Trailblazer: 2022/23

Longevity Neurotech

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BrainKey

BRAINKEY

Company Profile

“The brain longevity data platform”

BrainKey’s platform applies AI to brain imaging and genetic data to provide actionable brain health insights.

The team designed BrainKey to be two-sided with a focus on ease of use so that both patients and physicians can understand brain health visually, get treatment recommendations in plain English and monitor changes over time seamlessly. For example, BrainKey’s AI can take a patient’s black and white brain MRI scans and translate them into 3D with 25+ regions that can be tracked over time.

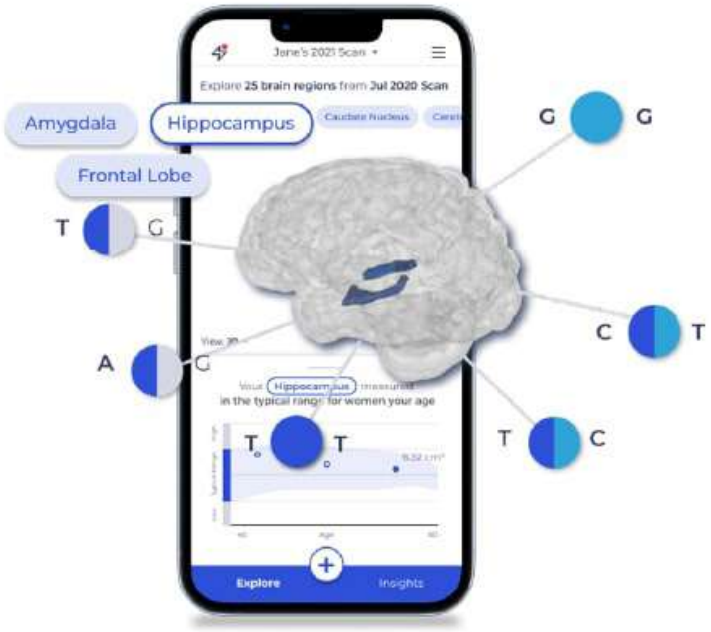
BrainKey has an entrepreneurial team of Stanford PhDs and YCombinator alumni with over 100 neuroscience and AI publications [271]. The team developed BrainKey to be the 1st company to incorporate imaging, genetics, and demographics into a single patient report.

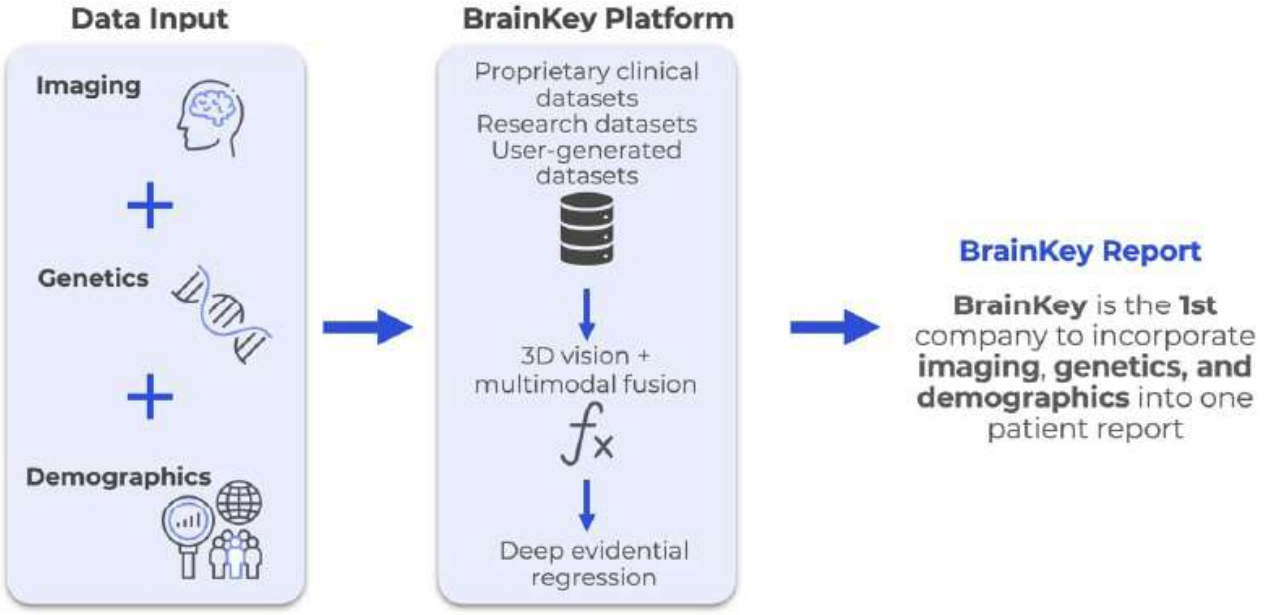
“Many of the technologies that are on the market today are focused on specific data types such as imaging or blood. It’s my belief that incorporating multiple datatypes is necessary to gain a full picture of the patient because the biology of brain aging is complex and can’t be fully understood with limited data.”

