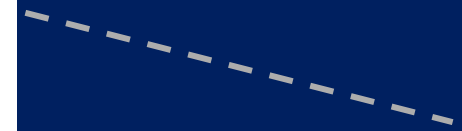
By Jonathan Wosen Jan. 30, 2024

Reprints



ADOBE

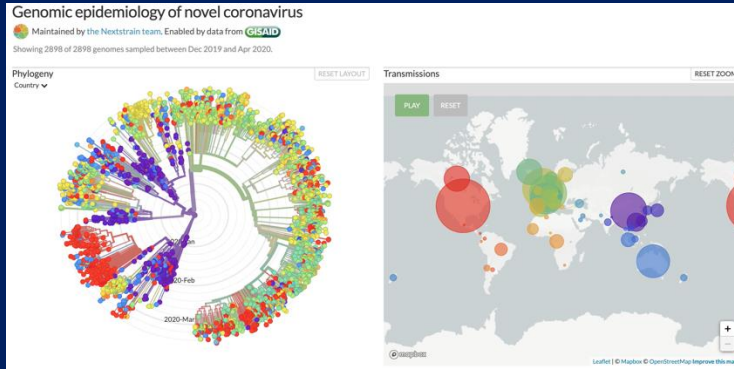
USD \$100



2022

USD \$525





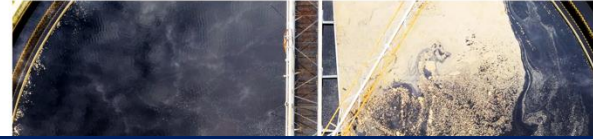
Sewage Sampling Already Tracks Covid. What Else Can It Find?

Everyone poops—and that reveals traces of pathogens. Comprehensively analyzing wastewater could help find flu and detect the next pandemic.

MARYN MCKENNA

SCIENCE

FEB 14, 2022 7:00 AM



WIRED

THE WHITE HOUSE



SEPTEMBER 12, 2022

Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy

BRIEFING ROOM PRESIDENTIAL ACTIONS

Section 1. Policy. It is the policy of my Administration to coordinate a whole-of-government approach to advance biotechnology and biomanufacturing towards innovative solutions in health, climate change, energy, food security, agriculture, supply chain resilience, and national and economic security.

Dozens of Top Scientists Sign Effort to Prevent A.I. Bioweapons

An agreement by more than 90 said, however, that artificial intelligence's benefit to the field of biology would exceed any potential harm.

The New York Times

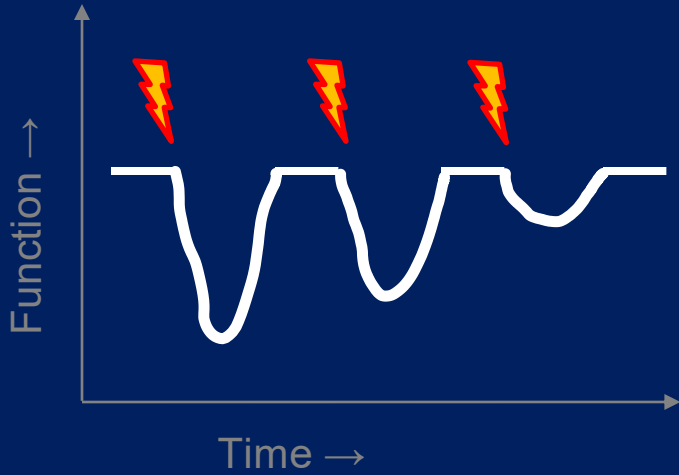


By Cade Metz

Reporting from San Francisco

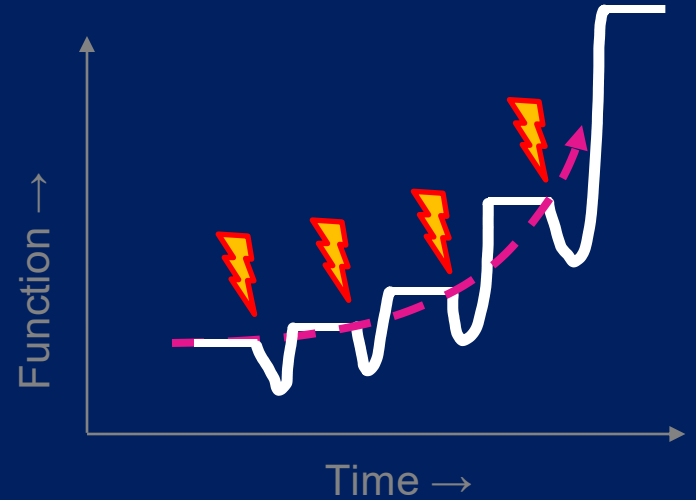
March 8, 2024

Resilience Has Changed ...



Polycrisis

... Because Baseline Is Changing



How **ready** are we for these futures?

Good to go!

