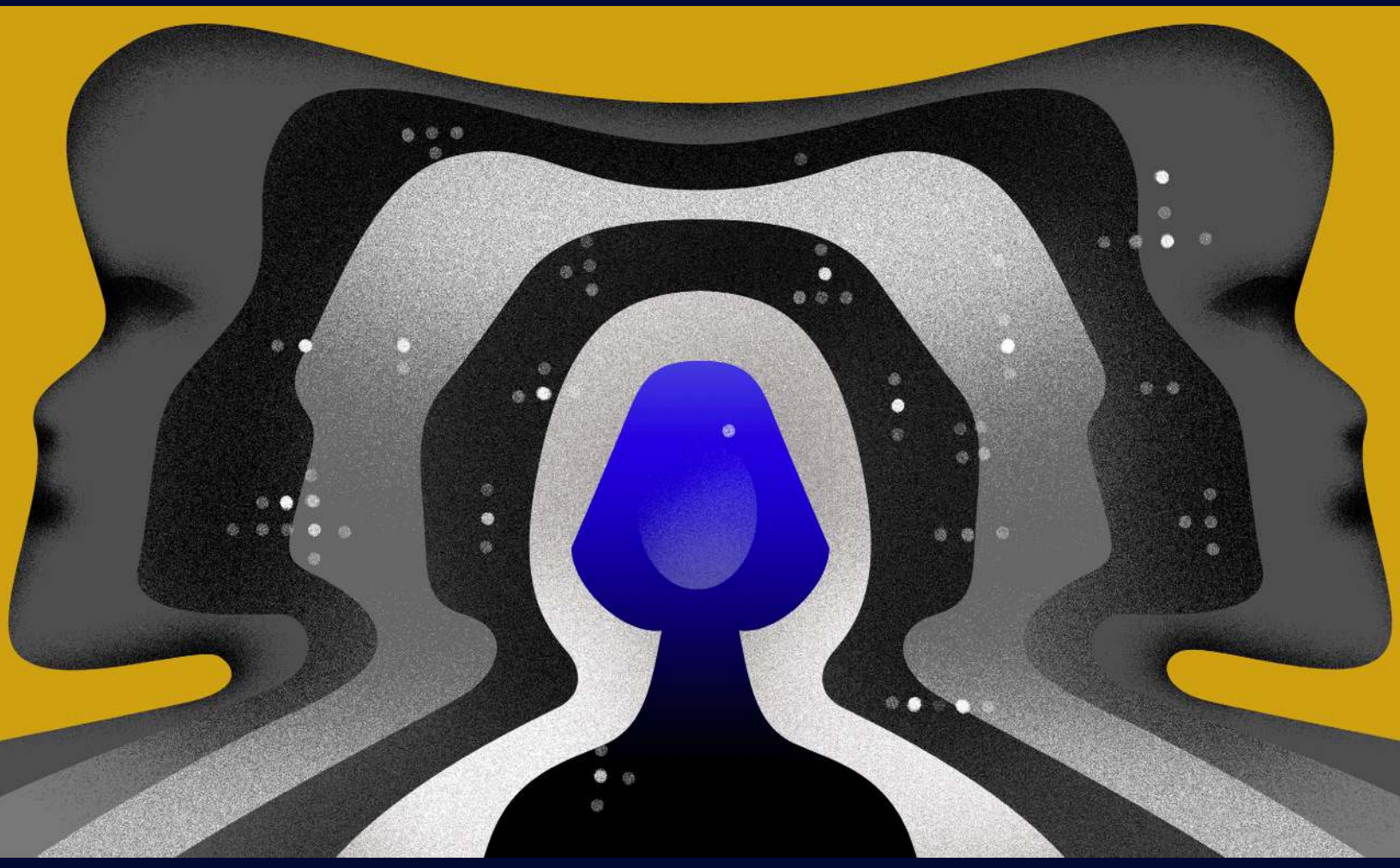
Trends to Watch in 2019 & Beyond



Acknowledgements

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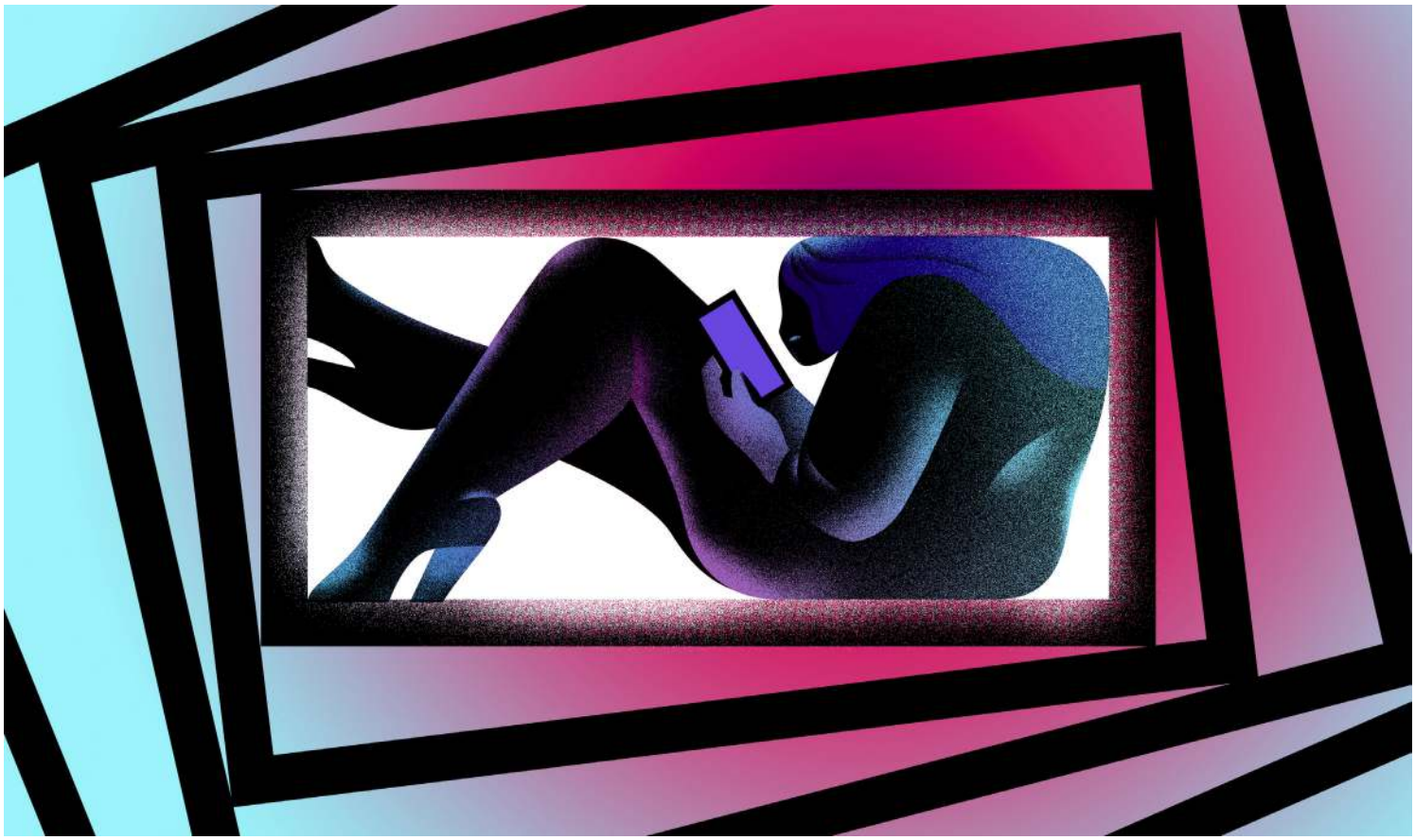

A Mental Health Pandemic: Is the World Getting More Addicted, Anxious, and Lonely?