Owen Phillips, PhD – CEO of BrainKey

The BrainKey team is designing the platform so that it is well positioned to:

- Detect dementia 10+ years before symptoms are present
- Differewntially diagnose from 100+ dementia types
- Recommend personalized treatments from 1000s of combinations of medications and surgical interventions. https://longevity.technology/research/wp-content/uploads/2022/05/BrainKey-1.jpg





BrainKey's AI Drives Its Vision

BrainKey's report and platform are powered by a novel AI system that BrainKey calls "3D AI" which fuses multimodal data to construct a high-dimensional representation of the patient, which is then compared to the larger BrainKey database to pinpoint brain abnormalities.

Although the underlying power of the platform is its AI technology, BrainKey is guided by the ethos that complex medical data must be made easily digestible to both patients and physicians for it to have real-world value.

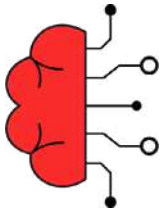
"At BrainKey, we believe physicians and patients need to be able to pull out their phone and quickly understand – here's what this data means and most importantly, here's what we can do to get the best outcome"

Nathan Strong, PhD – CTO of BrainKey

Ultimately, the goal of BrainKey is to empower patients with their own health data.

"My own mother has had a version of dementia that should have been identified and treated years ago. But it was missed, and her outcome is worse for it. I was frustrated about her struggle for an early and precise diagnosis. But as a neuroscientist who has worked with some of the world's leading neurologists and neurosurgeons, I've seen how tough it is to help patients with limited data. We can do better as a field. But to do so we need more data. We created BrainKey with the goal of pooling data from millions of patients to create a powerful new tool that can fundamentally improve how we identify, treat, and manage dementia. It's a personal mission for me but it's a global problem as 1 in 3 will experience dementia in their lifetime."

Owen Phillips, PhD, CEO of BrainKey



Founding and Partnerships:

CEO and Founder of BrainKey, Owen Phillips [272], PhD, has 50+ publications [273] incorporating, imaging and genetic data with collaborators from top universities all over the world such as Stanford, UC London, Charité – Universitätsmedizin Berlin, and the University of Toulouse.

BrainKey emerged as a project of Owen's while he was in a deep learning for genomics class as a post-doctoral researcher at Stanford University in 2018. BrainKey got off the ground in 2019 when the world's top start-up accelerator YCombinator backed them [271]. Owen subsequently recruited key domain experts such as Stanford AI PhD, Nathan Strong and renown physicist Kevin Aquino, PhD to help build BrainKey's infrastructure.

To expand on its competitive advantages BrainKey has collaborative projects with leading experts on specific subtypes of dementia. These collaborations include projects on dementia subtyping with UCSF and the SF VA, brain aging with UCLA, movement disorder subtypes with the University of Toulouse and autoimmune contributors to aging with Charité – Universitätsmedizin Berlin.

Flagship Product Deep Dive: BrainKey Platform

BrainKey's goal is to be the primary platform for the early detection, support differential diagnosis and treatment planning of dementia. There are other companies competing in this area, but they tend to be focused on diagnostics using single specific data types such as imaging, blood/genetics or demographic or smartphone-based biomarkers. BrainKey fuses many specific data types into one. For example, BrainKey can:

- Calculate BrainAge vs chronological age. An advanced BrainAge is associated with increased risk for dementia [274-278].
- Measure the memory area of the brain (hippocampus) associated with early atrophy in Alzheimer's disease volume loss with expert human accuracy from MRI scans [279].
- Identify 20+ genes associated with hippocampal volume from genetic data.
- Fusion of multimodal biomedical data with the patient's demographic information (such as age, and sex) and compare it against the underlying BrainKey database to provide detailed information about a patient's brain health back to the physician.

