From Artificial Intelligence to Artificial Consciousness?

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www.comascience.org
Who are we?

Coma Science Group

www.comascience.org
Prof. Steven Laureys, MD, PhD
Summary

1. Defining Consciousness
2. Neuroimaging
4. Machines vs. Humans
5. Machines for Humans
6. Machines like Humans
1. Consciousness
What is consciousness?
Consciousness: 2 components

Consciousness | Neuroimaging | Machine vs. Human | Machine for Human | Machine like Human

Laureys, *Trends in Cognitive Sciences*, 2005

“There’s nothing we can do... he’ll always be a vegetable.”
The networks of consciousness

**Internal network:**
- Consciousness of self
- Anterior cingulate
- Precuneus

**External network:**
- Consciousness of environment
- Lateral fronto-parietal cortices

Laureys, *Scientific American* 2007
Terry Schiavo
Why assess consciousness?

**Prognosis**
- Unresponsive wakefulness (UWS)
- Minimally conscious (MCS)
- Death

**Treatment**
- Thibaut et al, *Brain Inj* 2017

**Ethics**

**LIS diagnosis:**
- Mean time from onset: 79 days
- Made by family member in 54%

Cassol et al, unpublished data

León-Carrion et al, *Brain Injury* 2002
2. Neuroimaging
Electroencephalography (EEG)
Auditory evoked potentials

Boly et al, Science, 2011
Transcranial magnetic stimulation + EEG
Positron Emission Tomography (PET)
Magnetic Resonance Imaging (MRI)
3. Machines vs. Humans
Human vs. Supercomputer
Axons vs. wires
Axons vs. wires
Gary Kasparov vs. Deep Blue
Ken Jennings vs. IBM Watson
ASIMO
ATLAS
Alan Turing vs. Robots

Alan Turing, *Computing machinery and intelligence*, 1950
CAPTCHA vs. Robots
Cats vs. Robots?
Robots vs. Music

Toyota violin robot, 2007
Toyota violin robot, 2007
Toyota basketball robot, 2018
Imitation or Emotion?
Machines vs. Criminals

Policeman robot, police Dubaï 2017
Self consciousness & ego

Gallup Test

Ex Machina 2015
Self Consciousness & ego

Westworld, 2016
Uploading consciousness?
4. Machines for Humans
EEG : functional connectivity
PET: brain metabolism
PET: networks of consciousness

MRI: structural changes

**Grey matter**
Volume-Based Morphometry

**White matter**
Diffusion tensor imaging

Control
MCS
UWS
Functional MRI: Brain-Computer Interfaces

Imagine Tennis for YES
Imagine Navigate NO

Is your father called Alexander?
Is your father called Thomas?

Laureys et al, Lancet, 2000
EEG Machine Learning

Connectivity | Information | Spectral measures | Evoked potentials

| wSMI θ | K | PE θ | SE | | | P3b | MMN | CNV |

VSL/W | VS/UWS | MCS | CS | Healthy

Probabilty of consciousness

0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

VS/UWS | MCS

120 markers
5. Machines like Humans
# TD Learning & dopamine

<table>
<thead>
<tr>
<th>Training</th>
<th>Reward</th>
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<td>NO</td>
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<tr>
<td>YES</td>
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Supervised learning & the cerebellum
Conclusion
The mind is not digital
The mind is not digital
Digits do not make a mind (yet)
Human Consciousness
- Arousal & awareness
- Internal & external networks
- Brain imaging techniques: EEG, TMS, PET, MRI

Artificial Intelligence
- Computing power
- Imitation and accuracy
- Unable to generate original emotions

Artificial models contribute to the understanding of the human brain!
YESTERDAY I MADE A TURING TEST

INTERESTING! WHAT WAS THE RESULT?

I FAILED! THE MACHINE REALIZED IMMEDIATELY THAT IT WAS ME BEING THE DUMB HUMAN

BEAR UP!

TURING TEST 2208
Thank you!

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