Major work to do

Organization



Personally





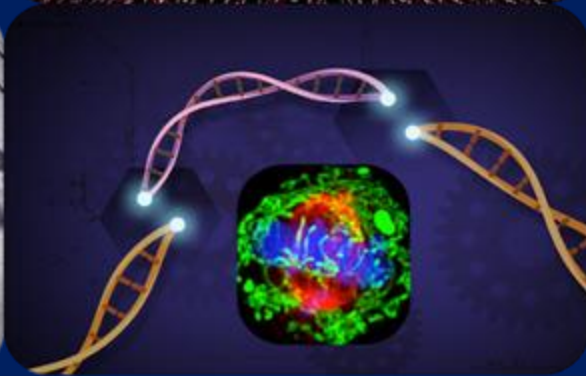
Systems change
Radical disruption

FAR HORIZON

DNA & Biomedical Data



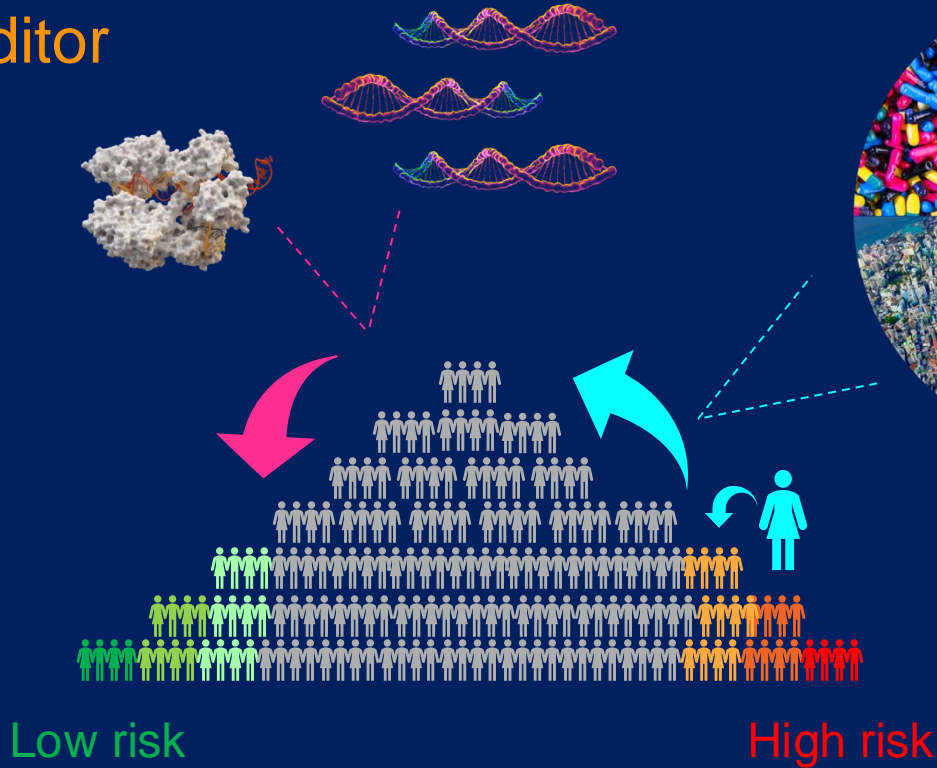
New Roles, Businesses



Trust



Biomed AI bias auditor




MEGAN MOLTENI

SCIENCE OCT 11, 2018 2:04 PM

WIRED

Genome Hackers Show No One's DNA Is Anonymous Anymore

Consumer genomics is making it easier than ever to identify individuals from anonymous DNA databases. Even if you've never spit in a tube.



“Losing your DNA is not like losing a credit card. You can order a new credit card, but you **cannot replace your DNA**. The loss of your DNA not only affects you, but your relatives and, potentially, **generations to come**.”

--National Counterintelligence & Security Center

Could mRNA make us superhuman?

(Image credit: Getty Images)

BBC

By *Tim Smedley* 22nd November 2021

Until recently most people had never even heard of mRNA vaccines. Now scientists believe they may be the key to solving a wealth of health problems.

MIRNATY™
concentrate

Rewriting Life

EXCLUSIVE: Chinese scientists are creating CRISPR babies

A daring effort is under way to create the first children whose DNA has been tailored using gene editing.

by Antonio Regalado November 25, 2018

MIT
Technology
Review



GOVINFO SECURITY®

Fertility Clinic Hacking Incident Affected Nearly 80,000

Practice Says Patient PHI, PII Compromised, But Not EMR System

Marianne Kolbasuk McGee ([HealthInfoSec](#)) • January 7, 2022



DNA PR Manager

Tech Policy

The biggest technology failures of 2018

From gene-edited babies to guaranteed-fatal brain uploads, it was a bumper year for technology misfires and misuses.

by Antonio Regalado

MIT
Technology
Review

Dec 27, 2018

Gattaca

1997 · PG-13



TheScientist
EXPLORING LIFE, INSPIRING INNOVATION

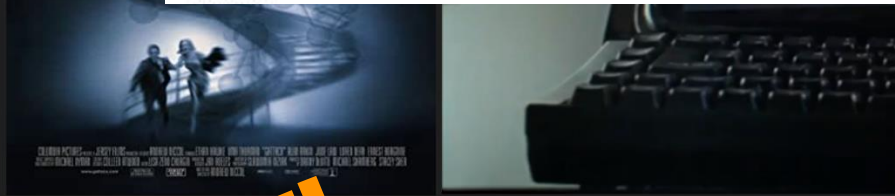
NEWS & OPINION MAGAZINE

Home / News & Opinion

China Is Using DNA from Uighurs to Predict Physical Features

An investigation reveals that the government is developing technology to try to reconstruct a person's appearance based on a genetic sample, raising concerns for the rights of Muslim minority groups in the country.