BrainKey's platform is powered by its proprietary "Rollerblade" system. Rollerblade is their in-house HIPAA compliant cloud infrastructure to structure and deploy imaging and biomedical data at scale. (To learn more about Rollerblade, please see: Rollerblade Data Analysis Engine [280]). Using the "Rollerblade" infrastructure, BrainKey developed an AI system that can reference different data types and create a single report that they call 3D AI. Built as containerized extensions of this are a number of specific analytical tools. A few of the highlights include:

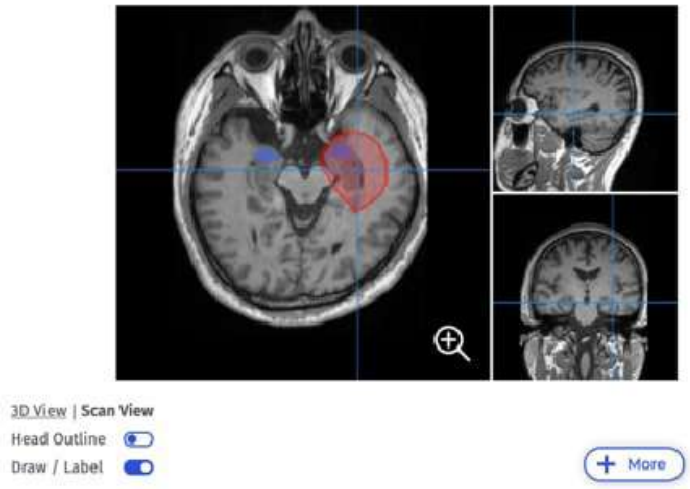
1. Brain Volume – This provides volume calculations such as hippocampal volume for a patient and additionally provides "normal ranges" for age and sex.

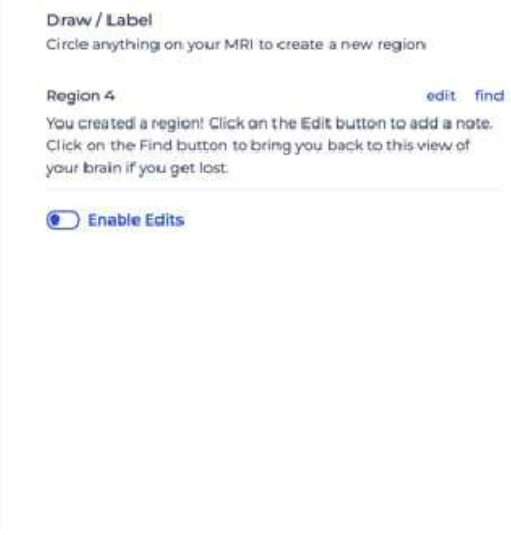
2. Gray Matter Thickness – This provides a calculation of how much grey matter a patient has at over 100,000 points along the surface of the cortex with additional information for "normal ranges" for age and sex. Cortical thickness is a sensitive marker for aging [281, 282].

3. Brain Age Calculator – An overall calculation of a patient's brain age with a comparison to their chronological age.

4. Hippocampal Volume Genetic Calculator – A polygenetic calculation of a patient's genes associated with hippocampal volume. Genes are identified based on published research [283, 284].

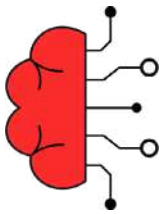
BrainKey also has useful user interface (UI) elements that enhance the product such as a DICOM Viewer which allows imaging data to be directly annotated. This can be useful for physicians who are explaining imaging data to patients.





Beyond analytics and its UI, BrainKey has also developed a custom high-resolution functional and structural brain MRI scan protocol with Stanford Integrative Biomedical Imaging Informatics and Radiology Professor Akshay Chaudhari [285]. This protocol includes the following sequences: 3D T1, T2, MRA, Diffusion, and resting-state functional MRI.

BrainKey also provides personal 3D prints of brain data to patients. For example, BrainKey helped raise money for the University College London (UCL) Rare Dementia Support (RDS) group by 3D printing the brain of the daughter of a patient with a rare dementia [286]: Posterior Cortical Atrophy.



