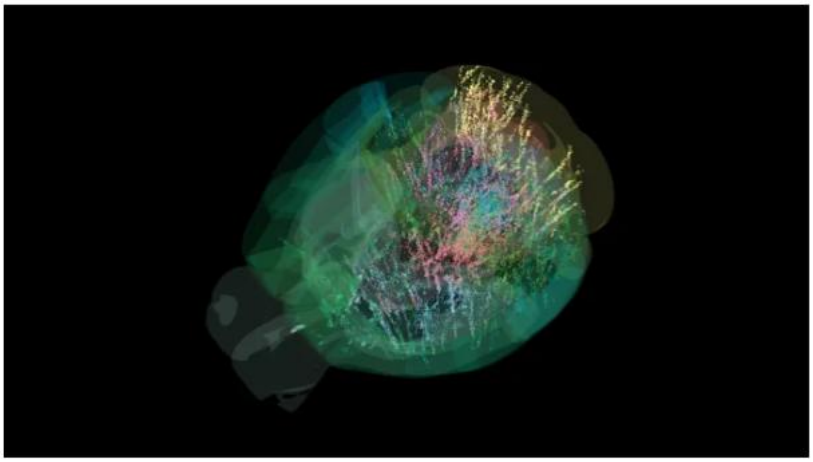
Show Notes 12 September 2025

Story 1: Map of 600,000 brain cells rewrites the textbook on how the brain makes decisions

Source: LiveScience.com Story by R.J. Mackenzie

Link: https://www.livescience.com/health/neuroscience/map-of-600-000-brain-cells-rewrites-the-textbook-on-how-the-brain-makes-decisions



This map shows tens of thousands of the brain cells analyzed during different stages of decision-making. (Image credit: Dan Birman, International Brain Laboratory)

- A massive neuroscience collaboration from the International Brain Laboratory has created the first comprehensive activity map of a mammalian brain during decision-making, using data from over 600,000 neurons across 139 mice.

- This effort spanned 12 labs and covered more than **95% of the mouse brain**, challenging long-held assumptions about how decisions are processed.

- **Here's the key finding:** Contrary to textbook models, decision-making is not localized in the brain. The research revealed that decision-related signals were found across nearly all brain regions, not just in the visual or prefrontal cortex.

    - **Side note -** Traditional View saw the Prefrontal Cortex as the "Decision Center"

        - Prefrontal Cortex: Historically seen as the brain's executive hub, responsible for rational thought, planning, and impulse control.

        - Dorsolateral Prefrontal Cortex: Often highlighted for its role in logical reasoning and resisting impulsive choices.

        - This view was reinforced by early lesion studies and neuroimaging, which showed impaired judgment when the Prefrontal Cortex was damaged.

- How the research was conducted - Using a standardized experiment process, the International Brain Laboratory team trained mice to respond to visual cues by turning a wheel, allowing researchers to track brain activity in a consistent, reproducible way.

- When visual cues were faint, mice relied on memory of previous trials—revealing that expectation-based decision signals were also *widely distributed in the brain*.

- **Why this is so significant:**

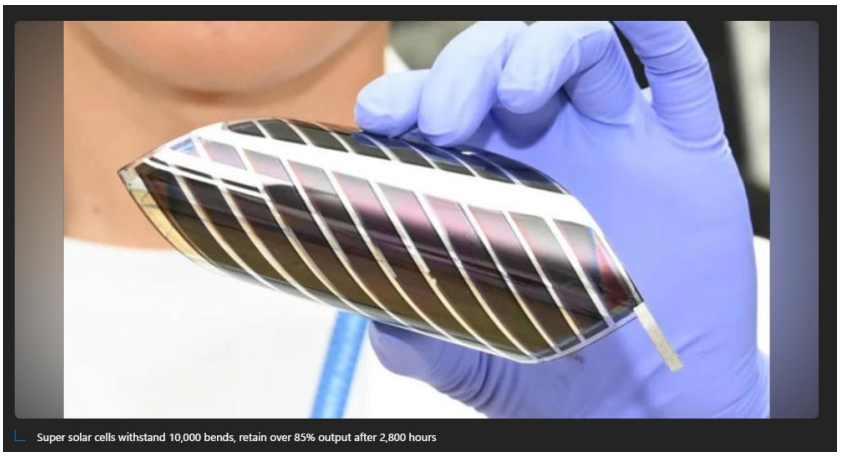
    - This work redefines how scientists understand the brain's decision-making architecture.