Mental health issues today have almost become pandemic.

Depression and anxiety in particular are increasing rapidly, with much still clinically under- and undiagnosed. This pattern is persistent around the world. The World Economic Forum estimated that direct and indirect costs of mental health amount to over 4 percent of global GDP, more than the cost of cancer, diabetes, and chronic respiratory disease combined. This could cost the global economy up to $16 trillion between 2010 and 2030 if a collective failure to respond is not addressed. Some of this global rise could be attributed to spreading norms around treatment; but hypotheses persist that mental health of global populations is increasingly at risk, in part due to a confluence of societal factors, such as: the stress of migration and cultural integration (including among refugee populations); an increasingly polarized world fueled by "us versus them" narratives; lack of available economic and employment opportunities; persistent gender- and race/ethnicity-based inequality, discrimination, and violence; shifting cultural norms and a feeling of "culture under threat"; and the role of

tech and social media, fueling everything from tech addiction to loneliness to body image issues. Furthering this trend is the opioid crisis, with signs of it being exported from the US to the rest of the world.

Part A: Mental Health Challenges on the Rise

Patterns Among What Is Getting Worse: Depression, Anxiety, and Loneliness

It was estimated by the World Health Organization (WHO) in 2015 that more than 322 million people have depression—about 4 percent of the world's population, an increase of 18.4 percent between 2005 and 2015. Loneliness is also on the rise. A recent study found that over 9 percent of adults in Japan, 22 percent in the US, and 23 percent in the UK always or often feel lonely or isolated. While this is more pervasive and rising more quickly among the young, demographic shifts, particularly aging populations in more developed markets, are leading to an increase in social isolation. From 1980 to 2015, the number of seniors in Japan living alone increased more than six-fold, to almost 6 million, resulting in some unusual actions, including lonely seniors, typically women, shoplifting in search of the community and stability of jail. More than half of seniors caught shoplifting live alone; 40 percent either don't have family or rarely speak with relatives. These people often say they have no one to turn to when they need help.

Technology Plays a Significant Role, Especially as an Amplifier

We know the "usual suspects," mental health issues resulting directly from technology—addiction, as social media platforms use the same techniques as gambling firms to create psychological dependencies and real imbalance of brain chemicals among teens that resembles depression and anxiety; and smartphone anxiety, including "low-battery anxiety," "nomophobia", the fear people can feel when they are out of mobile contact, even FOMO (fear of missing out), which has nearly 23 percent of students in India logging more than eight hours on their smartphones daily. The dependency is strong and globally pervasive, with nearly all of the 60 percent of Kenyans who own smartphones saying they find it hard to put them down. In China and South Korea, tech rehab camps are now common, and the World Health Organization officially recognizes video game addiction as a mental health disorder.

But there is evidence to suggest that we are just hitting the tip of the iceberg of tech-enabled mental health issues. Twenty-four/seven access to information can cause a kind of collective anxiety and helplessness. Researchers using health-monitoring devices found that entire populations' sleeping habits, heart rates, and distances walked can swing out of sync after large societal events (e.g., Brexit)—and much of this is heightened by a constant cycle of social media and digital news. We also see this manifesting socio-culturally. Smartphone use has replaced many in-person conversations. We are talking to each other less and having fewer meaningful conversations which can increase feelings of loneliness and anxiety. Not only are more people, particularly digital natives, craving "IRL" (in real life) connection, but studies have shown that people felt better and more connected during times when they only socialized face-to-face. This level of social disconnection can also endanger health. Loneliness has been alleged to have the same impact on life expectancy as smoking 15 cigarettes a day, with a risk factor that rivals excessive drinking or obesity. A lack of social contact can also speed up cognitive decline, heart disease, depression, and suicide. And, smartphones are methodically killing off boredom, which has a very important role in creativity. The seeds of ideas that may come from idle reflection are being replaced by constant distraction. And constant distraction—which causes dopamine to spike when confronted with newness and novelty, addictive but inherently unfulfilling, does not lead to a healthier mental state. Being creative, however, can.

Ultimately, we still have a less-refined understanding of what is happening at the now-pervasive nexus of mental health and technology. And things get complicated when we're also learning of many ways in which technology can improve mental health outcomes.

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Emerging Mental Health Epidemics: The US Opioid Crisis

It's difficult to talk about mental health without mentioning the US opioid crisis. The US faces a mental health epidemic; nearly 1 in 5 American adults suffering from a form of mental illness. Suicide rates are at an all-time high, 115 people die daily from opioid abuse, and 1 in 8 Americans over 12 years old take an antidepressant every day. The economic burden of depression alone is estimated to be at least $210 billion annually. People abusing opioids also often face the additional burden of depression. And while the opioid crisis is most pronounced in the US, the problem has begun migrating to Europe—which could portend an even greater, eventual global concern. The relationship between opioid abuse and depression is bi-directional, meaning that suffering from one increases the risk of the other. Many prescription opioid abusers may turn to using heroin. This addiction can lead to the feelings of hopelessness, despair, and guilt, and researchers estimate that 48 percent of people dependent on the drug will also experience depression.

Part B: Mental Health Innovations

Entrepreneurs, philanthropists, companies, and individuals have risen to the challenge, creating a range of tools and treatment options that go beyond traditional Western medicine. This includes the rise of "anti-tech tech," apps and mobile phone-based tools that help users reduce phone use (like this app recently launched in the UK that allows users to earn rewards for not going on their phones; and the MP02, designed for people who want to unplug from the world of apps and constant notifications and use a simple, stripped-down phone). In addition, other types of innovations—"technology Rx" and unusual applications of natural medicine—are being applied to mental health.

Technology Rx: Tech Tools for Mental Health

"Technology Rx" is part of the growing trend of adaptive technology that can personalize healthcare—outside of mobile phone-based apps.

Virtual Reality:

VR therapy is being used to address complex anxiety disorders, such as social anxiety, post-traumatic stress, and even paranoid schizophrenia. The Virtual Reality Medical Center in San Diego uses VR therapy as a treatment for reducing pain in patients undergoing procedures. Swedish pharmacy Apotek Hjärtat is prescribing its VR pain relief app, Happy Place, as a supplement to traditional pharmaceuticals.

Gaming:

Videogames can also be a tool in serving mental health needs. Akili Interactive Labs is creating a videogame to treat kids with ADHD. "Chill-out" games that focus on relaxation and aim to create a calming space for players are becoming more popular.

Robotic Therapists:

Woebot, the bot therapist, does not pretend to be human; it appears as a cartoon robot when it chats with you on Facebook Messenger all while doing psychological work. Researchers found that after two weeks of interacting with the bot, the test subjects had lower incidences of depression and anxiety.

Voice Analysis:

Researchers are increasingly enlisting smartphones and machine learning to find vocal patterns that might signal post-traumatic stress disorder or even heart disease. Vocal tests could be useful because they are non-invasive—people are often embarrassed to talk about their mental health, so these conditions frequently go underdiagnosed—and add a level of rigor to measurement that mental health diagnosis has traditionally lacked.

Artificial Intelligence (AI):

AI solutions can help psychiatrists and other mental health professionals do their jobs better. They collect and analyze reams of data much more quickly

than humans could and then suggest effective ways to treat patients. Ginger.io's virtual mental health services include video and text-based therapy and coaching sessions. Through analyzing past assessments and real-time data collected using mobile devices, the Ginger.io app can help specialists track patients' progress, identify times of crisis, and develop individualized care plans.