Evidence of safety and efficacy

Efficacy

Using state-of-the art deep learning algorithms, BrainKey can detect and isolate brain tissue with extraordinary precision, replacing the need of hand-drawn tissue tracings. BrainKey's algorithm has been trained on a host of different MR-images from different scanners across the world, and because of this BrainKey is able to provide reports from a wide range of recordings. This includes historical clinical data that often fails and is rejected by many other imaging platforms. Given this, BrainKey's efficacy has been tested on a range of data and has established <95% accuracy on automatic algorithms.

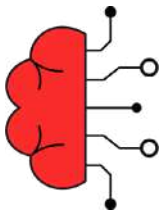
Safety

BrainKey provides actionable insights and metrics to its customers, as well as a large amount of information to consider and use. Currently, BrainKey does not provide direct diagnoses and does not replace advice from a physician or a neurologist, and so the product is of low risk. BrainKey continually strives to lower any risks that may be associated with the product by focusing on three pillars of safety.

- Quality control of MRIs and Biomedical data: any insights are restricted to data that passes bespoke quality control measures.
- Output quality control: each scan and report are inspected to ensure that it is of sufficient quality so that BrainKey lowers the risk of any errors.
- Adjusted Brain Measures: Lastly, BrainKey recognizes that like your height and weight and personality, patients all fall upon a wide spectrum of brain measures. BrainKey supplies a comprehensive report on patient's brain relative to the population adjusted for age and sex. Together this can help toward a holistic approach to brain health.

Target market

1 in 3 seniors will eventually develop dementia. The cost of dementia in the US will rise from $321 billion today to nearly $1 trillion by 2050. Making the matter worse, patients today already struggle with access to brain care with a ~19% shortage of neurologists in the US and an average 35+ day wait to see one. BrainKey's long-term plan is to help alleviate this problem by supporting physicians so they can manage more patients while simultaneously providing optimal care.



Channels to market

In the near term, BrainKey's go to market strategy is a B2B SaaS business model focused on high-end preventive health clinics. BrainKey's analysis tools such as the BrainAge and BrainKey's 3D visualization capabilities are a natural fit for physicians looking to offer their clients the most advanced solutions. BrainKey has already partnered with a number of high-end preventive health clinics such as Human Longevity/Health Nucleus and the Healthy Longevity Clinic.

"The longevity and high-end preventive health space has been a great beachhead for us to enter the market. Getting our platform into the real-world and into the hands of physicians and patients has been invaluable for us to improve the product."

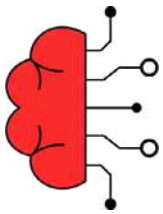
Owen Phillips, PhD, CEO of BrainKey

Additional Channels: BrainKey is also pursuing B2B partnerships with pharmaceutical companies to assist in remote clinic trial recruitment and patient monitoring.

Success Factors

Team and Reputation

- Owen Phillips, PhD, is the Founder and CEO of BrainKey. Owen has entrepreneurial training via YCombinator's accelerator, Stanford Graduate School of Business Ignite, and Stanford's Venture Studio. Owen has a deep network in the neurology space with 10+ years of research experience in three countries and 50+ publications in high-impact journals.
- Nathan Strong, PhD, is CTO of BrainKey and holds a PhD in engineering/AI from Stanford University. He has entrepreneurial experience and previously built an AI/computer vision company.
- Kevin Aquino, PhD, is BrainKey's Scientific Director. Kevin is a respected physicist with high-impact publications and a proven data pipeline engineer.
- BrainKey has key Board Members and Angel investors including:
    - Max Ibel, PhD who was a former Google Engineering VP
    - Jiangwen (Jen) Majeti, PhD a BioPharma Executive.
- BrainKey has a top medical and technology advisory team:



- Stanford Professor Akshay Chaudhari
- University of Toulouse, Professor Olivier Rascol, MD, PhD
- Neuroradiologist and previous NYU Professor Eddie Knopp, MD
- Medical Imaging Informatics UC London Professor James Cole, PhD
- Entrepreneur and former UCLA Professor Daniel Valentino, PhD.

- BrainKey's C-suite is YCombinator backed, and Stanford trained in AI, entrepreneurship, and AI
- BrainKey is backed by venture funds, Soma Capital, Amino Capital, YCombinator, Human Longevity, and the Longevity Tech Fund.