Catherine Offord
Dec 3, 2019



Drama Sci-Fi Thriller

DNA escrow officer

A genetically inferior man assumes the identity of a superior one in order to pursue his dream of space travel.

Director [Andrew Niccol](#)

Writer [Andrew Niccol](#)

Stars [Ethan Hawke](#) · [Uma Thurman](#) · [Jude Law](#)



IMDb RATING
★ 7.8/10
306K

YOUR RATING
☆ Rate

POPULARITY
🔥 1,557 166



▶

2 VIDEOS

Mass DNA Collection in the Tibet Autonomous Region from 2016–2022

By [Emile Dirks](#) September 13, 2022



Key Findings

- Analyzing 100 publicly available sources, we find that since June 2016 China's police have conducted a mass DNA collection program in the Tibet Autonomous Region. Out of the 100 sources we analyzed, 44 contained figures for the number of DNA samples police had collected in particular areas of Tibet. Based on our analysis of these 44 reports, we estimate that between June 2016 and July 2022, police may have collected between roughly 919,282 and 1,206,962 DNA samples, representing between one quarter (25.1%) and one third (32.9%) of Tibet's total population (3.66 million).
- Police have targeted men, women, and children for DNA collection outside of any ongoing criminal investigation. In some cases, police have targeted Buddhist monks. Authorities have justified mass DNA collection as a tool to fight crime, find missing

PHOTOS

score

FAR HORIZON

Algorithms & Robotics

Digital biomarkers

- ✓ Mental health
- ✓ Cognitive health
- ✓ Motor function
- ✓ Developmental milestones
- ✓ Recovery, healing
- ✓ Clinical trials