Brainwave Treatments:
While still in its infancy, technology using a patient's own brainwaves might offer hope against mental health issues such as PTSD and chronic stress, research suggests. NeuroSky technology can detect and interpret brainwaves and has even been used to develop a VR experience to help treat OCD.

New Forums and Ways to (Meaningfully) Connect

With loneliness and stigma both feeding into mental health challenges and preventing treatment, new efforts and organizations are creating community and connection to facilitate treatment.

Online Chat Forums:
Reddit may be helping people cope with mental disorders. Researchers learned that frequenting some of the site's subreddits (e.g., r/depression) improved the mental state of subscribers. Ironically, or perhaps predictably, some of its forums have done just the opposite.

Mental Health Text- and Hotlines:
Text messaging is a surprisingly effective way to do crisis counseling and address mental health issues. And it's the default mode of communication for young people. Three-quarters of US-based Crisis Text Line's users are under 25 years old and 12 percent are under 13. Sri Lanka's mental health problems skyrocketed after a three-decade civil war that ended in 2009. The CCC Line phone bank is a free counseling service run by volunteers.

Cathartic Experiences:
A Japanese company, Ikemeso Danshi—which roughly translates to "Handsome Weeping Boys"—provides cry-therapy services for men seeking a catharsis they feel unable to express in daily life. Cuddle therapy is also on the rise in the US as people seek out touch from strangers to feel soothed and pacified. With more digital and virtual relationships, rather than interpersonal, these services may likely increase.

Happiness Meters:
Alibaba is pursuing a new biometric concept at its Futuremart store: a happiness meter to reward customers for positive attitudes.

Alternative Health: Natural Health Takes on New Twists

Return to Happiness:
A new wave of "happiness classes" in India focuses on learning through inspirational stories and meditation exercises. This approach emphasizes concentration and self-awareness.

Nature:
Ecotherapy refers to a series of nature-based exercises intended to address both mental and physical health. Ecotherapists are a small but growing group of healthcare professionals who are essentially medicalizing nature. Researchers have found that when people did physical activities in natural settings, they experienced less anger, fatigue, and sadness. The Japanese have long engaged in "forest bathing" to promote positive health. Other countries are starting to follow suit with similar efforts (e.g., India, the UK, Hong Kong).

Plant Medicine and Psychedelics:
Since the beginning of human history, plants have served many important medicinal and healing purposes. Trends in this area are going beyond medicinal marijuana, to "magic mushrooms", ayahuasca tea, DMT, and MDMA. Psilocybin, the active chemical in magic mushrooms, may hold promise as a therapeutic approach for several mental health problems. Microdosing LSD has been found to increase mental clarity and treat conditions such as OCD (obsessive compulsive disorder).

Play:
Playing physical games is known to positively effect mental health. Children are so over-scheduled in the US that doctors are being told by the American Medical Association to prescribe free play.

Challenges & Questions

Despite the overwhelming need, political leaders and international development agencies frequently overlook the importance of mental health. In Africa, the "treatment gap"—the proportion of people with mental illness who don't get treatment—ranges from 75 percent in South Africa to more than 90 percent in Ethiopia and Nigeria. Overcoming the silence that comes with mental health is a growing issue in China. In India, 75 percent of millennials said they don't feel comfortable talking to medical professionals about mental illness because of the stigma attached to mental health problems. In northern countries like the US and UK, mental health services are plentiful but often expensive, inaccessible, and often stigmatized among minorities, immigrants, and young men.

Alternative therapies to combat mental health may become more mainstream. For instance, what would it look like to "prescribe nature"? What would nature-based methods of physical and psychological healing do to productivity? And what could this mean for the creation of sustainable communities—particularly in the developing world? Will more health insurance plans cover ecotherapy like they do cognitive therapy? Or cover prescription-strength video games? Will school psychologists be equipped with VR headsets? Will pet stores or animal shelters become wellness clinics? Will public parks turn into adult playgrounds? Will robots become our psychiatrists; therapists; confidantes? Will our smart homes, hospital rooms, classrooms, offices, retail spaces, and military arenas of the future be able to respond to individual moods and current mental health states? And while more employers are embedding yoga, meditation, and mindfulness practices into current wellness programs, it will be equally important to examine what technological tools employees are being given to optimize both their performance and their mental health.

Could Technologies Designed to Measure Mental Health Be Used to Manipulate It?

Our environments will increasingly be populated with technologies that anticipate people's feelings, determine if they are suffering from something like depression, or have mental health issues. One of the important ethical quandaries going forward will be how those technologies could manipulate individuals' mental health using those data points. A practical example we see today is a Chinese school using facial-recognition to analyze student behavior. The technology records facial expressions, categorizing them into happy, angry, fearful, confused, or upset categories—and the school can tailor its approaches accordingly. We will likely see more applications of this among global populations—in academia, in the workplace, and, in some instances, through direct utilization by governments.

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The Rise—and Fall?—of the Social Media Influencer

We are in the Age of the Social Media Influencer.

With estimates of more than 1 million worldwide, "influencers" speak to 84 billion accounts, shaping viewer opinions and purchasing patterns through videos, pictures, tweets, "stories," and more. They are distinct from celebrities, politicians, and athletes because they gained their influence through social media platforms first, usually building off of an authentic voice that speaks to a specific (usually millennial) audience, and yes, attractiveness, especially for visual-based media, helps. The three biggest platforms for individual influence are Instagram, Twitter, and YouTube—though the blogosphere has long been an influencer haven. In 2017, Instagram alone had ~12.9 million brand-sponsored influencer posts. That number is estimated to double by the end 2018, creating an estimated market size of nearly $1.7 billion. Some project total influencer marketing could reach $10 billion by 2020, enabled by growing influencer marketing platforms that allow easy search and access to influencers by advertisers. Decentralized communication platforms have inspired a true influence revolution, with

cascading effects. But as the power of this channel grows, it changes just as rapidly, blurring the lines between fact and fiction, authenticity and advertising—even when you're not actually getting paid, as we learn how to tap into its power. With its remarkable growth, we've also seen major controversies, from YouTube beauty community scandal, to the now infamous Fyre Festival disaster, a hoax musical festival built on social media influence and very little else. Social media influence, as quickly as it rose, may just as quickly die, or transform, in a vacuum of personal meaning and authenticity—the driving forces that led to this alternative universe in the first place. There is change in store for influence in 2019. Here are a handful of emerging trends in the world of personal branding and influence we are particularly fascinated by:

Influence in Global Consumption

China's influencer economy totaled $17 billion in 2017. The recent "flaunt your wealth challenge" generated more than a million posts on Weibo. China's growing army of social influencers have played a role in popularizing the meme. They usually pose as if they've just fallen out of a luxury car and spilled their most valuable possessions onto the pavement. Chinese influencers have also capitalized on their online popularity to launch clothing and beauty lines, and even sell cars directly to fans through livestreaming apps that reach an audience of 398 million. Many own businesses that sell products created around their personalities and lifestyles. In India, influencers have inverted the funnel to such an extent that marketers are starting to factor them into their annual calendars. Young African influencers are coming onto the scene strong in fashion, music, arts, and food. With new products and services being consistently introduced in Africa, there are myriad opportunities for influencers to introduce new brands or products to a wider market. Influence is even crossing over into healthcare. Patients in the US, for instance, with social media influence are getting paid by pharma companies for their opinions.

