

THE MISSION

A RADAR TO DETECT CONSCIOUSNESS AFTER COMA

The primary objective of Intrinsic Powers inc. is to optimize, certify, and commercialize a reliable, practical tool to detect track and recovery of consciousness in the clinical practice.

THE PROBLEM

WE LACK A RELIABLE TOOL TO DETECT CONSCIOUSNESS

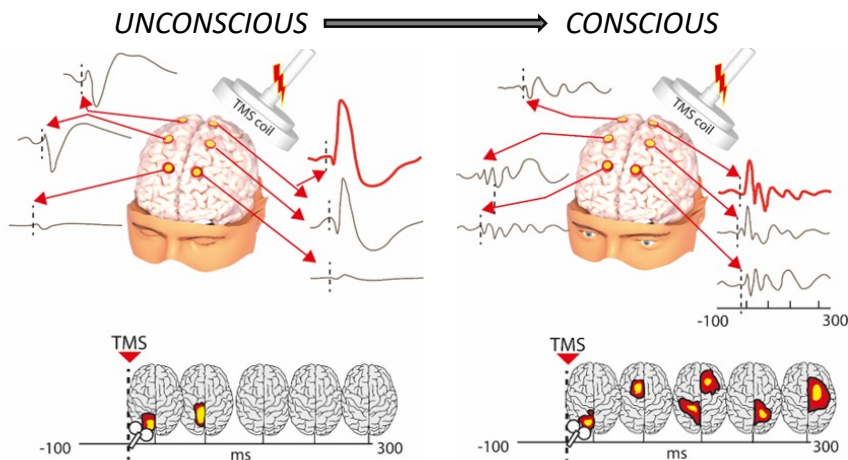
Current methods for assessing recovery of consciousness in coma patients rely either on the observation of motor behavior or on the administration of sensory stimulation to analyze brain responses. Both methods can fail if brain injured patients are disconnected from the external environment.

As a results, 40% of patients recover consciousness but are erroneously labeled as vegetative state patients

THE SOLUTION

A PROBE WE CALL 'PRESENCE'

By combining transcranial magnetic stimulation (TMS) and EEG recordings, **PRESENCE** measures directly the brain's internal communication and reliably detect recovery of consciousness in unresponsive patients



THE EXPERIENCE

BUILDING ON 20 YEARS OF SOLID SCIENCE

Massimini et al., *Science* 2005

Masimini et al., *PNAS* 2007

Rosanova et al., *Brain* 2013

Ferrarelli et al *PNAS*, 2010

Sarasso, Boly et al., *Curr Biol* 2015

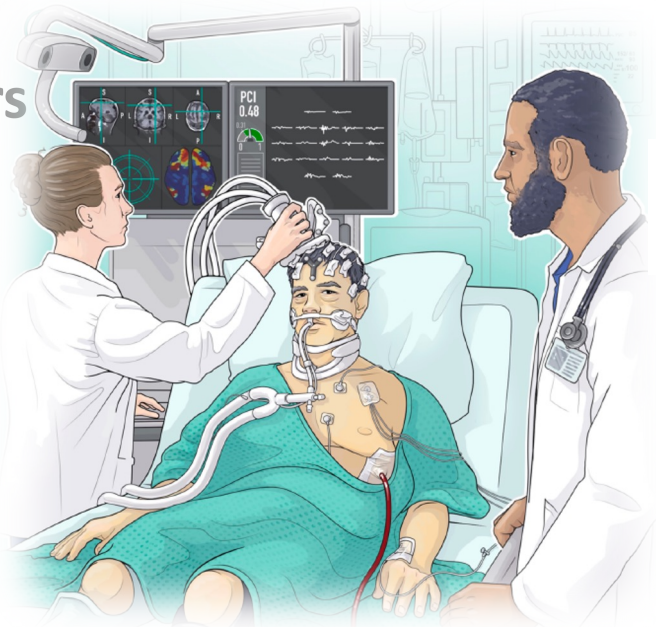
Casali et al., *Science Transl Med* 2013

Casarotto et al, *Ann Neurology* 2016

Rosanova et al, *Nat Comm* 2018

Comolatti et al, *Brain Stim* 2019

Lee et al., *Nat. Comm* 2022



THE VALUES:

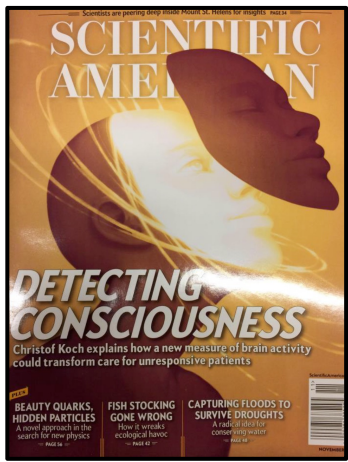
- *INFORM DECISIONS*
- *MINIMIZE ERRORS*
- *ALLOCATE RESOURCES*

Intensive Care Unit (ICU): to inform early decisions and minimize the risk of inappropriate withdrawal of care in unresponsive patients who are conscious
 → a safety net