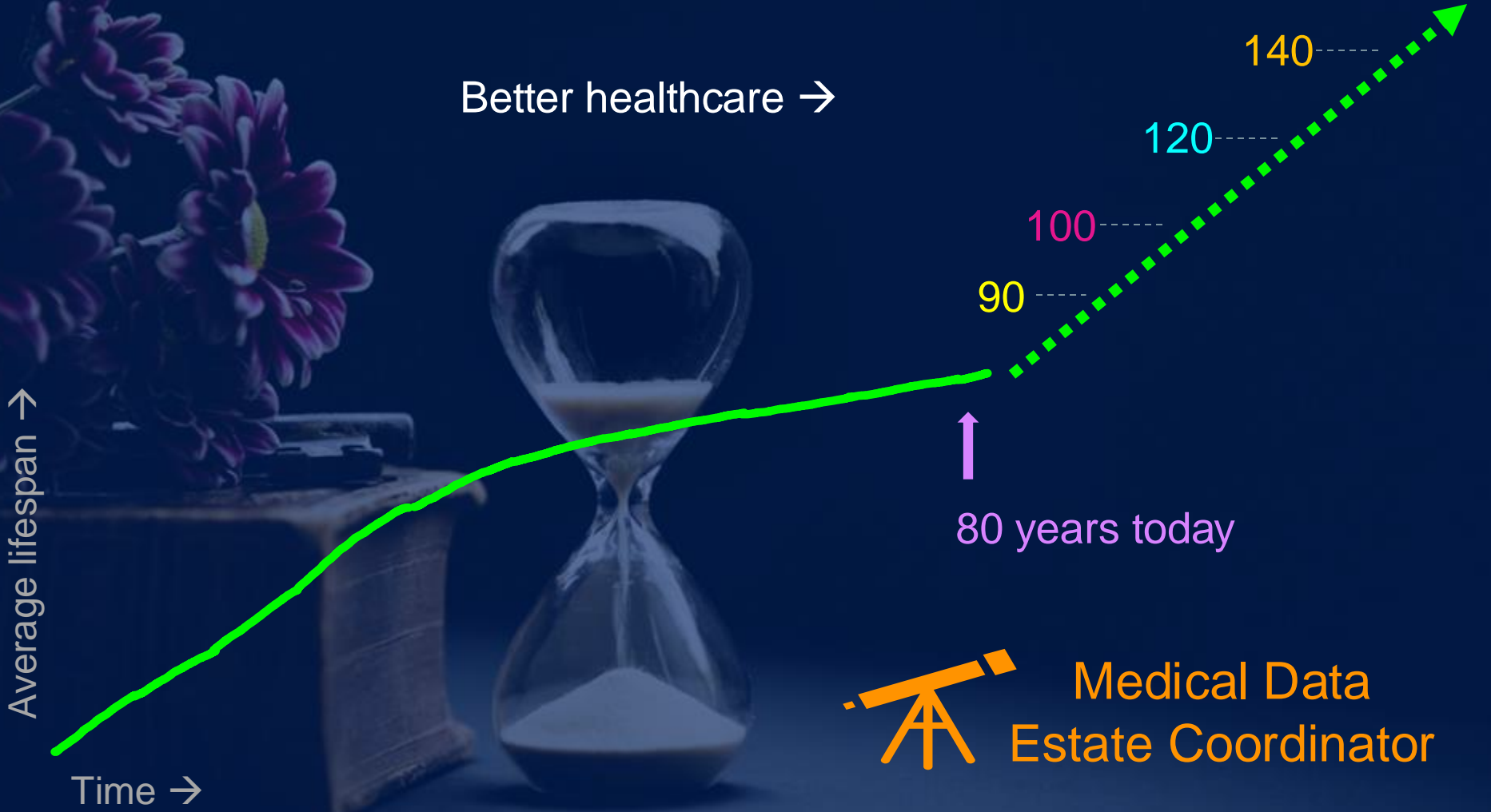
Digital health counselor

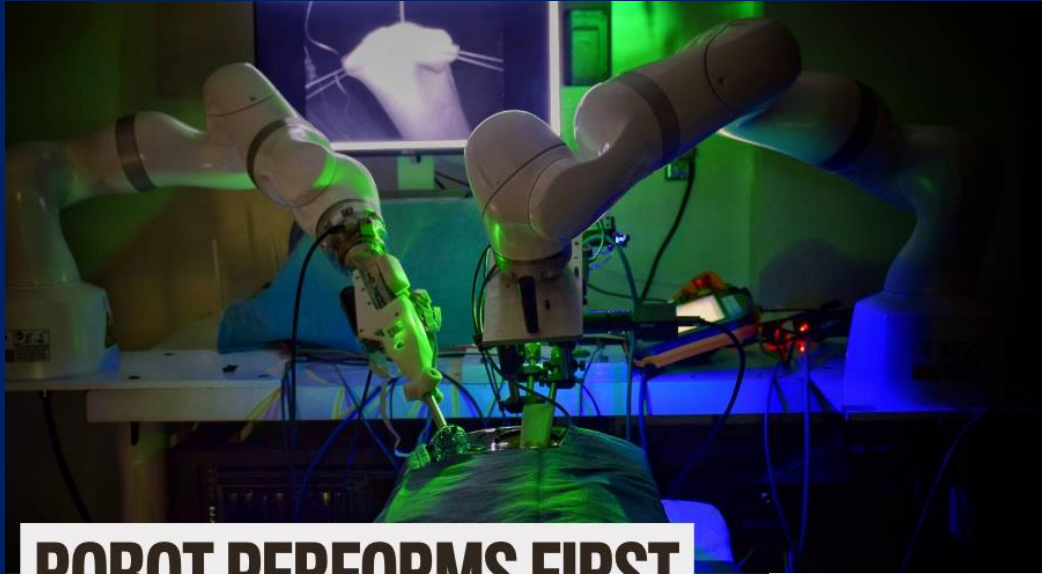
Who owns the data?

Who controls permission?

✓ Cybersecurity

Who do you trust?





ROBOT PERFORMS FIRST LAPAROSCOPIC SURGERY WITHOUT HUMAN HELP

 **JOHNS HOPKINS**
UNIVERSITY

HUB 

In four experiments on pig tissues, the robot excelled at suturing two ends of intestine—one of the most intricate and delicate tasks in abdominal surgery

Catherine Graham /  Jan 26

AUG 3, 1:00 AM EDT / BY VICTOR TANGERMANN

ROBOT PERFORMS FIRST EVER FULLY AUTONOMOUS DENTAL SURGERY ON LIVE PATIENT

THE COMPANY CLAIMS IT'S EIGHT TIMES FASTER THAN A HUMAN DENTIST.

NEOSCOPE



Health records



Robotics



5G

Connectivity



Augmented reality



Artificial intelligence

Virtual reality



Feedback



Telemedicine

“AI *plus* the scientists
or AI *plus* the clinicians
will replace the clinicians without AI.”

