The Future of Accessible Neurostimulation

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Why does everybody may need it?

- Cognition & performance enhancement
  - Task – specific, generic, combined
- Countering ageing effects!
- Sensory enhancement including for entertainment purposes (e.g. in gaming)
- Stress-protection, ergotropic, rehab use
- Borderline disorders correction
  - Anxiety, sleep disorders, mild depression, neuroses, motivation problems, chronic fatigue…

General Methodologies

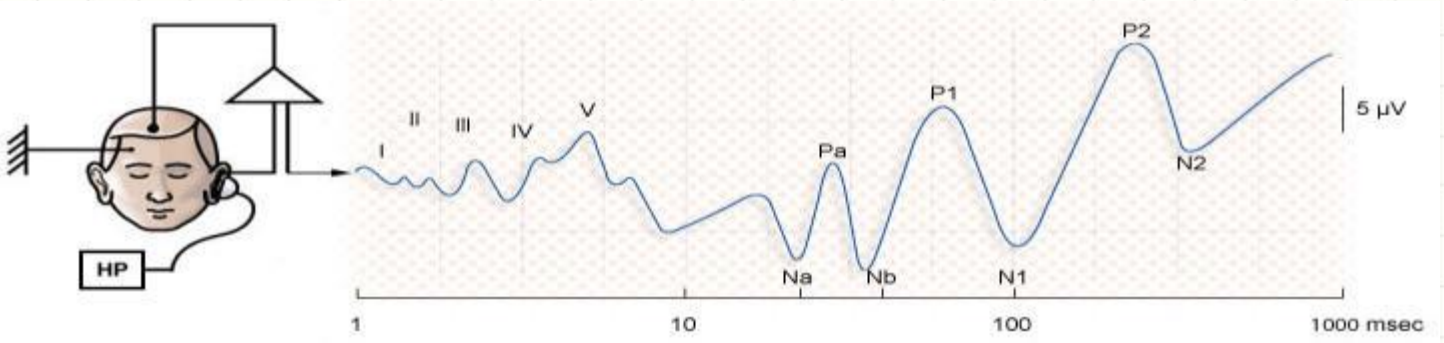
- Biophysical stimulation
  - ELECTROMAGNETIC (ranging from static field or DC and ULF to visible light)
  - MECHANIC (acoustic, esp. ultrasound)
  - During wakefulness or selected sleep stages! (NeuroON, Marshall group tSOS…)
- Bio (neuro) feedback
- Pharmacology (nootropics, ergotropics and stress-protectors, motivation/mood correction substances etc.)
- All of the above can be successfully combined in a single methodology!

Don’t let the term deceive you!

- Neurostimulation can have both excitatory and inhibitory, as well as more complex effects
- Optimal cognitive performance / other desirable effect window is to be established and found
  - Depending on a stimulation method
  - Depending on the task performed and its stage
  - Depending on the group or individual characteristics
  - Depending on environmental conditions
- Ideally, it should be more akin to neurofeedback than a “one pill fits all” solution
- How do we tailor it?

Measurement!

- Real time data are highly desirable!
- Feedback loop to control and adjust stimulation
- Bringing neurofeedback methods in!
- Generation of valuable data to advance our knowledge of neuroscience and develop novel stimulation methods
- Crowdsourcing and crowdfunding projects, advancement of “garage science”
- **Bottom line: accessible stimulation methods must be compatible with the accessible measurement techniques**



Today's Accessible Measurement

1

- Psychological testing online (e.g. quantified-mind.com)

2

- EEG – like (wider measurement spectrum might be required)

3

- Metabolic assessment ("poor man's fMRI/BOLD/PET"):
  - Very slow potentials (< 1 Hz) (Kropotov, Fokin) – "omegametry"
  - Functional near-infrared spectroscopy (fNIRs)

