טכנולוגיות חדשניות בחקר המוח ויישומן בתהליכי שינוי

פרופ' אלי וקיל

המחלקה לפסיכולוגיה והמרכז לחקר המוח
אוניברסיטת בר אילן

מה זאת אינטליגנציה?

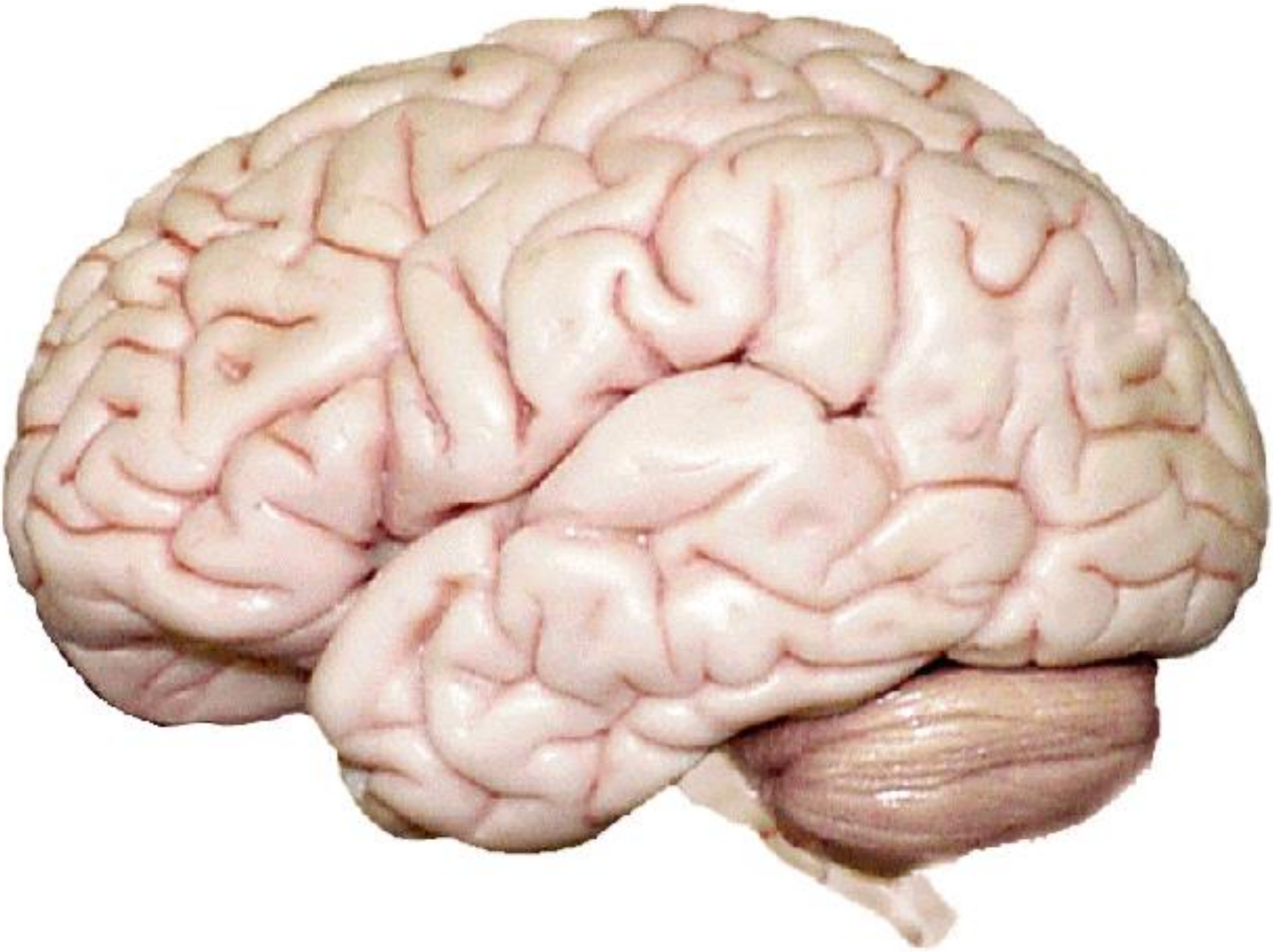
הגדרה של אינטליגנציה

- היכולת להפיק תועלת מניסיון
- היכולת לפעול לקראת מטרה (תכנון, בקרה וכו׳)
- היכולת להסתגלות לשינויים בסביבה
- יכולת לחשיבה מופשטת