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Role of the Nanoinfluencer

Mega-influencers are highly valued by consumer goods and fashion, but nano-influencers can be just as valuable, especially for brands and ideas that trade on trust and authenticity. Nanoinfluencer is a new term to describe people who have as few as 1,000 followers and are willing to advertise products on social media. Their lack of fame is one of the qualities that make them approachable and appear genuine. At its core, influencer marketing is about storytelling and the co-creation of unique and engaging content. Honesty and transparency are often important, and this category especially has given voice to a spectrum of voices and perspectives that are often missed by mainstream media, channels, and advertisers.

Influence in Politics

Influencer marketing has pushed digital campaigning to a new level. Research indicates that social media platforms" election mobilization features (i.e., digital equivalents of the "I Voted" sticker) have influenced voting behaviors. We've seen influencers use their reputation to back specific candidates and become active—and activist—voices. In Africa, where a generational divide between aging political rulers and their young constituents is strongly felt, youth influencers are playing an active role challenging corruption, censorship, and economic crisis plaguing much of the continent. Some predict "influencers [will] become the new liberated power in Africa" in 2019. To many this feels like a way for regular people to make their mark on politics. But, as we've already seen, there are risks when social media is combined with elections, that we're seeing creep into the influencer landscape as well. In Indonesia, political actors are paying social media influencers to spread propaganda ahead of the 2019 elections. Dozens of influencers, referred to as "buzzers," are working in swarms to flood social media in order to influence election results.

Influencer to Celebrity—the Compounding Effect of Influence

It's common for a celebrity to use influence platforms to build their brand, increasing their value as they negotiate media deals and contracts. We see the same trend among influencers—savvy influencers using their following,

personal brand, and social capital to further their careers, start new businesses (e.g., Tammy Hebrow, fitness influencer, now with a $3.6 million athleisure brand), sometimes propelling them into new areas, or into becoming celebrities themselves.

Influence and the Role of Bots

Bots are increasingly playing a significant and transformative role in social influence not just as followers or creators of content, but as influencers themselves. And it's becoming more difficult to differentiate between real human influencers and artificial ones.

The Social Media Fembot:
We are beginning to see the rise of the social media fembot. Poppy, a human android-themed pop star and YouTube influencer, is one example. Poppy's videos have been viewed more than 257 million times. Last year, Microsoft's chatbot Zo partnered with Poppy to create "influential" internet content. Then there is Lil Miquela, a computer-animated creation posing as a human. This Instagram model is edited into real backgrounds, posed with real people and dressed in real streetwear that real people can buy. Her rise to nebulous online fame has led to collaborations with brands like Prada.

Bot vs. Bot:
In April 2018, Miquela's profile was hacked, by another social media bot. Many photos were deleted and replaced with photos of a different computer-generated avatar, Bermuda. While potentially politically-driven (Miquela is liberal and Bermuda is pro-Trump), it also represents what the professional wrestling world calls kayfabe—the blanket term for anything within a storyline that's meant to seem real, even if it's fake.

The Follower Bot:
Bot followers have been inflating influencer fan counts for years, but now brands who collaborate with influencers have a heightened reason for skepticism. As many as 48 million of Twitter's reported active users (15 percent) may be automated accounts designed to simulate real people. Facebook deleted 583 million fake accounts in the first three months of 2018, and in November 2017, revealed that up to 60 million automated accounts may roam the site. While Twitter and other platforms prohibit buying followers, other sites openly sell them to celebrities, businesses, and anyone who wants to seem more popular or exert influence.

The Social Activist Bot:
"Woke" chatbots have appeared on Twitter and have been dubbed the "next frontier of online activism." While both Follower Bots and Woke the Social Activist Bot are not "influencers" in fashion or brand, these chatbots can play a critical role in gaining momentum behind movements, and have their own "influence" game to play.

Influencer Regulation

With the pickup of social media advertising, regulation has followed. The UK Advertising Standards Agency and Competition and Markets Authority has created an Influencer's Guide with rules around social media advertising. The US Federal Trade Commission has started selectively bringing legal action against notable brands and paid influencers who haven't disclosed sponsorships, saying disclosure tools by platforms like Facebook are insufficient as they are. In the Middle East, where media can be influencer-led given blocks on traditional new sources and content, countries like the UAE are even introducing regulations requiring expensive licenses to become an influencer.

In a world of digital influence, the "who" (and increasingly, the "what") becomes harder to define. While influencers can help brands gain trust and authenticity due to their "real life" authority, we can, through social media, craft an idealized persona through fake followers, fake content, fake images, fake recognition, even fake experience, none of which can be verified or proven otherwise, the exact opposite of its original intent. Deepfakes are further blurring the line between reality and falsehoods, raising many questions: How do we begin to prove that online political movements are

real if we can't even tell if they are created, managed, or followed by AI/bots or actual people? This becomes murky territory for advertisers in the business of influencer marketing. A new status marker has emerged: the number of people who follow, like, or "friend" you. But deciphering who has real marketplace and consumer influence is getting harder, particularly as it becomes more difficult to differentiate on social media between humans and AIs impersonating humans. This could all very well lead to the demise of the influencer, or at least its transformation, as those in search of authentic experience and unmediated relationships look to new channels and voices.

Reputation is a new currency, for employability, value in society; but how is "influencer value" affecting us—both socio-culturally and geopolitically? What effect will influencer-coordinated misinformation campaigns on social media have on global politics? Or global citizenry? Mainstream media? More broadly, what effect will social influence have on everything from corporate shareholder profit to hiring practices to future employability? Will it reinforce pre-existing beliefs to dangerous levels? Ignite more polarizing and extremist viewpoints? Or could it give voice to the disenfranchised, the marginalized, and the subjugated? What made us seek out and listen to influencers in the first place? What new power "influence institutions" are being created, and what will the counter-reaction be?

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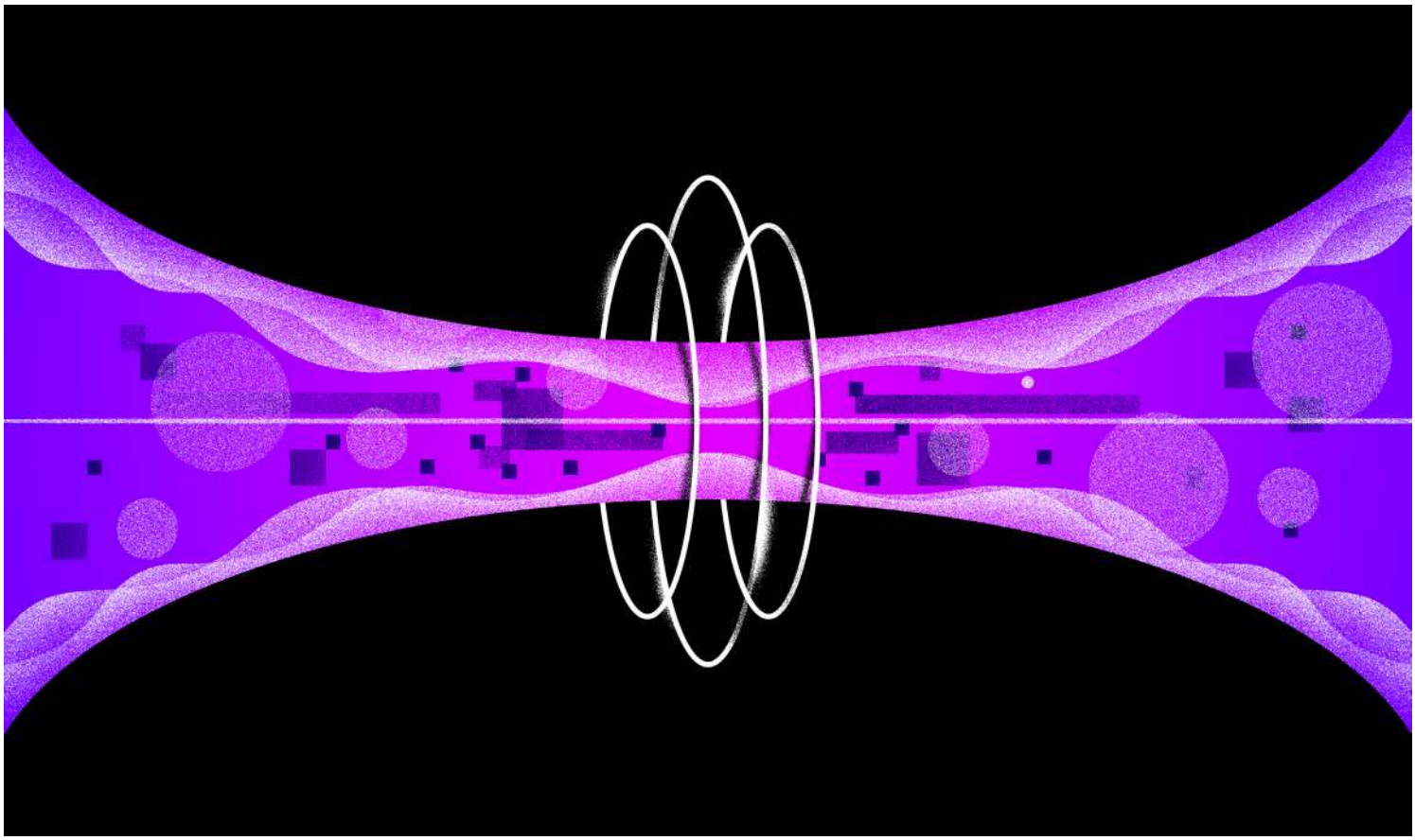