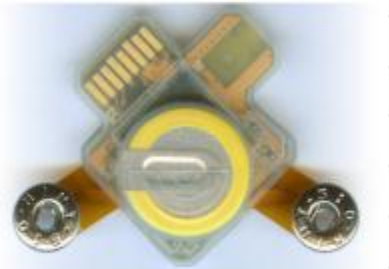
Problems of measurement

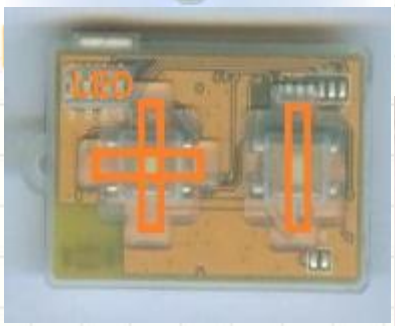
- Meaningful correlations between measured data and cognitive performance:
  - Psychological tests are “to the point” but not real time
  - Real time data might be co-incidental or weakly related to the effect
  - Example: EEG data and cognitive performance: from “limbic bursts” to complex coherence/decoherence maps dependent on gender, age etc.
- Evoked potentials (EP’s) can provide better insight and control for task-specific performance, and especially with low electrode number gadgets, but

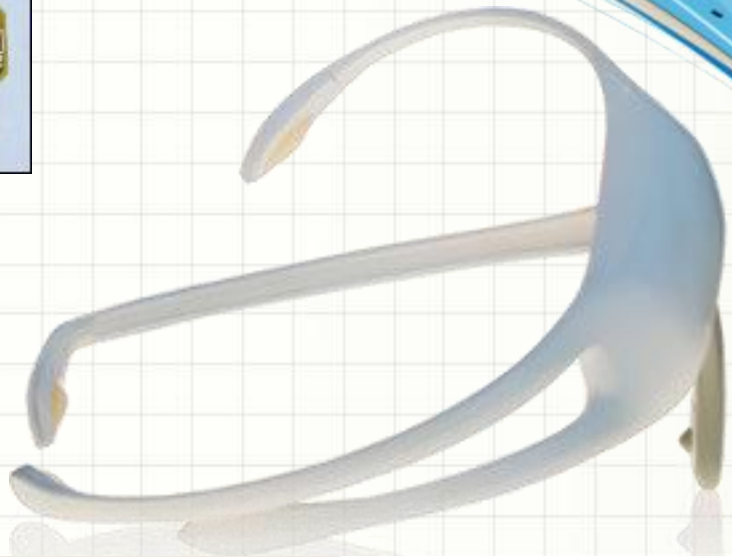
  a) more correlational studies and data are clearly needed

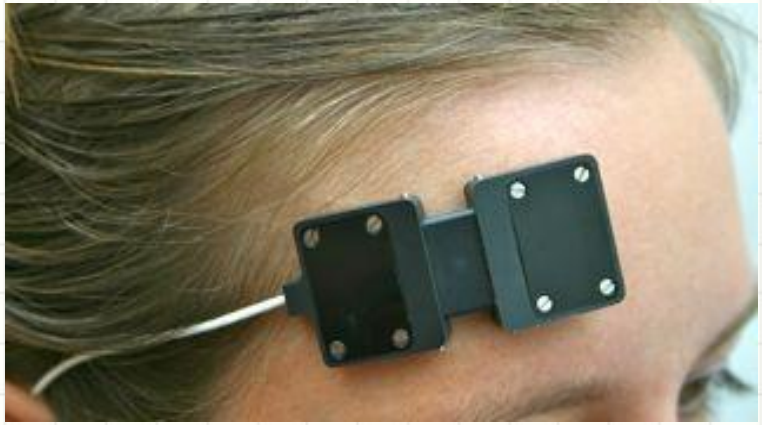
  b) no EP’s analysis software available for current end-user gadgets! ☹
- Availability of accessible, easy-to-use, quality devices
  - fNIRs appliances are still too expensive for an enthusiast
  - Slow potential measurement-based methods little known in the West