גמישות

היכולת להשתנות בהתאם לנסיבות המשתנות מנבאת הצלחה של

- האדם הפרטי
  משפחה
  תחום עיסקי או מדעי
  חברה




009
MOTUL
MICHELIN
INFONIZER
Ontime


קובי דגן©

קידמה ושינוי:
איזון בין הפוטנציאל החיובי ולבין הפוטנציאל ההרסני

- לא להשליך את התינוק עם המים
- צורך לחזות קדימה את היישומים האפשריים גם אם אינם ישימים כיום
- השלכות מדעיות תיאורטיות, השלכות קליניות, מוסריות וחוקיות

Monitoring and Manipulating Brain Function

New Neuroscience Technologies and Their Ethical Implications

by Martha J. Farah and Paul Root Wolpe

The eye may be window to the soul, but neuroscientists aim to get inside and measure the interior directly. There's also talk about moving some walls.

ממשק מוח ואתיקה

- התפתחויות טכנולוגיות – יישומים בחקר המוח
- קריאת מחשבות
- הכתבת מחשבות
- בחירה חופשית

שיטות לחקר המוח

- Electroencephalography – EEG
- Magnetoencephalography - (MEG)
- Single cell recording – רישום מתא עצב בודד
- CT, MRI – הדמיה מוחית מבנית
- PET, fMRI – הדמיה מוחית פונקציונאלית
- Eye tracking – ניטור תנועות עיניים

Trends Neurosci. 2006 September ; 29(9): 511–517.

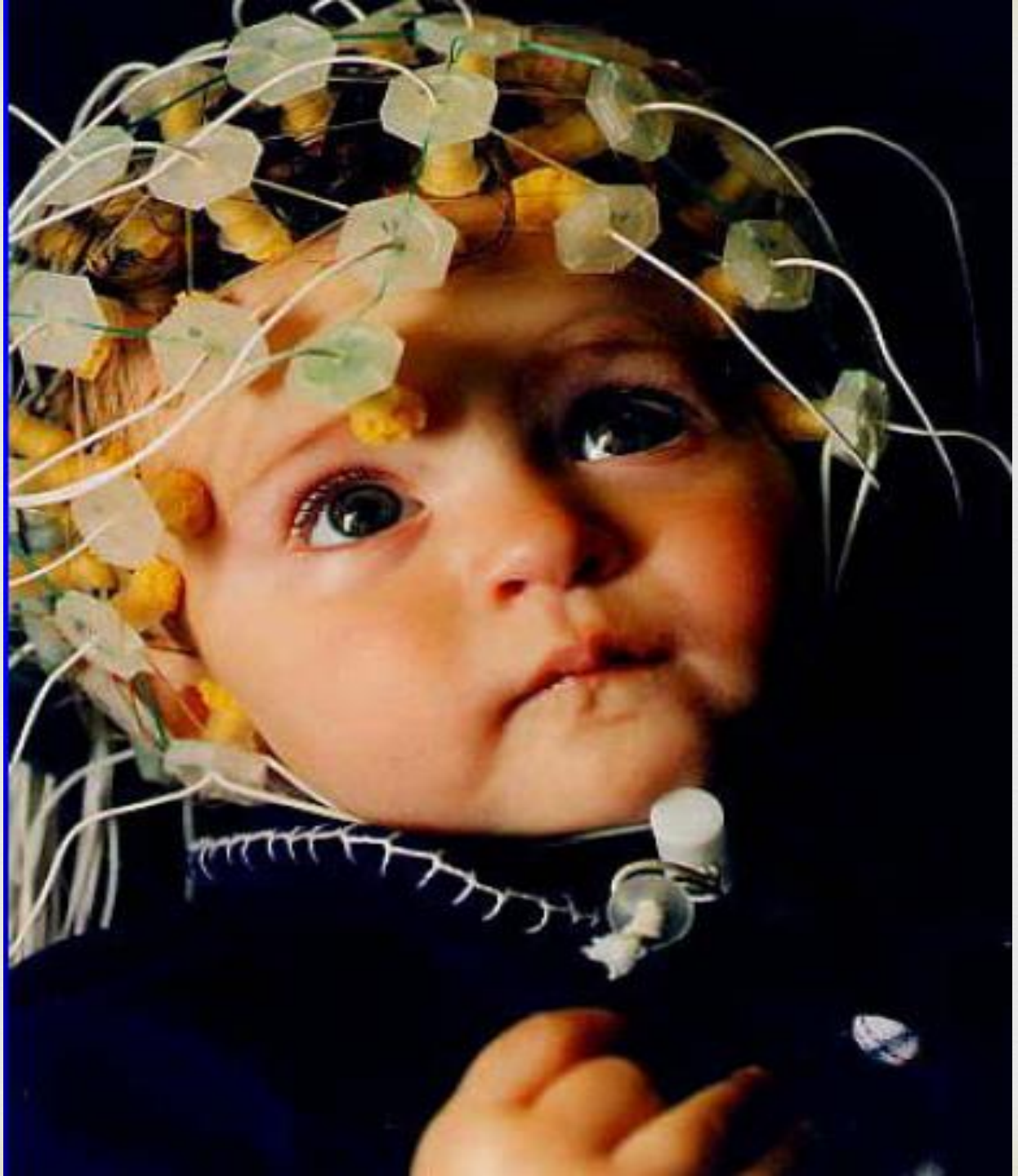
Neuroethics: a modern context for ethics in neuroscience