--Dr. Ping Zhang, Ohio State University



Human-machine teaming manager

DEEP MEDICINE

HOW ARTIFICIAL
INTELLIGENCE
CAN MAKE
HEALTHCARE
HUMAN AGAIN

ERIC TOPOL

With a foreword by
ABRAHAM VERESHKIN,
author of *Cracking the Code*



Human-Machine
Teaming Manager



Biomed AI
Bias Auditor



These images were made with resp. from DallE

Digital Health
Counselor



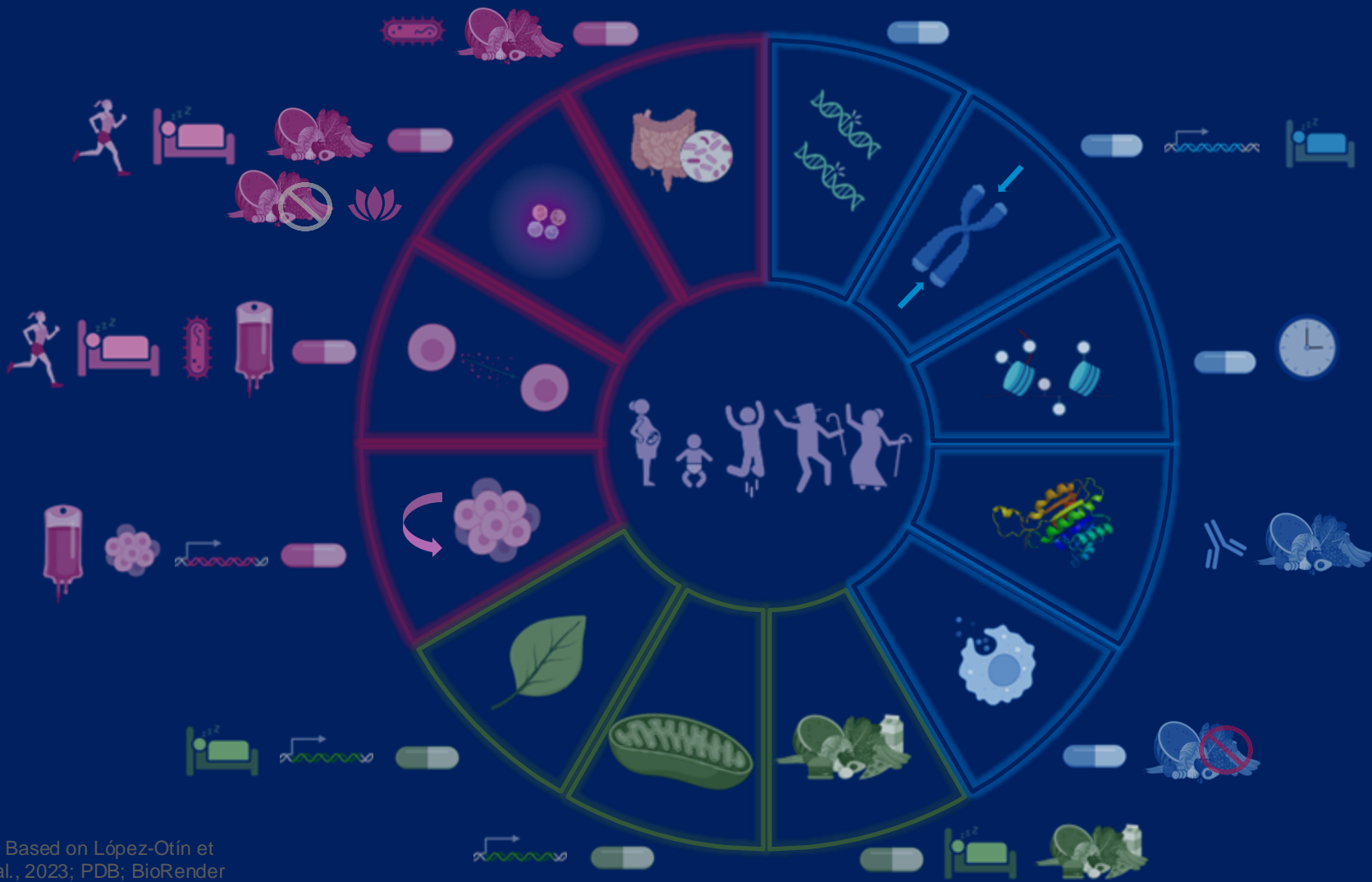
DNA PR
Manager



FAR HORIZON?

Longer, Healthier Lives

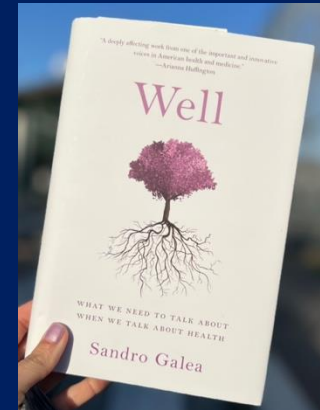
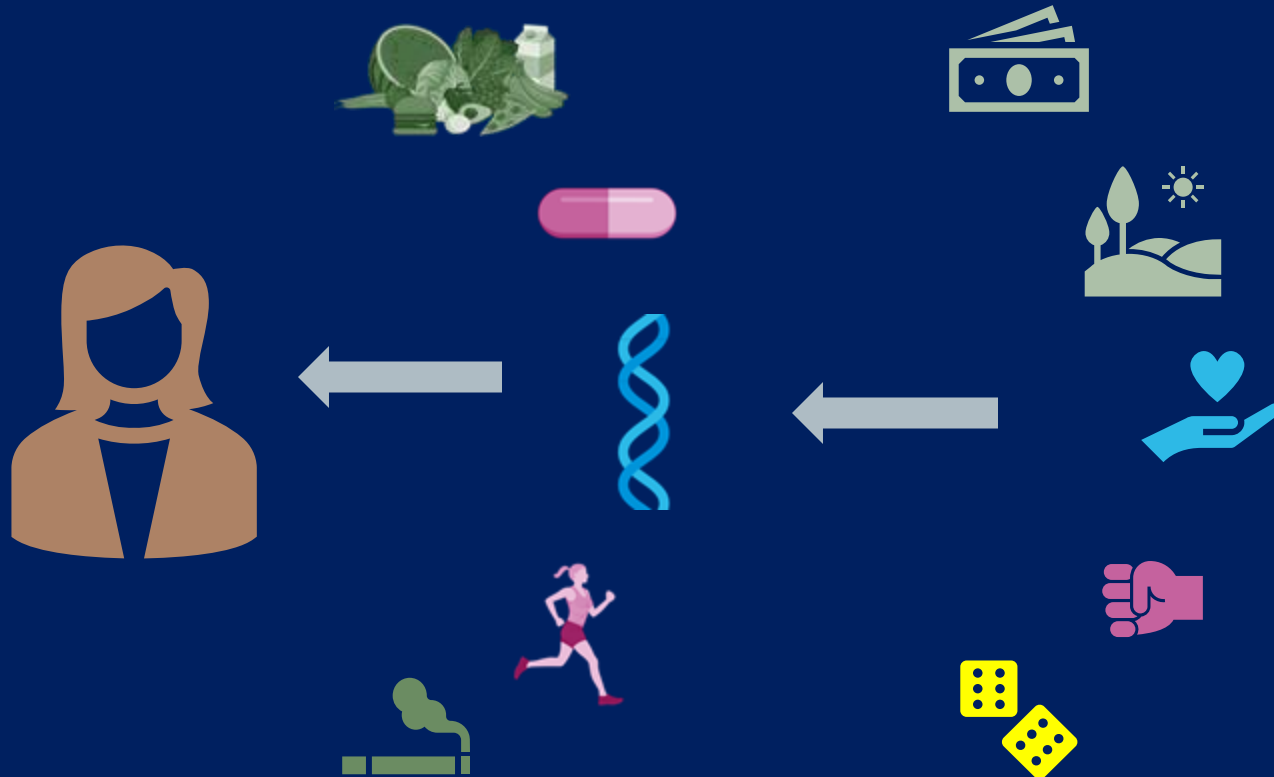