TrueSense 1.0

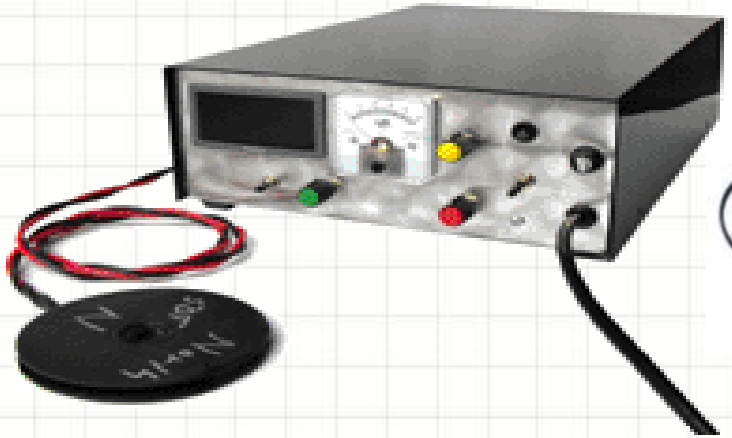









VivaLight pro

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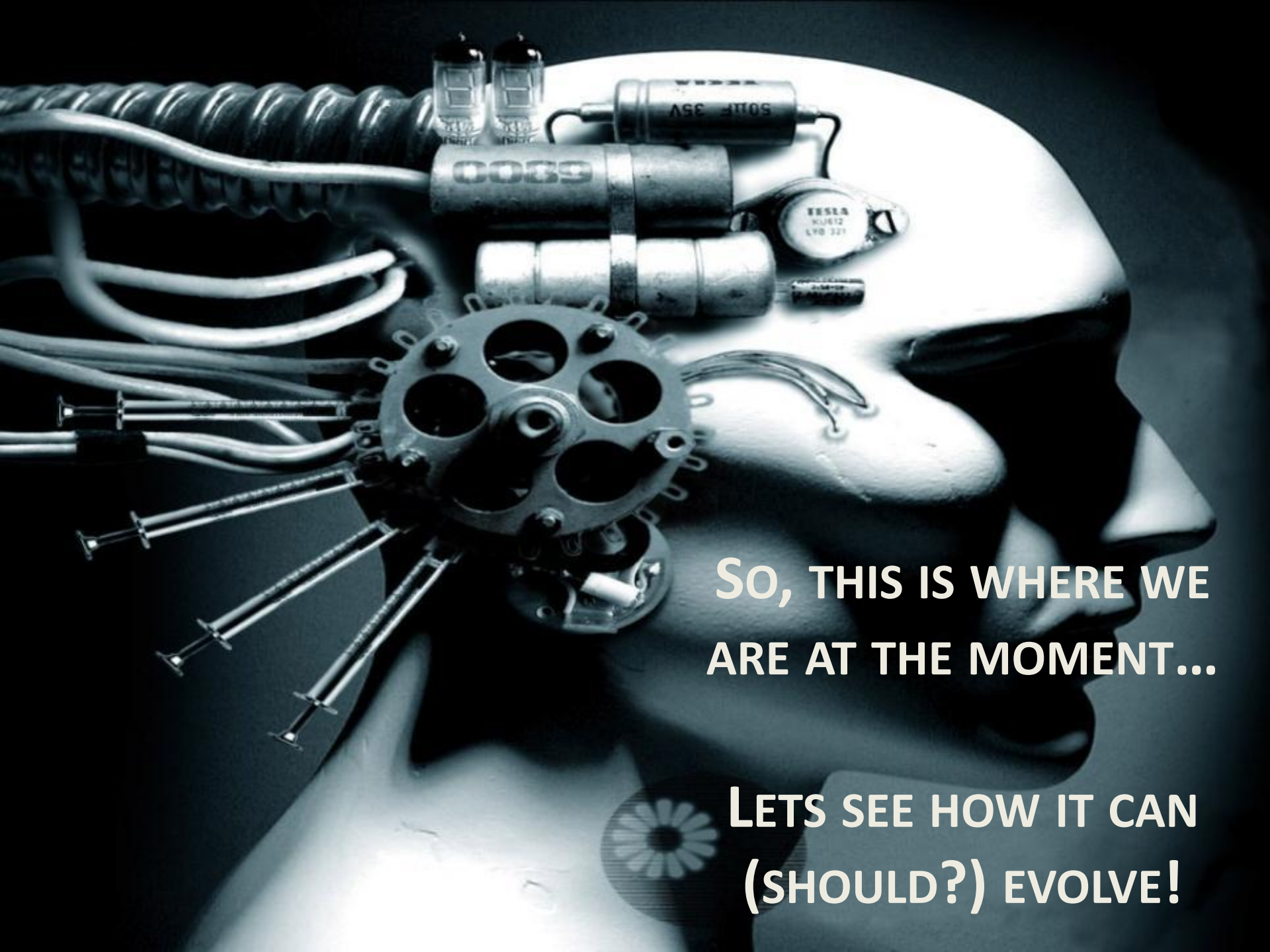