Judy Illes[1] and **Stephanie J. Bird**[2]

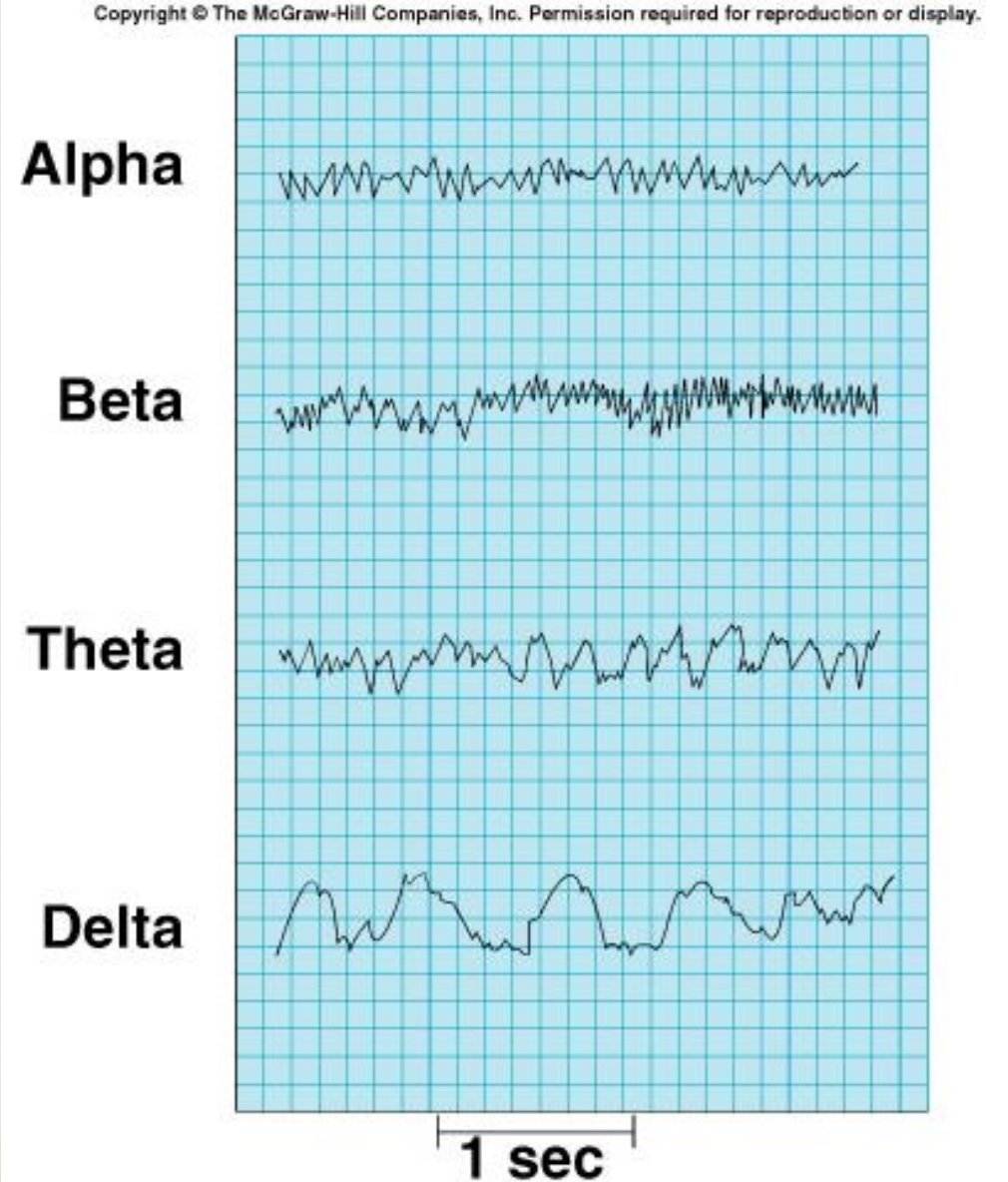
Emerging ethical issues in neuroscience

Martha J. Farah

There is growing public awareness of the ethical issues raised by progress in many areas of neuroscience. This commentary reviews the issues, which are triaged in terms of their novelty and their imminence, with an exploration of the relevant ethical principles in each case.