Based on López-Otín et al., 2023; PDB; BioRender

“Healthcare can secure the temporary absence of disease, which is not the same as health.”

--Dr. Sandro Galea, Prof, & Dean, BU





Scientific

Technological

Economic

Environmental

Political

Social

What if
120
is the next 80?

120

140

160

180



Scientific

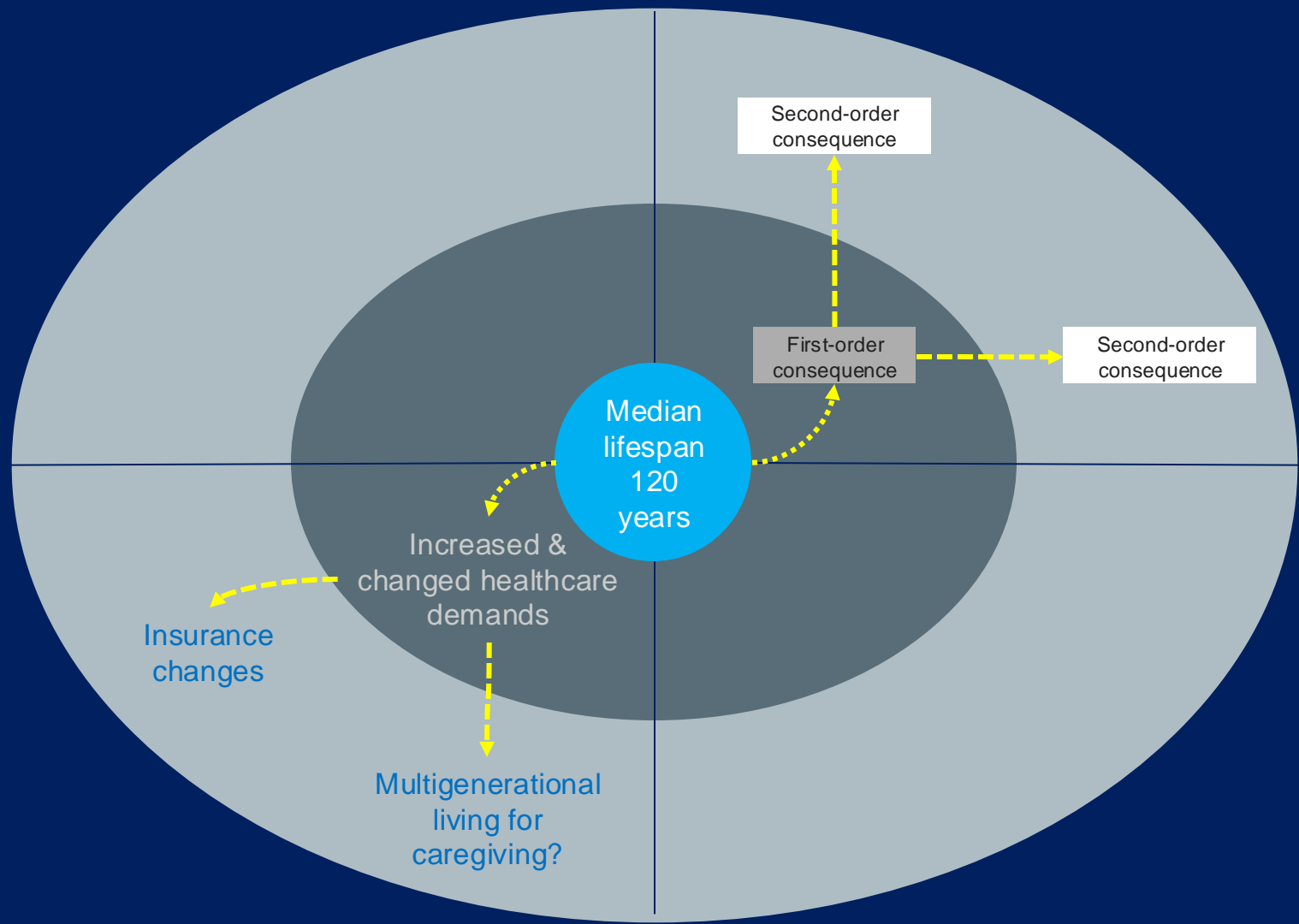
Technological