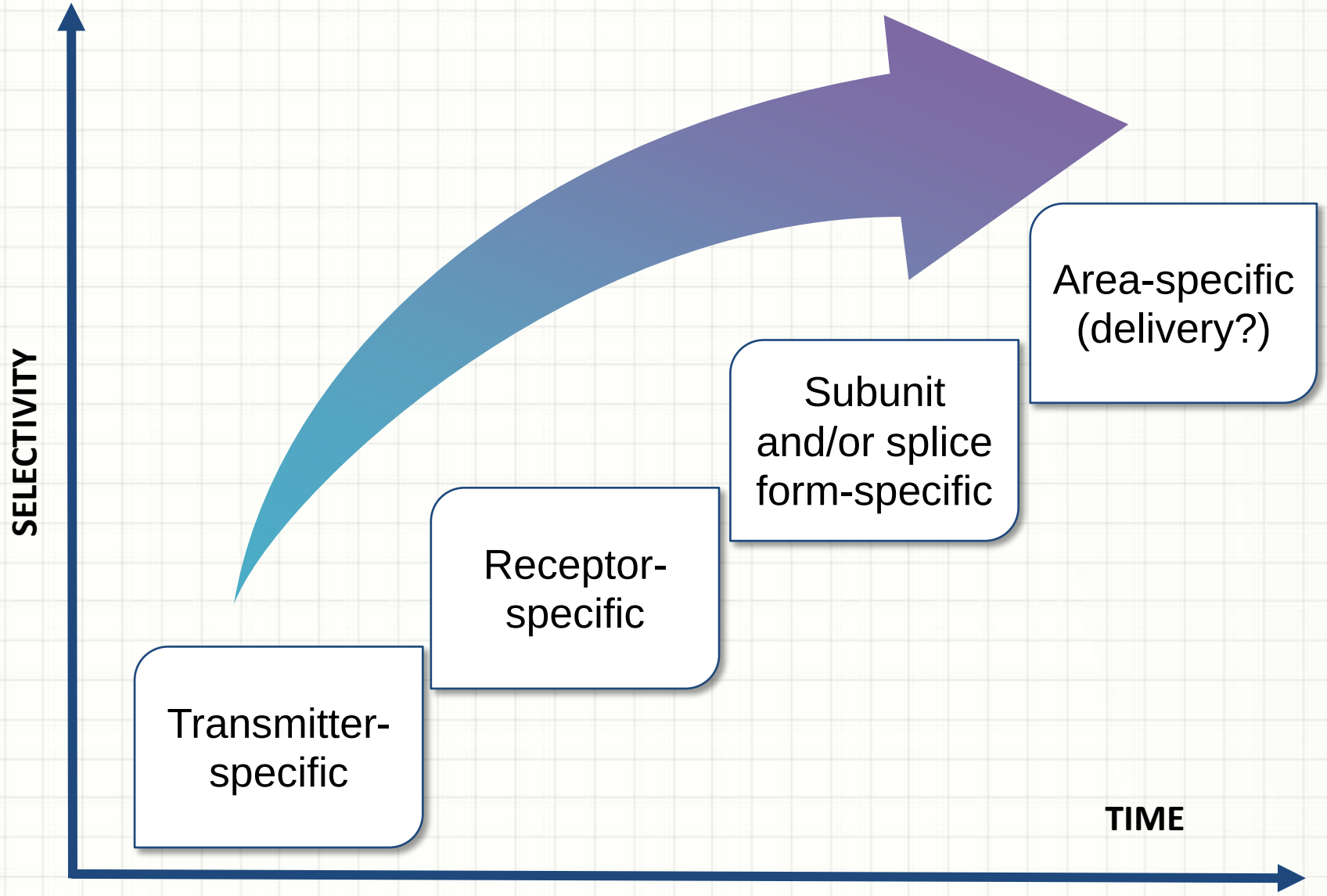
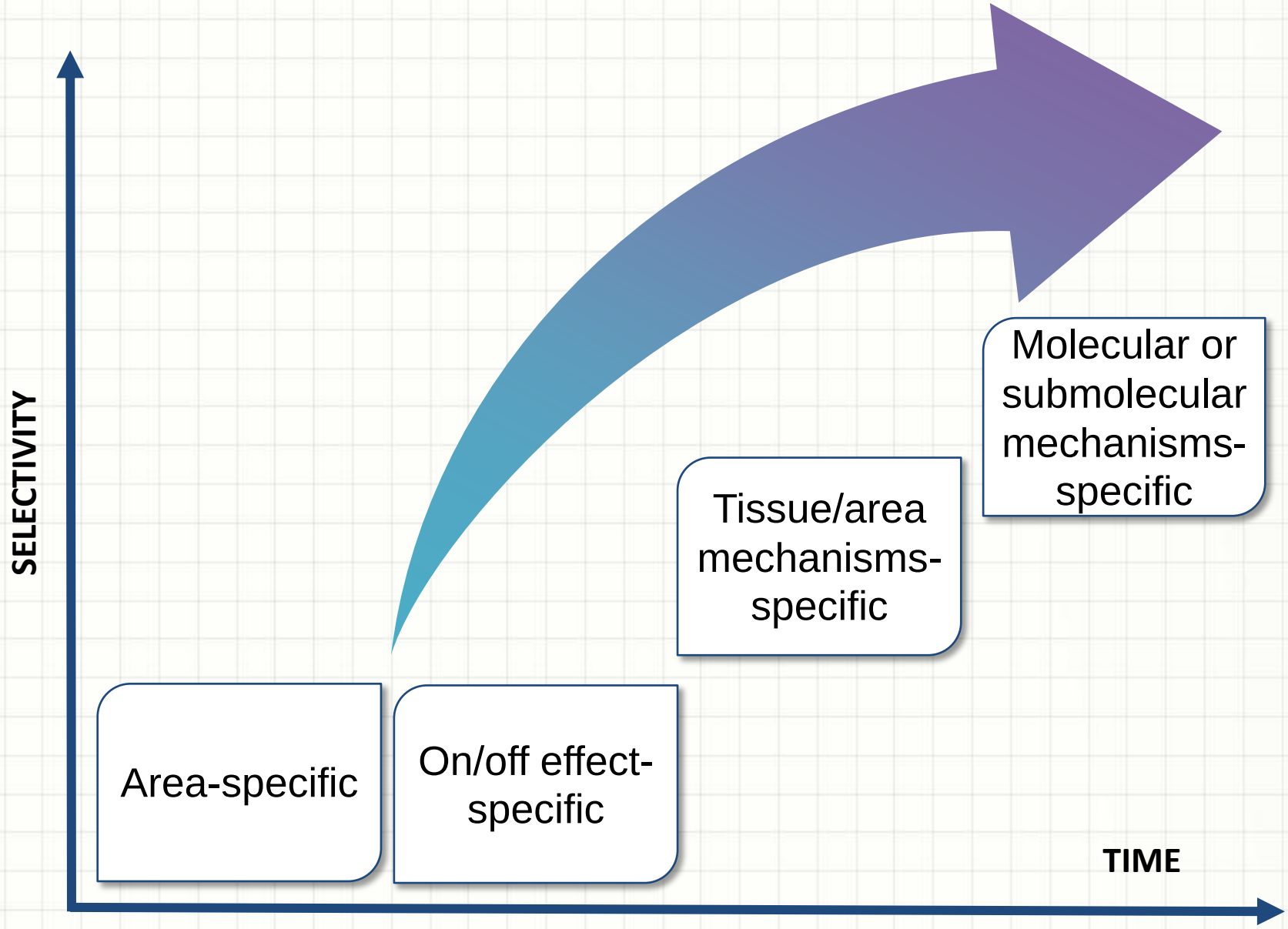