Intensive Rehabilitation Unit (IRU): to stratify patients for the intensity of rehabilitation and prognosis
 → a guide to recover

THE IMPACT

CLINICAL, ETHICAL AND SOCIETAL
 Consciousness is all that matters in life



THE KEY TO CONSCIOUSNESS, A JOURNEY INTO THE STUFF OF THOUGHTS



THE FOUNDERS:

LEADERS IN THE FIELD OF CONSCIOUSNESS



Christof Koch, PhD



Marcello Massimini MD, PhD










Giulio Tononi MD, PhD



Harpreet Singh PhD

THE BUSINESS MODEL CANVAS:

 <p>Key Partners</p> <ul style="list-style-type: none"> -Nexstim (Finland) TMS hardware manufacturing -Bittium (Finland) EEG hardware manufacturing -Mass General Hospital -University of Wisconsin -Clinical partners 	 <p>Key Activities</p> <ul style="list-style-type: none"> -Prototype refinement -Software debugging -Clinical trials -Grant writing/fund 	 <p>Value Propositions</p> <p>Uncertainty reduction and evidence-based support for caregivers and families in critical/distressing decision making:</p> <ul style="list-style-type: none"> • Is my patient conscious? • Is my relative conscious? • Is treatment working? • Is she/he recovering? • Will she/he recover? 	 <p>Customer Relationships</p> <ul style="list-style-type: none"> Membership to forum Co-creation (data/research) Online assistance Onsite assistance Scientific/technical workshops 	 <p>Customer Segments</p> <ul style="list-style-type: none"> Neuro-intensive care units Intensive Rehabilitation Units: <ul style="list-style-type: none"> - Severe brain injury - stroke
 <p>Cost Structure</p> <ul style="list-style-type: none"> R&D (Hardware/software) Regulatory consultants Medical officer Trial management, data analysis and support Personnel for online/onsite service Marketing 		 <p>Revenue Streams</p> <ul style="list-style-type: none"> Hardware lease (Nexstim) Software sale and updates Service (exam/data analysis/report) Consumables (TMS coils, trackers, EEG caps) Training courses 		

FIRST STEPS:

PATENTS

Current:

US patent 8,457,731: a method based on TMS-EEG to assess consciousness

Pending:

Patent 1: A method for detecting the presence of consciousness in brain-injured unresponsive patients based on the reactivity of cortical circuits

Patent 2: A perturbational method for localizing and quantifying neurophysiological alterations after focal and multifocal brain injury to guide rehabilitation

PARTNERSHIPS

Nexstim (Finland)

For TMS hardware

Bittium (Finland)

For EEG hardware

WHAT WE NEED:

CURRENTLY LOOKING FOR A SEED INVESTMENT

NEXT STEPS:

R&D

Phase I Small Business Innovation Research (SBIR)
for set-up simplification and reduction
Quality Management setup and MVP

- - Clinical Trial
- - ISO 13485 & FDA (regulatory approval)
- - CE Approval

THE VISION:

TMS-EEG LIKE ULTRASOUND SONOGRAPHY



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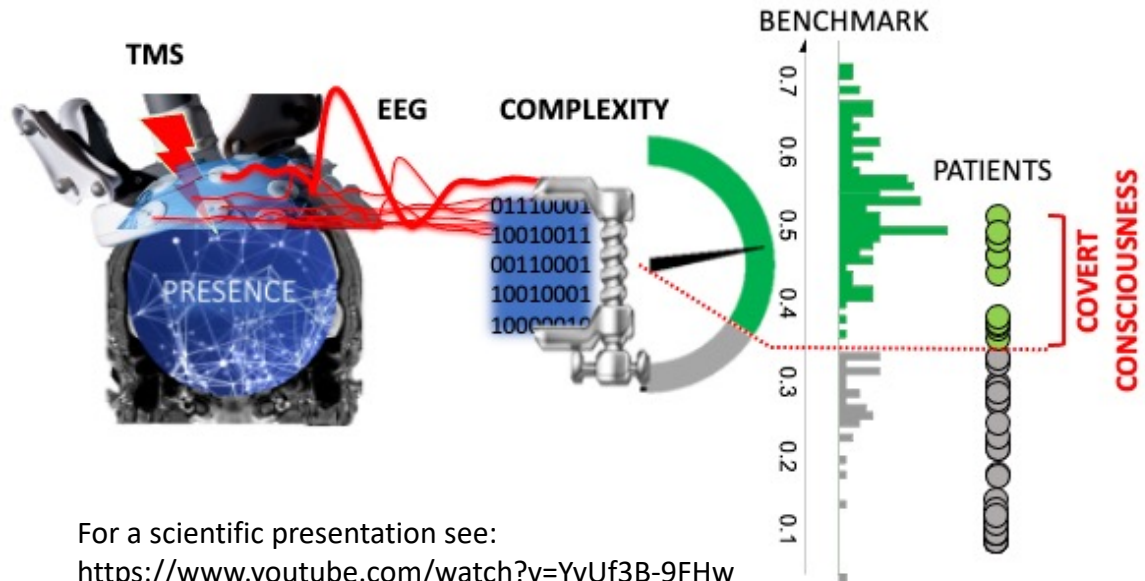
MORE BACKGROUND:

For both ethical and clinical reasons, there is thus an **urgent need for a new technique** that can be routinely used to 1) reliably detect the potential for covert consciousness in brain-injured patients who cannot communicate; and 2) provide a sensitive readout of the mechanisms that are relevant for recovery of consciousness – spontaneously or in response to therapy. Since consciousness can be present even in the absence of sensory processing and executive/motor functions, **it is important for this technique to directly probe the state of cortico-thalamic circuits and their internal ability to sustain recurrent causal interactions**, a key prerequisite for consciousness and the recovery of behavioral responsiveness. **The product developed by Intrinsic Powers is unique as it does precisely this:** by combining direct cortical stimulation and recordings, it bypasses sensory and motor function (often impaired in brain-injured patients) to directly assess the state of thalamocortical circuits.

As also highlighted in the attached market analysis there is a **lack of reliable tools to assess consciousness and other techniques are characterized by low sensitivity:** around 10% in the case of fMRI active paradigm, 33% in the case of ERPs (P3b wave) and 60-70% in the case of EEG (see consensus paper by Comanducci et al., Clin Neurophys 2019). **The present approach based on TMS-EEG is characterized by the unprecedented sensitivity of 94%** (Casarotto et al., Ann Neurol 2016).

THE TECHNOLOGY

The technology involves briefly **perturbing** the patient’s cerebral cortex using a magnetic pulse, delivered by a Transcranial Magnetic Stimulation (TMS) device, and **recording** the resultant electrical activity using one or more electroencephalographic (EEG) electrodes placed on the scalp (US patent 8,457,731). Analysis of the resultant activity, averaged over repeated pulses delivered at one or more cortical sites, using **information-related algorithms** (two patents pending), probes whether the ability of cortico-thalamic circuits to sustain complex patterns of reverberant excitatory activity, a fundamental mechanism that supports the presence of consciousness, is preserved or disrupted.



For a scientific presentation see:
<https://www.youtube.com/watch?v=YvUf3B-9FHw>

THE FOUNDERS (SHORT BIO):

Christof Koch, PhD is an American neurophysiologist and computational neuroscientist best known for his work on the neural basis of consciousness together with Nobel Laureate Francis Crick. He is the president and chief scientist of the Allen Institute for Brain Science in Seattle. From 1986 until 2013, he was a professor at the California Institute of Technology. Koch has authored more than 300 scientific papers (H-index: 157; total citations: 137,860) and five books about how computers and neurons process information and on the mechanisms of consciousness.

Marcello Massimini MD, PhD was trained as a medical doctor and is professor of Physiology at the University of Milan. He is known for his work on the mechanism of loss and recovery of consciousness during sleep, anesthesia and in brain injured patients. Together with Giulio Tononi at the University of Wisconsin and other colleagues at the University of Milan, he developed novel neurophysiological tools to assess consciousness after brain injury. On these subjects he has published more than 60 papers (H-index 61; total citations 19,700) a book and received many awards and international grants.

Giulio Tononi MD, PhD is an Italian-american neuroscientist and psychiatrist who holds the David P. White Chair in Sleep Medicine, as well as a Distinguished Chair in Consciousness Science, at the University of Wisconsin. Tononi collaborated with Nobel laureate Gerald Edelman and developed the integrated information theory (IIT): a theory of what consciousness is, how it is correlated with brain states, how it fades during sleep and how it can be measured. On these subjects, he published more than 200 papers (H-Index 129; Total citations: 77,400) and several books.

Harpreet Singh PhD Harpreet Singh is a biomedical engineer, a technical strategist having international consulting experience across Europe, USA and Asia and the CEO of Child Health Imprints, Singapore parent entity of iNICU Korea and CHI India. His experience spans across diverse industries and skill sets. He is having a collective experience of 18+ years in software product development and management. He has published several scientific articles and sold medical software products to EGI (subsidiary of Philips) and Sun Pharma.