Economic

Environmental

Political

Social



Scientific

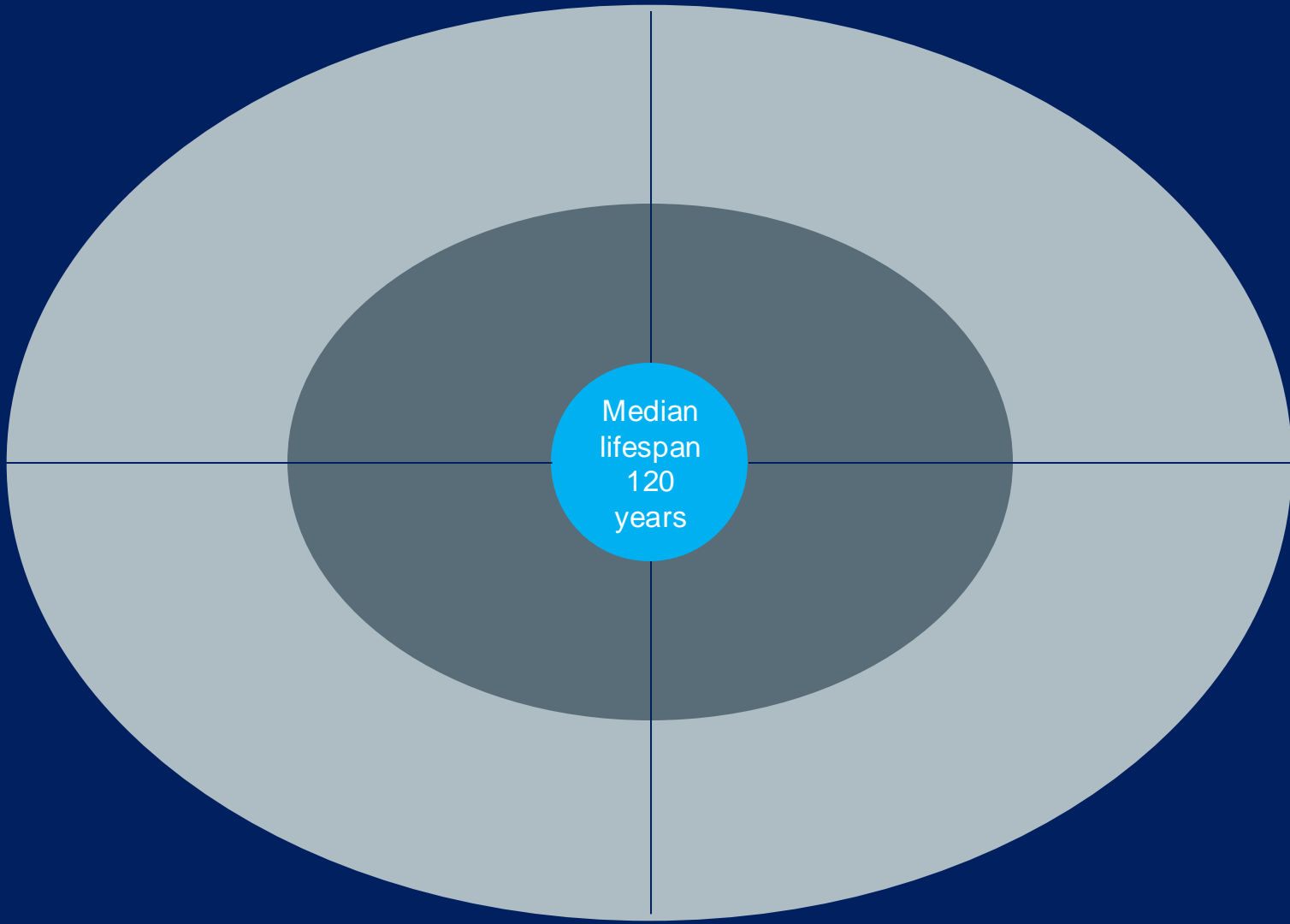
Technological

Economic

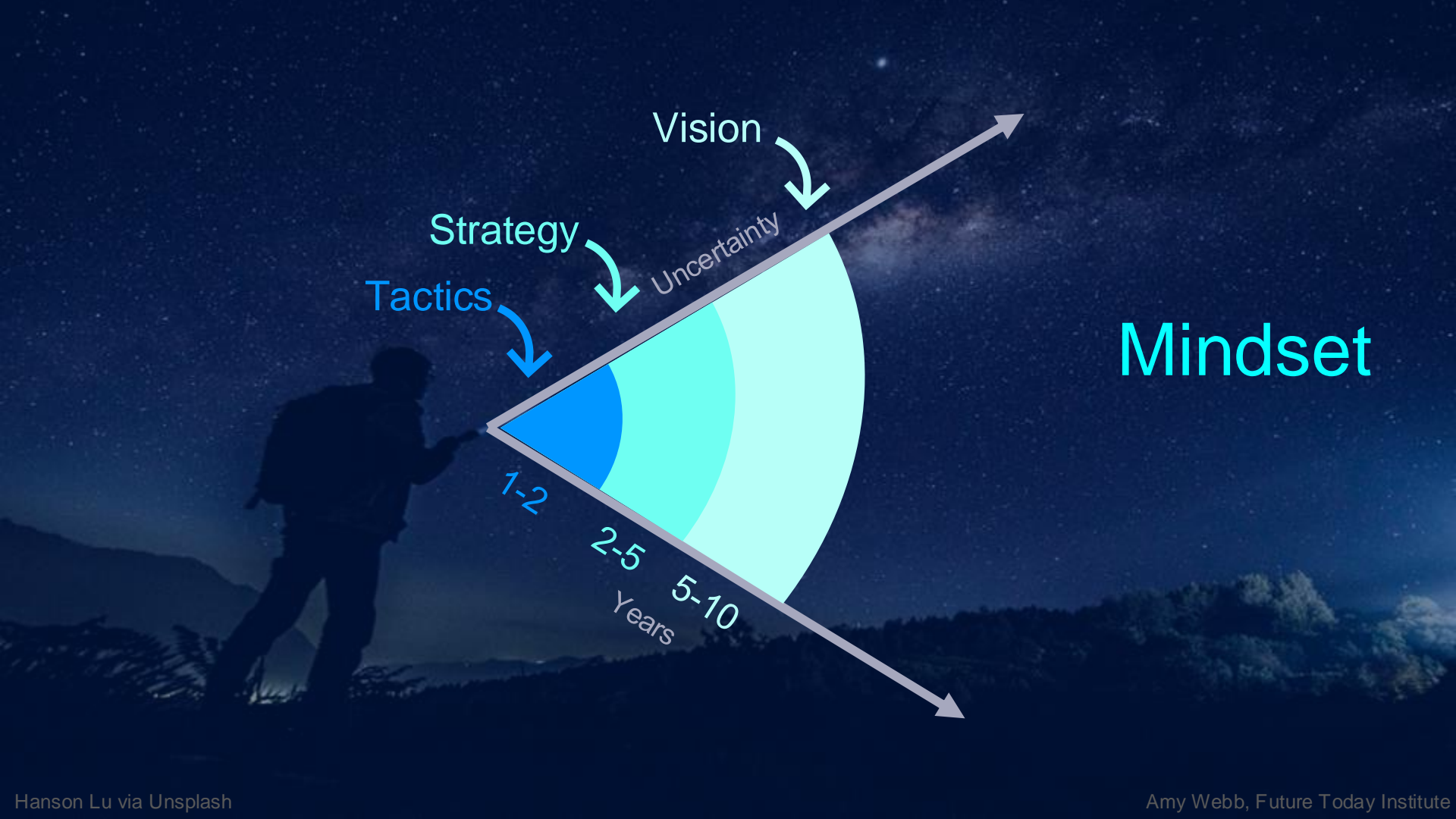
Environmental

Political

Social







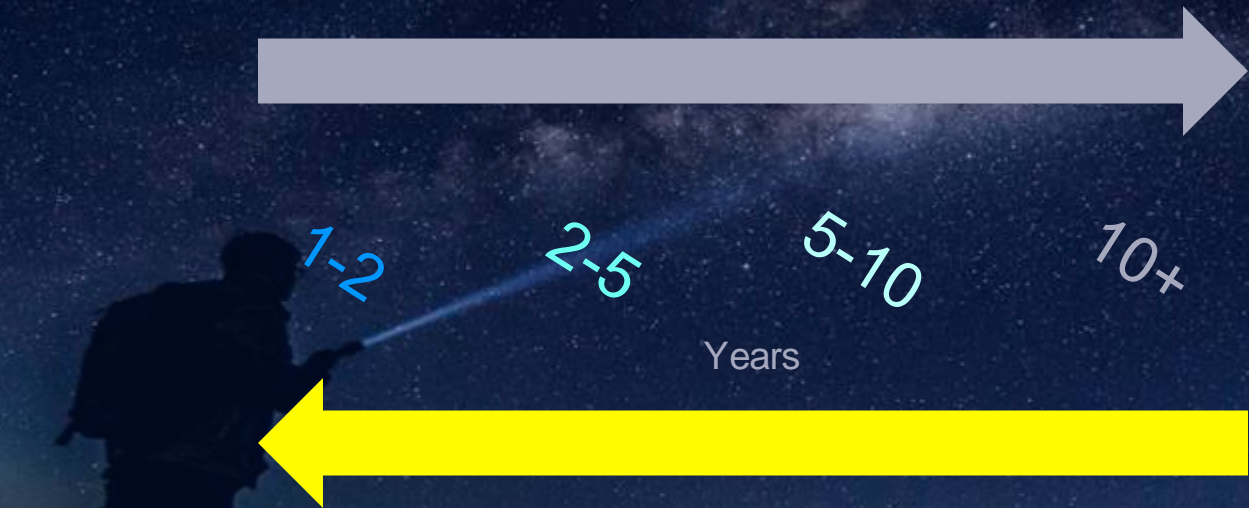
Mindset

Envision the Extremes

Success in 20 years



Failure in 20 years



How many **miracles**? Which ones?

Success in 20 years

... AND

A new thought or detail!

... AND





Isn't that **interesting**?

How can I help build
the **best possible future(s)**?

Our Exponential Healthcare Future: Navigating Uncertainty



Remind me that we met at the
AOHC conference!

hello@tiffanyvora.com



[@tiffanyjvora](https://www.instagram.com/tiffanyjvora)

Dr. Tiffany Vora
September 18, 2024