The Quantum Race

There have been many advancements in the pursuit of quantum computing, which at its most basic level integrates computer science and the principles of quantum mechanics (e.g., superposition, entanglement, interference). Large-scale quantum computers could theoretically solve many societal, governmental, and business challenges much more quickly than our best current technology. Quantum computers can crunch big data problems that involve finding optimum solutions from vast numbers of options and solve computational problems currently out of reach. But what is quantum computing, what can it do, and why are so many countries racing for "quantum supremacy", especially given … working quantum computers don't actually exist yet.

What Is Quantum Computing?

Quantum computers harness the speed and behavior of atoms, which function radically differently than silicon computer chips, to perform seemingly impossible calculations. They are powered by qubits, the subatomic

workhorses and building blocks of quantum computing. There are a few key differences between a classical computer and a quantum computer. A classic computer uses bits that are either in a 0 or 1 state. But quantum bits, or qubits, can also be both 1 and 0 at the same time. The quantum circuits that use these qubits to transfer information or carry out a calculation are called quantum logic gates; just as a classic circuit controls the flow of electricity within a computer's circuitry, these gates steer the individual qubits via photons (quantum light particles). This means qubits can achieve an exponentially higher information density than classical computers. Quantum computing offers the potential for computers to operate much faster, using much less power. Some theorists believe that quantum computing will eventually be so powerful that many current forms of encryption will become obsolete.

Quantum Geopolitics

Some speculate that quantum capability could be used to define future global economic hegemony. China is surging ahead with quantum satellite technology, as it is in AI and robotics, that can send entangled photons from space to stations back on Earth. It is developing a large ground-based network that uses quantum communication to protect messages, a first step toward worldwide secure quantum communications. It enabled the first intercontinental video call that was completely "unhackable," with surveillance or eavesdropping immediately detected due to the effect measurement would have on the quantum particles. Governments may soon race to test out quantum theory in orbit, and eventually build a "quantum internet," which will give rise to new kinds of coding and allow for faster-than-light communication—possibilities that have powerful appeal for government agencies and the private sector alike.

Currently, the Chinese government is working on a $10 billion national lab for quantum research set to open in 2020, and e-commerce giant Alibaba is building a lab of its own. Europe, too, is entering the race. QuTech is working on a quantum mechanics system with the aim of creating a secure communications network between four different cities in the Netherlands by the end of 2020. In 2016, the EU invested $1.2 billion in quantum computing. In December, the US Congress passed the National Quantum Initiative Act, which allocates $1.275 billion to quantum research from 2019 to 2023.

Quantum supremacy could also have meaningful implications for private sector actors. At a minimum, a cloud computing company with quantum computers could outperform its conventional rivals in power, speed, and security. At a maximum, companies controlling the "quantum internet" could make an unsurveillable network for those who can afford it, while the rest of the world is relegated to a slower mode of communications where nothing is guaranteed to be private.

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Implications & Applications: What Is Quantum For?

Quantum computers have the potential to propel breakthroughs in medicine, finance, and defense capabilities, especially in areas where current computation is considered slow or insecure. They also have the potential to optimize new drug therapies, models for climate change, and designs for new machines. They can achieve faster delivery of products, lower costs for manufactured goods, and more efficient transportation. The speed of quantum, combined with AI and machine learning, is a fascinating proposition. Lockheed Martin plans to use its D-Wave quantum computer to test autopilot software that is currently too complex for classical computers. Google is using a quantum computer to design software that can distinguish cars from landmarks.

The most immediately evident and popular applications, however, are in national security. Quantum computers have the potential to disrupt current security protocols that protect global financial markets, render many of today's sophisticated encryption systems inoperable, and upend secret government intelligence. International competition is of grave concern because one of these machines could in theory crack the encryption that protects sensitive information inside governments and businesses around the world. Quantum communications and cryptography would also offer a dis-

tinct tactical advantage to any actor that employs them on the battlefield. Using quantum communications for the purposes of transmitting classified data is appealing to military planners across the world, as they are impossible to tap clandestinely thanks to the fundamental properties of matter. This poses an opportunity for a veritable "quantum leap" forward in military communication. China has invested disproportionately in quantum cryptography, and many researchers believe they lead the world in this sector. The EU has taken a leadership position in quantum communications, more generally, and the US has focused its efforts on quantum computers.