    - It sets the stage for future research into the relationship between a cause and effect, not just correlation, in brain activity and behavior.

Story 2: Super solar cells withstand 10,000 bends, retain over 85% output after 2,800 hours

Source: InterestingEngineering.com via MSN Story by Aman Tripathi

Link: https://www.msn.com/en-us/technology/renewable-energy/super-solar-cells-withstand-10-000-bends-retain-over-85-output-after-2-800-hours/ar-AA1JEC2z



- Researchers at the Korea Institute of Materials Science have developed a new material and fabrication process for flexible perovskite solar cells, enabling their production in ambient air conditions.
    - **Side note about perovskite**:
        - Perovskite is both a specific mineral and a broader class of materials with a distinctive crystal structure that's turning heads in science and tech.
    - **What It Is**
        - **Original mineral**: Calcium titanium oxide ($CaTiO_3$), discovered in 1839 and named after Russian mineralogist Lev Perovski.
        - **Perovskite structure**: A general crystal form with the formula **ABX_3**, where:
            - A = large cation (positively charged ion)
            - B = smaller cation
            - X = anion (negatively charged ion)

        - This structure is highly versatile—you can swap out different atoms or molecules to create materials with radically different properties.

    - **Why It Matters**

        - Perovskites are a materials science dream because they can exhibit:
        - **Superconductivity** (zero electrical resistance)

        - **Ferroelectricity** (spontaneous electric polarization)

        - **Colossal magnetoresistance** (resistance changes in magnetic fields)

    - **In Solar Tech**

        - Perovskite has been a material of intense interest for replacing conventional silicon in solar cells due to its excellent light absorption properties and potential for low-cost production as thin, flexible films.

- [*In addition to creating a flexible perovskite solar cell*] The Korea Institute of Materials Science research [also] directly addresses perovskite's significant vulnerability to moisture, a long-standing barrier to its widespread commercial use.

- Perovskite's chemical instability in the presence of moisture has historically necessitated manufacturing in controlled, low-humidity environments or inert gas atmospheres, which requires expensive, specialized equipment.

- To solve this, the Korea Institute of Materials Science team implemented a *"defect passivation strategy,"* which involves sandwiching the primary light-absorbing perovskite layer between two protective layers of a two-dimensional perovskite material.

- The resulting solar cells demonstrate notable durability. In longevity tests under operational conditions, the cells successfully retained over 85% of their initial efficiency after 2,800 hours.

- The devices also proved their mechanical resilience [i.e. flexibility], maintaining 96% of their initial efficiency after undergoing 10,000 bending cycles.

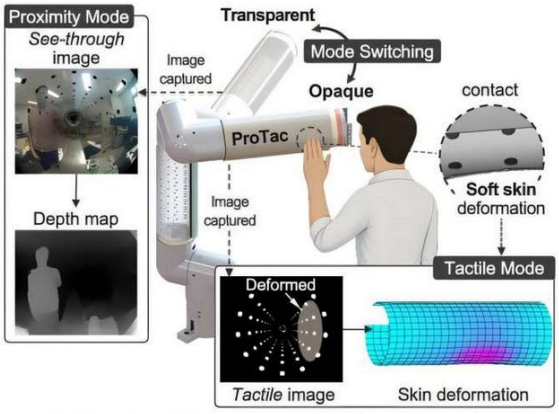
- The key significant benefit of this research has to do with overcoming the chemical instability of perovskite in the presence of moisture. The ability to manufacture in open-air conditions without extensive environmental controls presents a direct path toward reducing production costs [of perovskite solar cells].

Story 3: Soft skin, sharp senses: New robotic 'touch' sees danger before it hits

Source: TechExplore.com Story by Robert Egan

Link: https://techxplore.com/news/2025-08-soft-skin-sharp-robotic-danger.html

See research paper here: https://ieeexplore.ieee.org/document/11097357



(a) Illustration of ProTac multi-modal *soft* sensing technology

(b) ProTac's potential applications

- Robots are becoming increasingly integrated into everyday environments—from homes and hospitals to factories and farms. However, safely operating around humans requires more than strength or speed. Robots must also sense their surroundings, detect physical contact, and respond quickly. Conventional sensors, especially those embedded in soft materials, often fall short when it comes to real-time, large-area tactile and proximity sensing.