So, this is where we are at the moment...
Lets see how it can (should?) evolve!

(Neuro)pharmacology example



Neurostimulation



STIMULATION METHOD	TARGET MECHANISM SELECTIVITY	SPATIAL RESOLUTION	REAL TIME MEASURE	END USER ACCESS / SAFETY
Direct Current (tDCS)	Low (+/-)	~ 4 cm^2	EEG-like + fNRI +++	Very High Safety+++
Monophasic pulse current (tPCS, tSOC)	High	~ 4 cm^2	As above	High Safety++
Alternating Current (tACS)	Medium to High	Low to none	As above	High Safety++
Random Noise Stimulation (tRNS)	Low (unless noise colours used!)	Subject to being mono or biphasic	As above	High Safety++
Magnetic Field (TMS)	Low (on/off)	~ 2-3 cm^2 Cortex surface only	EEG-like ++ fNRI +++	Low Safety+
Low H Magnetic Field (liTMS)	High to Very High ???	Lower than TMS? Depth stim possible?	EEG-like +++ fNRI +++	High Safety+++
Light (non-modulated)	Medium to High (?)	Low (spot size?) Up to 7 cm depth	EEG-like +++ fNRI +	High Safety++
Light (modulated)	High to Very High???	As above	As above	High Safety++
Ultrasound	Currently Low (on) mechanosensitivity??	As low as 2 mm^2	EEG-like +++ fNRI +++	Low Safety ?

Building an ultimate neurostimulator?

- Combination of static and pulsed magnetic fields and coherent or decoherent light
- Attempt custom Brodmann area-sized targeting
- Be fully compatible with the accessible measurement means and devices: cooperation with the existing vendors? potential incorporation of relevant sensors in the future?
- Wireless, smartphone/tablet – controlled etc.
- Networked with other devices including over the Internet – here the neurosocial net begins

Matrix: The Revolution? ☺

- The challenge
  - The current state of sensor/data gathering, not to mention neurostimulation devices, truly resembles pre-Internet, or even pre-LAN computing!
  - Even devices from the same vendor are not internetworked while being computer-controlled!
- The solution?
  - Internetworked gadgets and control software
  - Common data formats (already there for EEG)
  - Application layer communication stack
  - Shared SaaS representation/control/comms GUI

Neurosocial Network Capabilities?