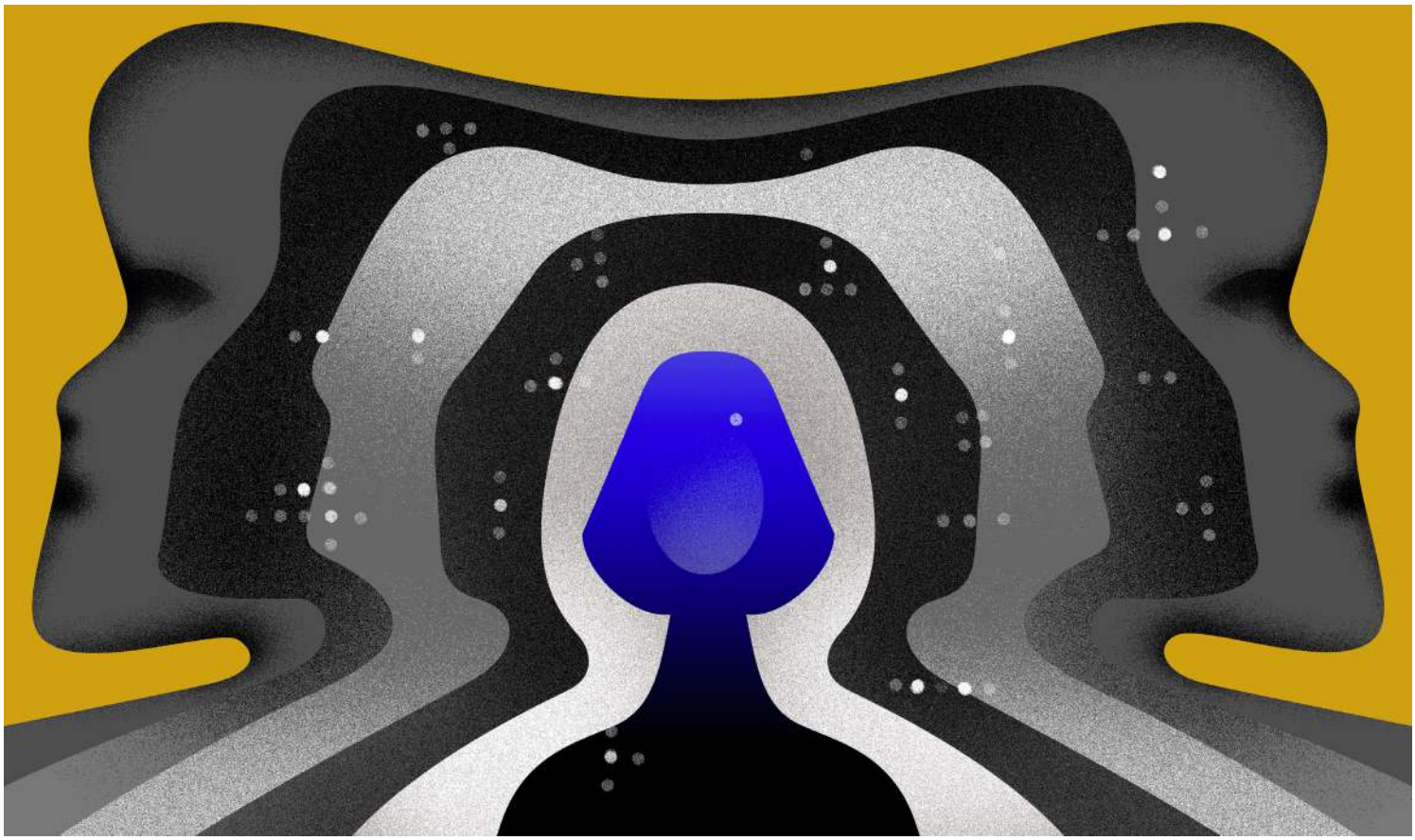
Quantum Hype?

While quantum computers offer breakthroughs in computing performance, the applications of this technology do not presently differ significantly from those today, and at best, quantum computing is in beta stage. Communications have been demonstrated in a lab environment, but it remains to be seen if they'd be equally viable "in the wild." Researchers aren't even sure that large-scale quantum computing is possible yet. It's been estimated what the world's first commercial quantum computer could come as soon as 2022, but that may be more hype than reality. Others estimate that the full impact of quantum computing is a decade—or several—away.

Lack of talent adds a significant restriction on the pace of development. Fewer than a thousand people in the world are estimated to be doing leading research in the field. Private and public entities will have trouble attracting the talent needed to build quantum technology.

Questions & Takeaways

While the exact timeline for quantum computing is largely unknown, it still raises important questions. What is the real potential of quantum—will it simply speed up existing technology, or will it lead to new innovation and applications? Will quantum power be decentralized and available to everyone? Or will it be hoarded and traded by global tech companies and wealthy governments? As quantum computers become viable, governments may need to prepare for the potential cybersecurity consequences. Will the current geopolitical landscape of increasing nationalistic policies and reduced cross-border collaboration mean that quantum becomes the next geopolitical "battleground"? Will countries split into factions and choose their "quantum alliance"? What about security implications for individuals? Quantum computing power in the hands of hackers makes possible all sorts of scams that don't even exist yet. What effect would this have on identity theft schemes? Could cybercriminals begin selling quantum encryption-busting services on the dark web? Some believe the quantum computing apocalypse is imminent. With all new and powerful technology, a looming question remains—will quantum computing be used as a tool of creation, destruction, or both, and who will decide?



8 Billion "MEcosystems": Transhumanism Becomes Reality

The world is increasingly interconnected through technologies like the internet and IoT (Internet of Things), enabling the concept of a noosphere, or future global "brain." But there is a parallel track to innovation centered around the individual—where people are now capable of becoming their own fully-integrated and customizable bio-digital ecosystem, what we will call a "MEcosystem." This is essentially technology intersecting with the physical body, and we see it most prominently in several nascent technological developments—advanced wearables (including embeddables, implantables, even ingestibles), 3D printing for human augmentation, and gene editing, plus many other emerging developments. Advancing technology has the potential to push the evolution of humans forward, beyond their own biology, and potentially toward a transhumanist future where human bodies are optimized with technology.

Wearables aka "How We Become Cyborgs"

Wearables have been evolving into embeddables, implantables, invisibles, even ingestibles, early steps toward a future where humans become more like cyborgs. Subdermal RFID chips can hold personal details, credit card numbers, and medical records. By one estimate, there are 10,000 such "cyborgs" with chip implants around the world. Chip enthusiasts include followers of a transhumanist ideology that seeks to optimize human bodies with technology. Examples include haptic communication that lets users receive messages through the skin on their arms, exoskeleton vests that augment lifting, neuromodulation as an alternative to painkillers, and an e-dermis that allows amputees to feel pain and other sensations.

3D Printing for Human Augmentation

Advanced 3D (and eventually 4D) printing techniques that use fully or partially organic materials will also help repair and augment the human body. Researchers are using 3D printers to create new strips of healthy skin, "bio-ink"-based corneas, stem cell-infused scaffolds for repairing nerve damage, and even grow-your-own organs technology.

Gene Editing for Inheritable Evolution

Gene editing is the process through which DNA is inserted, deleted, modified or replaced in the genome of a living organism. CRISPR, a cheap and easy technique for making targeted changes to DNA, is in research trials as a way to potentially treat diseases. Much of the leading research today focuses on gene editing during the earliest stages of life—including on fertilized embryos, culminating in the recent groundbreaking and controversial experiment where gene edits were made to two embryos in Shenzhen. Biologists are trying to go further, applying the CRISPR gene-editing machinery directly into mature human sperm.

But gene-editing experimentation is not confined to a lab, and that is perhaps what is most interesting about it. The process has entered mainstream consciousness and accessibility with devices like the CRISPR-Cas9. Josiah Zayner, a biochemist and biophysicist once employed by NASA, was made famous for being the first person known to have edited his own genes (and now runs a company that sells DIY CRISPR kits). He kicked off a series of public gene-editing stunts, a fad he may now regret. From teens in California to a research team at the University of Alberta that recreated from scratch extinct horsepox, a cousin of smallpox, DIY gene-editing experiments are catching on rapidly around the world. Unencumbered by labs, research institutions, degrees, and regulation, it is the hardest strain of gene-editing to predict, "citizen scientists" would argue the most innovative, and a cornerstone of the transhumanist movement.

Looking Farther Out ... Digital Cloning?

If we can push our imaginations beyond currently developing technologies, we can envision a future which consists of transhumanist MEcosystems—one in which we can use highly advanced AI as a means to upload our minds and consciousnesses into dynamic, continuously learning "digital clones" of ourselves. The Terasem Movement Foundation was formed around the hypothesis that we may be able to circumvent aging by placing the parts of us that matter most (e.g., our identity, consciousness, and memories—called a "mindfile") into something like a robot or avatar. These largely theoretical future technologies fall under the classification of "mindware." As far out as these sound, an experiment is underway to test this hypothesis by uploading a real woman's memories into a robot called Bina48. Over time, the goal is for Bina48 to grow smarter the more she learns. Inevitably, this type of technology holds the potential for people to not only create one personal ecosystem constrained in part by their own body, but multiple that go well beyond those physical parameters.