- To address this challenge, a research team from the Japan Advanced Institute of Science and Technology, developed **ProTac**, a novel vision-based soft sensing skin for robots.

- At the core of ProTac is a polymer-dispersed liquid crystal layer that can switch between transparent and opaque states when voltage is applied.

    - When transparent, embedded cameras can "see" through the skin to detect nearby objects.

    - When opaque, those same cameras track how the skin deforms, allowing the robot to sense touch, pressure, and the location of contact.

    - This dual-mode sensing enables real-time environmental perception using a single soft layer, eliminating the need for complex embedded electronics.

- A lead researcher on the project noted, *"This innovation with sensor design simplicity allows robots to perceive both contact and nearby obstacles across a large-area skin in real time, which is difficult to achieve with conventional electronic skins."*

- To validate the design, the team developed a prototype called the **ProTac link**, a cylindrical robot arm segment wrapped in a soft sensing skin and equipped with stereo cameras at both ends.

- This prototype can detect approaching objects from multiple angles, estimate distance, and recognize multiple touch points with high accuracy. It also supports adaptive behaviors such as proximity-based speed adjustment and reflexive contact avoidance.

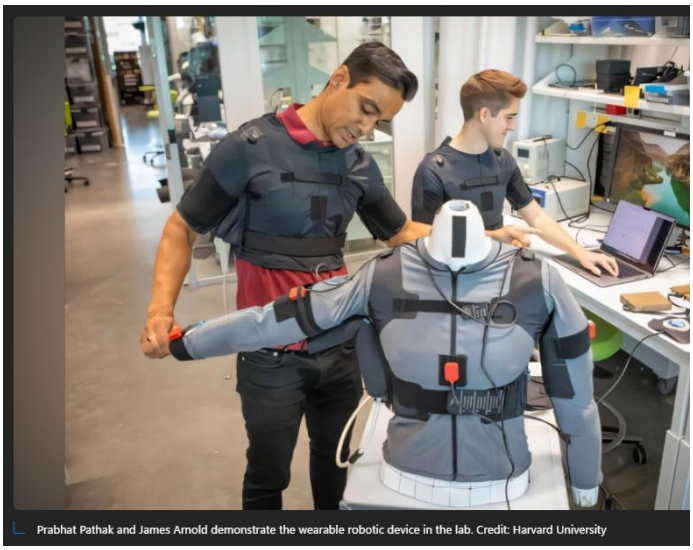
Story 4: Soft wearable robot jacket responds to movements, supports upper-limb impairments

Source: InterestingEngineering.com Story by Prabhat Ranjan Mishra

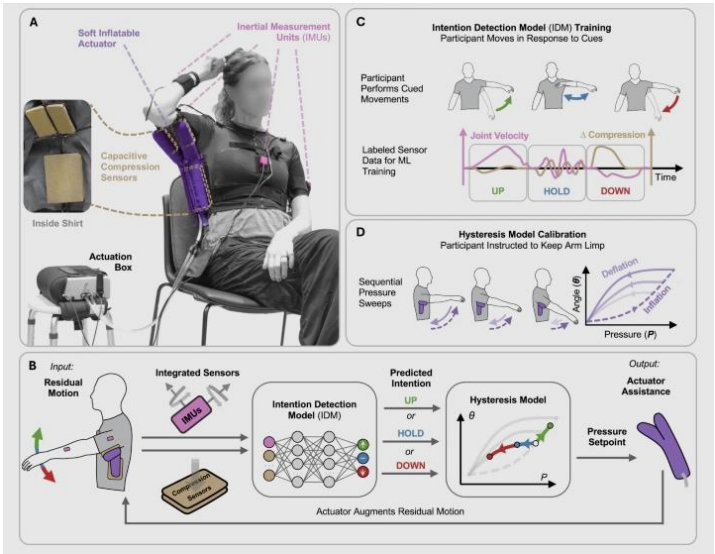
Link: https://interestingengineering.com/innovation/us-engineers-robot-worn-like-jackets

See research paper here: https://www.nature.com/articles/s41467-025-62538-8

See video here: https://www.youtube.com/watch?v=dFHTyUrAaz0&t=12s



Prabhat Pathak and James Arnold demonstrate the wearable robotic device in the lab. Credit: Harvard University



- Engineers at Harvard have developed a soft, wearable robotic jacket designed to assist individuals with upper-limb impairments, such as those caused by stroke or ALS [Amyotrophic Lateral Sclerosis].