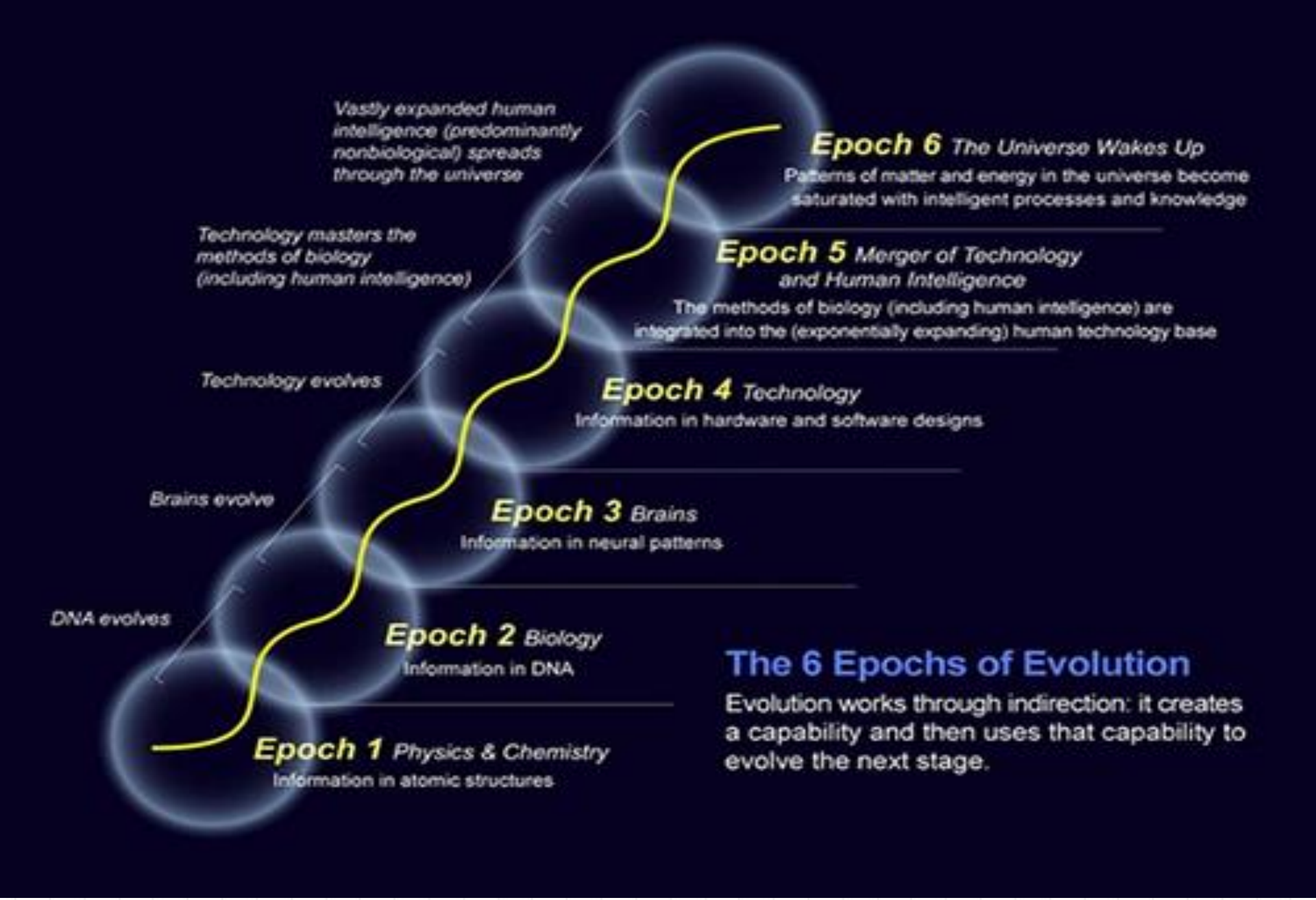
- “Collective coherence” (or the “conductor mode”): inducing/promoting similarity
- “Collective decoherence” (or the “diversity hive”): inducing/promoting dissimilarity
- Other “direct” “neurosocial engineering”, collective “digital nootropics”/global scale enhancement
- “Social bio(neuro)feedback” (peripheral sensors can be used) including collective control of virtual characters, game/film storylines, in robotics etc.
- Study of global factor effects (geomagnetic etc.), massive neurosocial info induction/gathering

Finally…

- Novel neurostimulation methodologies are under testing and development for over 2 years with some interesting results (EEG, omegametric, subjective observations) produced on healthy volunteers
- Schemes and components already laid out
- Qualified team is practically assembled and open to suitable participants
- Unless there is sudden investment, we are coming soon to Kickstarter next to you!

Would the envisioned "neurosocial network" bring us closer to creation of the "hive overSelf" / "feedback noosphere" (and, ultimately, the "singularity") without having any detrimental effects upon individuality?

IN A MEANWHILE, ANY SMARTPHONE, TABLET OR OTHER COMPUTER CAN BE TURNED INTO A LOW INDUCTION MAGNETIC FIELD (LITMS) NEUROSTIMULATION DEVICE FOR PENNIES ☺


Vastly expanded human intelligence (predominantly nonbiological) spreads through the universe
Epoch 6 The Universe Wakes Up
Patterns of matter and energy in the universe become saturated with intelligent processes and knowledge
Technology masters the methods of biology (including human intelligence)
Epoch 5 Merger of Technology and Human Intelligence
The methods of biology (including human intelligence) are integrated into the (exponentially expanding) human technology base
Technology evolves
Epoch 4 Technology
Information in hardware and software designs
Brains evolve
Epoch 3 Brains
Information in neural patterns
DNA evolves
Epoch 2 Biology
Information in DNA
Epoch 1 Physics & Chemistry
Information in atomic structures
The 6 Epochs of Evolution
Evolution works through indirection: it creates a capability and then uses that capability to evolve the next stage.

QUESTIONS?