Within each of these cutting-edge and controversial developments is a world of opportunity and a minefield

"The Terasem Movement Foundation was formed around the hypothesis that we may be able to circumvent aging by placing the parts of us that matter most (e.g., our identity, consciousness, and memories—called a 'mindfile') into something like a robot or avatar."

of risk. Accessible and personalizing technologies like 3D printers ($400) and CRISPR ($150), even emerging biotech "hackerspaces" like BioCurious, provide the tools needed to potentially bring transhumanist aspirations to nearly anyone. This could result in lifesaving breakthroughs, super-human development, the reemergence of extinct diseases, and irreversible genetic changes inheritable by generations. Regulation is, typically, lagging, but even if a government deemed it illegal, could one simply travel to another country where regulation is lax or even encouraging? Will some countries try to build a competitive advantage around super-human enhancements for medical tourism? There is talk that it could be the next frontier of cheating in sports. And, ultimately, what does the impact of income and access disparity have on this; could it lead to a class division of gene editing "haves" and "have nots?" While the application of MEcosystems has centralized around the individual, in a closed "walled garden" controlled by the operator, with embedded technologies like wearables and implantables, each personal ecosystem could be turned on to connect with other digital systems, voluntarily, automatically, or surreptitiously. This opens up a world of cybersecurity and privacy concerns, as well as opportunities like more efficient functioning of "smart" cities.

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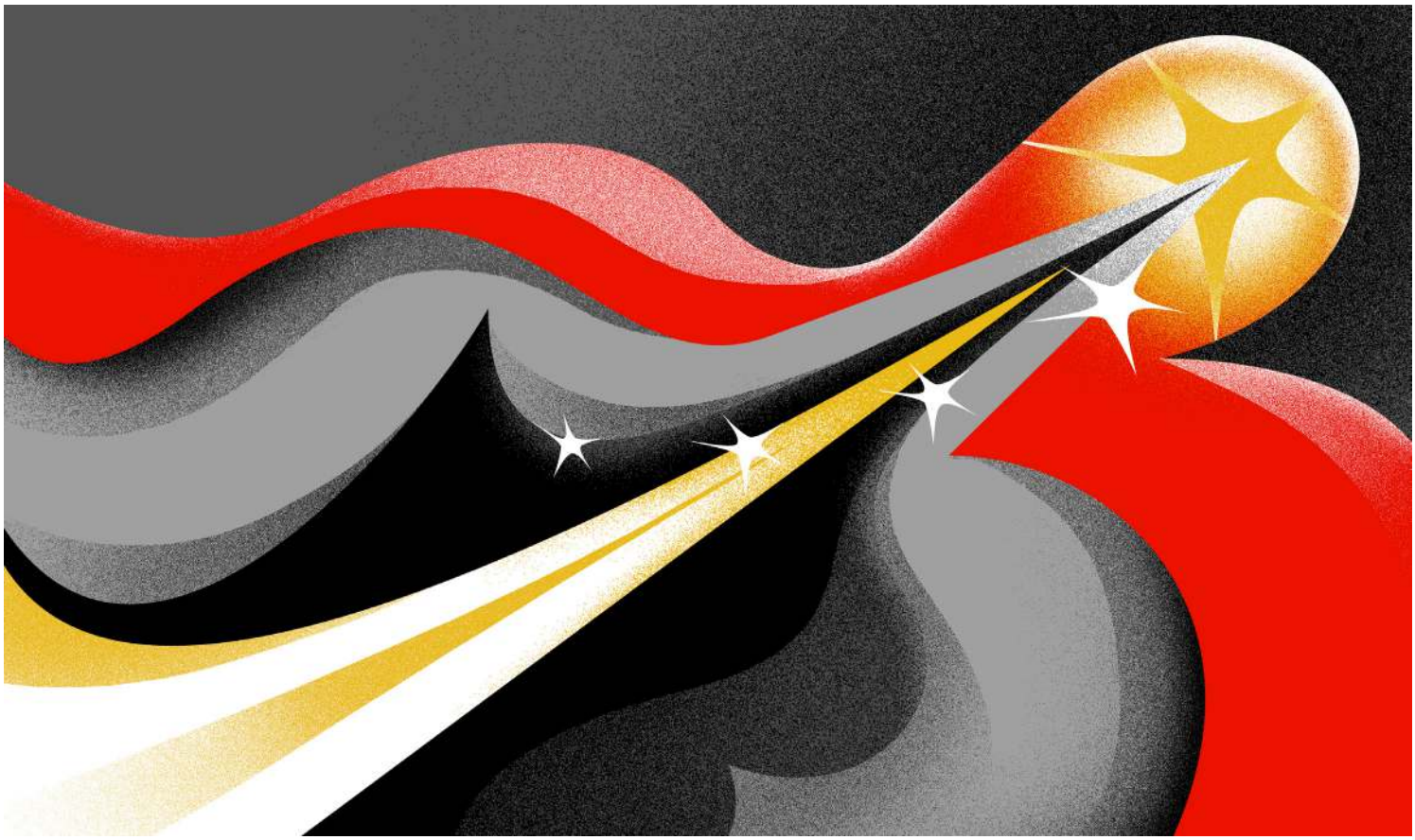

China Ascendant: "Soft Power" in an Open Global Order

China is rapidly gaining global influence through the application of soft power—the ability to shape the world without the use of military force or coercion.

Examples of significant wins include its move within the IMF to make the renminbi a reserve currency alongside the dollar, and the creation of its own multinational development bank, which has secured the participation of countries from a variety of geopolitical blocs. The Chinese government has become the largest contributor to international peacekeeping efforts among the five permanent members of the U.N. Security Council. And its ambitious Belt and Road Initiative (BRI) is a long-range plan for a vast network of transportation, energy, and telecommunications infrastructure, linking roughly 70 countries throughout Eurasia, Africa, and even Latin America, with an announced investment as high as $8 trillion.

While the Chinese government continues to make inroads in diplomatic, financial, and academic areas, China's "soft power" strategy has three important components: 1) Digital power—or tech-driven strength; 2) "Fore-power"—the power achieved from top-down, long-range planning and foresight, and the top-down po-

litical system that allows them to act on it; and 3) Sharp power—the ability of authoritarian regimes to manipulate opinion abroad. But its strategy comes with substantial risk—for which, given its growing global role, the world may collectively pay.

Digital Power

China has an abundance of computing power and capital. China's nearly 1.4 billion people generate more data than almost all other nations combined. And it has more internet users than any other country—more than 800 million, 98 percent of them mobile. The three Chinese tech powerhouses, Baidu, Tencent, and Alibaba, have enormous global influence and spending power—in many cases, besting their US counterparts with the achievement of major AI milestones in areas like speech recognition and deep learning. AI is projected to give the Chinese economy a 26 percent boost over the next 13 years. And, a large chunk of forecasted Chinese GDP gains ($6.6 trillion) are expected to come from increased labor productivity, with businesses automating processes or using AI. While this is both a blessing and a curse—by virtue of having the world's largest labor force, China risks the world's highest AI-driven labor displacement—the advantages of this technology outweigh the drawbacks, and are a smart long-term play given its aging population.

Outside of AI, the Chinese government has also made manufacturing and robotics a priority with its "Made in China 2025" initiative, has more than 500 smart cities testing smart sensors to autonomous vehicles, is on the cutting edge of facial recognition projects, and isn't shy to test innovations like state-owned social credit systems (or things like bitcoin, though they may act just as quickly to close them). Chinese technologists are also building apps in local Indian dialects, well ahead of US tech companies.