- The robot uses a combination of machine learning and a physics-based hysteresis model to learn and respond to *each user's unique movements*.

    - **Side note**: Hysteresis refers to a system's tendency to "lag behind" changes in the forces or inputs acting on it. In other words, the output doesn't just depend on the current input—it also depends on the system's history.

        - Key characteristics:
            - Memory effect: The system "remembers" past states.
            - Path dependence: The route taken to reach a state affects the outcome.
            - Nonlinearity: The response isn't always proportional or immediate.

- The Harvard wearable robotic jacket decodes motion intention using sensors and adjusts support dynamically based on the user's kinematic state.

    - Specifically, the sensors employed are Inertial Measurement Units, or ***IMUs***, which is a sensor that tracks body motion and orientation - and compression.

    - **Side note** - kinematic state refers to the complete description of an object's motion without considering the forces that cause it. It's all about how something moves, not why it moves.

- The new Harvard device helps [disabled] users perform everyday tasks like eating and drinking, offering both assistive and rehabilitative benefits.

- The project involved physician-scientists from Massachusetts General Hospital and Harvard Medical School, ensuring medical relevance and testing with actual patients.

Honorable Mentions

Story: Some People Are Immune to All Viruses. Scientists Now Want to Replicate This Ability for a Universal Antiviral

Source: ZME Science Story by Tibi Puiu

Link: https://www.zmescience.com/medicine/universal-antiviral/

- **Discovery of Viral Immunity -ISG15 Mutation**: A rare genetic mutation disables the immune regulator ISG15.
- **Effect**: People with this mutation are more vulnerable to certain bacterial infections but appear immune to all known viruses — including flu, COVID, measles, and chickenpox.
- **Observation**: Though viruses leave traces in their blood, these individuals don't get sick.
- **Scientific Implications:**
    - **Constant Immune Alert**: Their immune systems maintain a low-level antiviral response at all times, due to the absence of normal "brakes" on immune activity.

- **No Harmful Inflammation**: This persistent defense doesn't trigger damaging inflammation, making it a unique balance of protection and safety.

- **Research Goals**

  - **Universal Antiviral**: Scientists, led by Dusan Bogunovic at Columbia University, aim to replicate this natural immunity to create a treatment that could protect against nearly any virus — even unknown ones.

  - **Potential Breakthrough**: If successful, this could revolutionize how we prevent and treat viral infections globally.

Story: Generative AI designs compounds that can kill drug-resistant bacteria

Source: Phys.org Story by Robert Egan

Link: https://phys.org/news/2025-08-generative-ai-compounds-drug-resistant.html

See research paper here: https://www.cell.com/cell/abstract/S0092-8674(25)00855-4

A colorized scanning electron micrograph of MRSA. Credit: National Institute of Allergy and Infectious D...

- MIT researchers used generative AI to create novel antibiotics targeting two dangerous pathogens:
  - *Neisseria gonorrhoeae* (drug-resistant gonorrhea)
  - *Staphylococcus aureus* (MRSA)

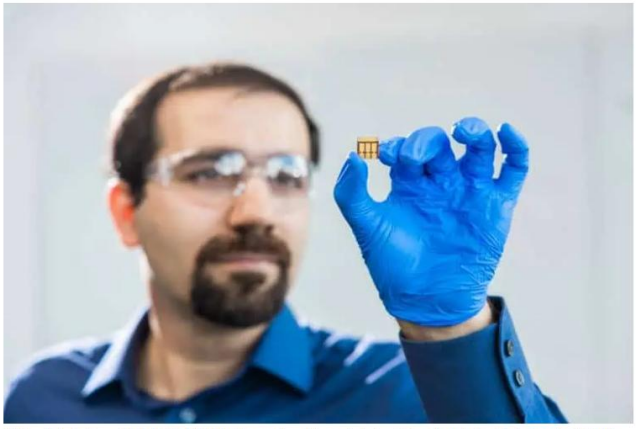
- Over **36 million compounds** were designed and screened computationally.