China is leading on frontier technology as well. In 2016, China launched the world's first quantum satellite, in an effort to establish worldwide secure quantum communications and maybe even a quantum internet (for more, see Race to Quantum). China is making inroads in emerging markets by taking on many Digital ID and facial recognition projects. Some projects have stalled, but that is as much a product of the markets they are in (Venezuela, Zimbabwe) as it is Chinese execution. And, while China has not planned to export its state-owned social credit system, companies like Ant Financial are monetizing social credit by applying its techniques to loans and other financial products.

"The important insight here isn't about a single advancement but the pattern overall—that China, its government and enterprises within it, has made technology a priority, and will continue to push its advancement as central to its success."

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Fore-Power

Practicing foresight is increasingly becoming a top-down existential imperative in an increasingly complex geopolitical environment. China has launched state-led efforts across technology (e.g., AI and quantum computing), agriculture, infrastructure (e.g., BRI), manufacturing, and robotics ("Made in China 2025"), to cultivate expertise and global leadership. China's government has increasingly shifted focus to reforming agriculture. It is spending billions on water systems, seeds, robots, and data science. And, many young Chinese workers are moving from manufacturing into service industries. China announced a five-year plan to eliminate excess capacity and lay off workers in the coal and steel industries, in a bid to restructure the economy. While each of these initiatives can begin as internally focused, their eventual success can turn them into comparative global advantages. The ability to make long-term plans is not an inherent advantage, as China's not-as-recent history demonstrates. However, China's ability to distinguish itself in a world where G7s and BRI[C]S are increasingly unstable creates a natural leadership role on the world stage.

Looking beyond China's borders, Chinese economic influence, through both trade and regional/bilateral investment, is expanding worldwide across developed and emerging markets. It should be noted, however, that while these may seem like thoughtfully crafted and coordinated projects, many contend it's just the opposite, not to mention unprofitable (more in "Risks to China's Future" below).

Europe:

Chinese money is pouring into Europe at a time when public investment in the EU is at its lowest level in 20

years. China's attention is on northern European innovation hubs as much as on infrastructure, but crisis-hit southern economies have also taken advantage. In that spirit, leaders of the EU and China recently met to praise "EU-China connectivity."

South and Southeast Asia:
China has been aggressively expanding its presence in Pakistan (as part of the "China Pakistan Economic Corridor," valued at $62 billion) and Malaysia, where it has given its largest BRI loans to-date, and increasingly Maldives, Nepal, Sri Lanka, and Bangladesh. "China's penetration of South Asia is the biggest game changer in 100 years," says Constantino Xavier, a Fellow at the thinktank Carnegie India. "The Russians tried, the Americans tried. This is the first time since WWII that a massive power is contesting the Indian state." These moves are seen as a powerful combination of political and financial clout, and how these play out, as demonstrated recently with Malaysia, will be considered a signal of their success—or failure—as a diplomatic global power.

Latin America:
Earlier this year, China held its second ministerial meeting with the Community of Latin American and Caribbean States (CELAC). There, China announced plans to have the BRI invest in Latin America. Over the past decade, Chinese policy banks have provided more than $140 billion in loan commitments to Latin America. Latin America has become the second-largest destination for Chinese overseas investment. Between 2015 and 2019, China plans to invest $250 billion in direct investment and about $500 billion in trade. China is already the largest trading partner of Argentina, Brazil, Chile, and Peru. China has increasingly sought to pair ideological and political influence with these investments. One concrete example is in Venezuela, where investment by Chinese private sector actors led to the introduction of a China-style social credit system.

Africa:
And, China's growing economic influence is no more apparent than in Africa. In the next 35 years, 1 in 4 people in the world will be African. Chinese firms have been disproportionately awarded infrastructural development projects in Africa, and trade has ballooned over the last two decades. China officially surpassed the US as Africa's largest trade partner in 2009. China is now the single largest bilateral financier of infrastructure in Africa. A McKinsey analysis found that the amount of loans Beijing had made to Africa had tripled since 2012. In 2017 alone, the newly signed value of Chinese contracted projects in Africa registered $76.5 billion.

Beyond … :
In 2014, China's president Xi Jinping said that China wanted to become a "polar great power." And, China's ambitions now even extend to supremacy in outer space. More than 60 Chinese companies have entered the commercial space industry in the past three years. China wants to be one of the world's top three aerospace powers by 2030. China is also working on the construction of a lunar base, to be used for new energy development and living space expansion.

Sharp Power

Although China does not seek to conquer foreign lands through the use of traditional hard power, some fear that China seeks to conquer foreign minds through "sharp power," a term coined by the National Endowment for Democracy in its report, Sharp Power: Rising Authoritarian Influence. Sharp power helps authoritarian regimes manipulate opinion abroad—not to "win hearts and minds," but to "manage their target audiences by manipulating or poisoning the information that reaches them," a particular threat to vulnerable democracies. China's sharp power was felt acutely in Taiwan, where President Tsai Ing-wen's government "accused China of meddling in [local elections] by spreading disinformation, steering money to the opposition and inducing Taiwanese media to provide slanted coverage,"

resulting in a decisive defeat of the Democratic Progressive Party she represents. While attempts to set up pro-China news networks abroad have been met with middling success, setting up China-aligned "Confucius Institutes" worldwide has been more successful, as well as efforts to engage citizens of other countries with Chinese descent to identify as "overseas Chinese"—though the ultimate impact of this is unknown, as many in the 60 million-person Chinese diaspora remains distrusting of the Chinese Communist Party and its history with human rights.

This "sharp power" activity suggests that China senses a window of opportunity to pursue its goals, especially with the Trump administration seen as withdrawing the US from its longstanding role as guardian of the liberal international order, joining many other northern countries now turning inward.

Risks to China's Future

While China's ascendance has been impressive, it has significant risks to contend with, including debt-fueled growth, rising inequality at home, a US trade standoff, US and European restrictions on tech transfer to China, contracting exports, reluctance to shrink the state sector despite increasingly crowding out private enterprise, $200 billion in loans to Belt & Road countries with already astounding debt loads, notable human rights abuses, as seen by its recent detention of Muslim majority Uyghurs in Xinjiang, not to mention its tendency toward vast, uncoordinated activity. The Chinese government is known for taking more of a "campaign"-style approach—setting vision but not necessarily organizing activity. While this tactic can be highly effective for tech investment, it can be the opposite for infrastructure projects, leading to misalignment, duplication, even corruption. As one expert describes, "While outsiders tend to credit Chinese leaders with long-term vision and exquisite strategizing, policy implementation has in fact often been fragmented and patchy. The negative side effects of rapid, large-scale mobilization are generally disregarded until they grow too serious to ignore."

Where will global economic order fall? Will China lead the world, or will the global economy split into two: one centered in the US and the EU, another revolving around China? Will China's debt-fueled rise finally implode, bringing down with it dozens of loan-backed countries who must quickly scramble back to the traditional lenders to stabilize their economies? How does this intersect with increasing nationalist policies around the world? And what about disillusionment with democracy, and growing patterns of authoritarianism? Many developing nations are looking to China, and its strong state system, as an alternative to the economic liberalization of "the West." Will we see more countries both partner with, and emulate, China? One thing is clear, China operates at one scale—huge. Huge production, growth, user base, loans, aspirations. As it enmeshes itself into the global economy and polity, just as hugely, its success—and downfall—becomes tied to that of Asia, Africa, and the world. Despite growing global tension, suspicion, and isolationism, we may very well all rise—or fall—together.

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"Where will global economic order fall? Will China lead the world, or will the global economy split into two: one centered in the US and the EU, another revolving around China?"