- Top candidates are **structurally unique** and work via **new mechanisms**, disrupting bacterial membranes.
- The AI approach allowed exploration of **vast chemical spaces** previously inaccessible.
- Researchers aim to apply this method to other bacterial species in future drug development.
- James Collins, senior author and MIT professor, emphasized the potential of AI to revolutionize antibiotic discovery.
- Lead authors include Aarti Krishnan, Melis Anahtar, and Jacqueline Valeri. Would you like a deeper dive into how the AI model works or how this compares to traditional antibiotic development methods?

Story: This New Indoor Solar Cell Could Power the Entire Internet of Things Using Only the Light from Your Ceiling

Source: ZME Science Story by Tabi Puiu

Link: https://www.zmescience.com/science/news-science/this-new-indoor-solar-cell-could-power-the-entire-internet-of-things-using-only-the-light-from-your-ceiling/



Associate Professor Mojtaba Abdi-Jalebi with a small prototype of photovoltaic cells optimized for indoor light. Credit: UCL / James Tye.

- In the sterile, LED-lit gloom of an office, a solar panel is about as useful as a sundial. Traditional silicon cells are built for the unfiltered fire of the Sun but work miserably with artificial light. Yet billions of small devices — remote controls,

alarms, wireless sensors — live their entire lives under ceilings. They have to be powered by disposable batteries, each a tiny packet of mined metals destined for the landfill.

- Now, researchers at University College London and their collaborators have engineered a new class of indoor solar cell that doesn't just work under artificial light — it thrives. Their device turns 37.6% of the light in a well-lit room into usable electricity, a world record for this type of technology. That's roughly six times better than the best commercial indoor cells. And unlike earlier prototypes, it lasts not weeks or months, but years.

- The secret lies in perovskite, a crystalline material whose atomic lattice can be tuned to sip from the specific wavelengths emitted by LEDs and fluorescent bulbs.

- Experts hail perovskites as the future of solar energy. They cost less, offer more versatility than silicon, and can be printed like newspaper ink. They're already pushing efficiency limits in outdoor solar panels. But indoors, they've faced a fundamental flaw.

- Tiny defects, called "traps," lurk deep inside the crystal structure of perovskite, snagging electrons and draining their energy as heat. These traps also contribute to the material breaking down over time.

- Dr. Abdi-Jalebi's team tackled this challenge with a triple-chemical treatment. First, they introduced rubidium chloride, which helped the crystals grow more uniformly and reduced strain. Then they added two organic compounds—DMOAI and PEACl—to keep the ions in the material stable and in place.

Story: Researchers Explore 'Biomining' Seaweed for Critical Minerals

Source: Pacific Northwest National Laboratory Story by JoAnna Wendel

Link: https://www.pnnl.gov/news-media/researchers-explore-biomining-seaweed-critical-minerals

- Pacific Northwest National Laboratory researchers are exploring seaweed as a sustainable source of rare earth elements and other critical minerals like nickel, cobalt, and dysprosium.

- Seaweed naturally bioaccumulates minerals from seawater—sometimes at concentrations over a million times higher than the surrounding water.

- Different seaweed species have the ability to concentrate different minerals:
    - *Fucus* (brown seaweed) is rich in nickel.
    - *Ulva* (sea lettuce) excels at accumulating rare earth elements.

- Researchers grow seaweed in controlled lab conditions using seawater from Sequim Bay, Washington.

- Seaweed is ground into a paste and mixed with acidic liquids (lixiviants) to release minerals.

- Heat and pH adjustments help break chemical bonds and extract the minerals.

- The goal is to recover at least 50% of the mineral content from the biomass.

- Seaweed grows quickly, doesn’t require freshwater, and the leftover biomass can be repurposed for biofuels, plastics, or adhesives.

- Researchers are testing cost-effective methods, including using waste acids from other processes.

- The diversity of seaweed species allows for tailored mineral harvesting based on evolving technological needs.
- Biomining could offer a domestic, eco-friendly alternative to traditional mining.