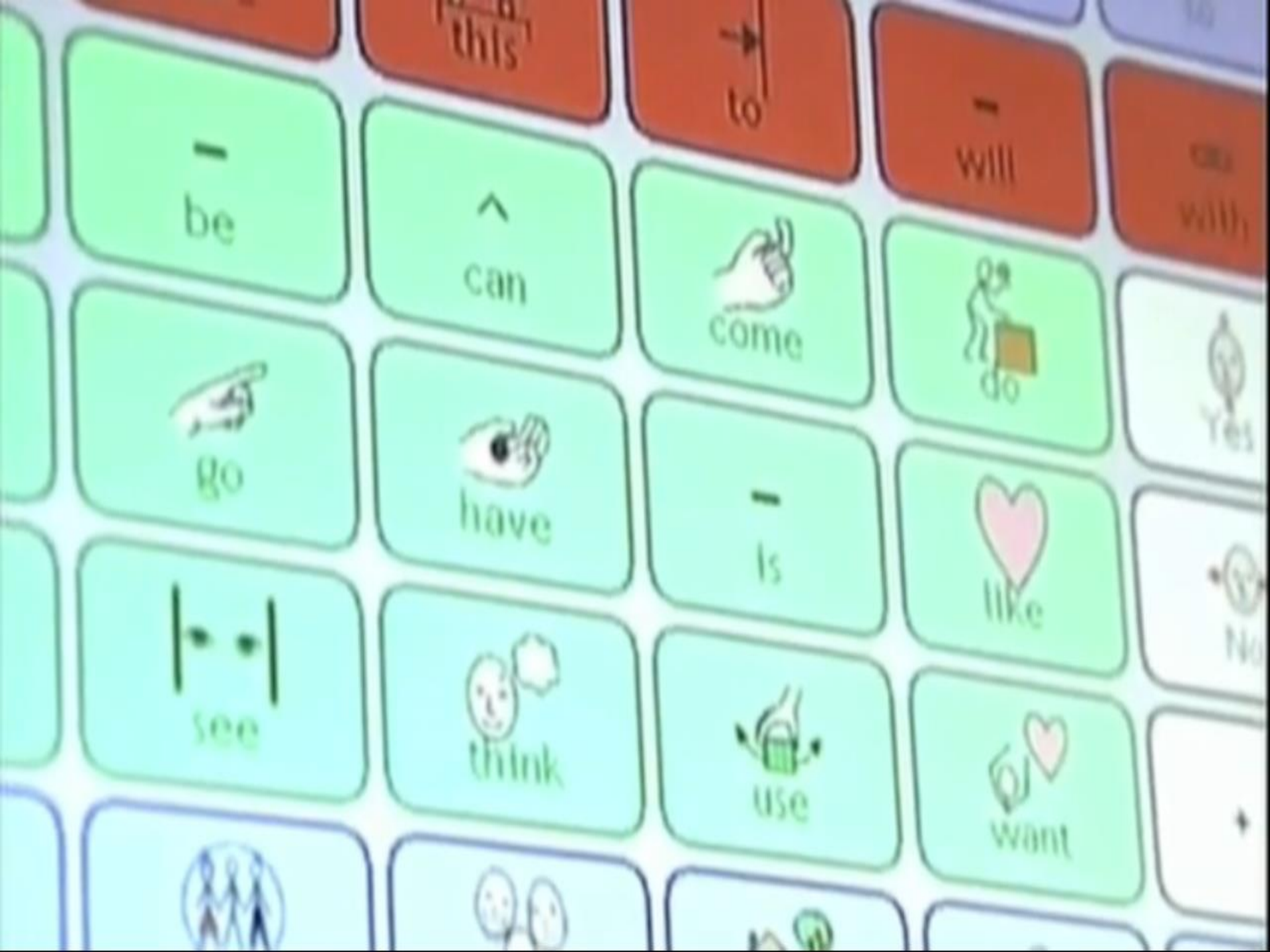
Electroencephalogram (EEG)



Magnetoencephalography (MEG)

Locked-in-Syndrome Neurofeedback

Fig. 1 Training patient HPS in his home: on the *right side* is the PC, which controls the on-line system and shows the EEG and electrooculogram. In the *middle* is the trainer surveying the patient's behavior. In the *back*, one can see the amplifier, and on the *left side* is a PC giving slow-cortical-potential feedback to the patient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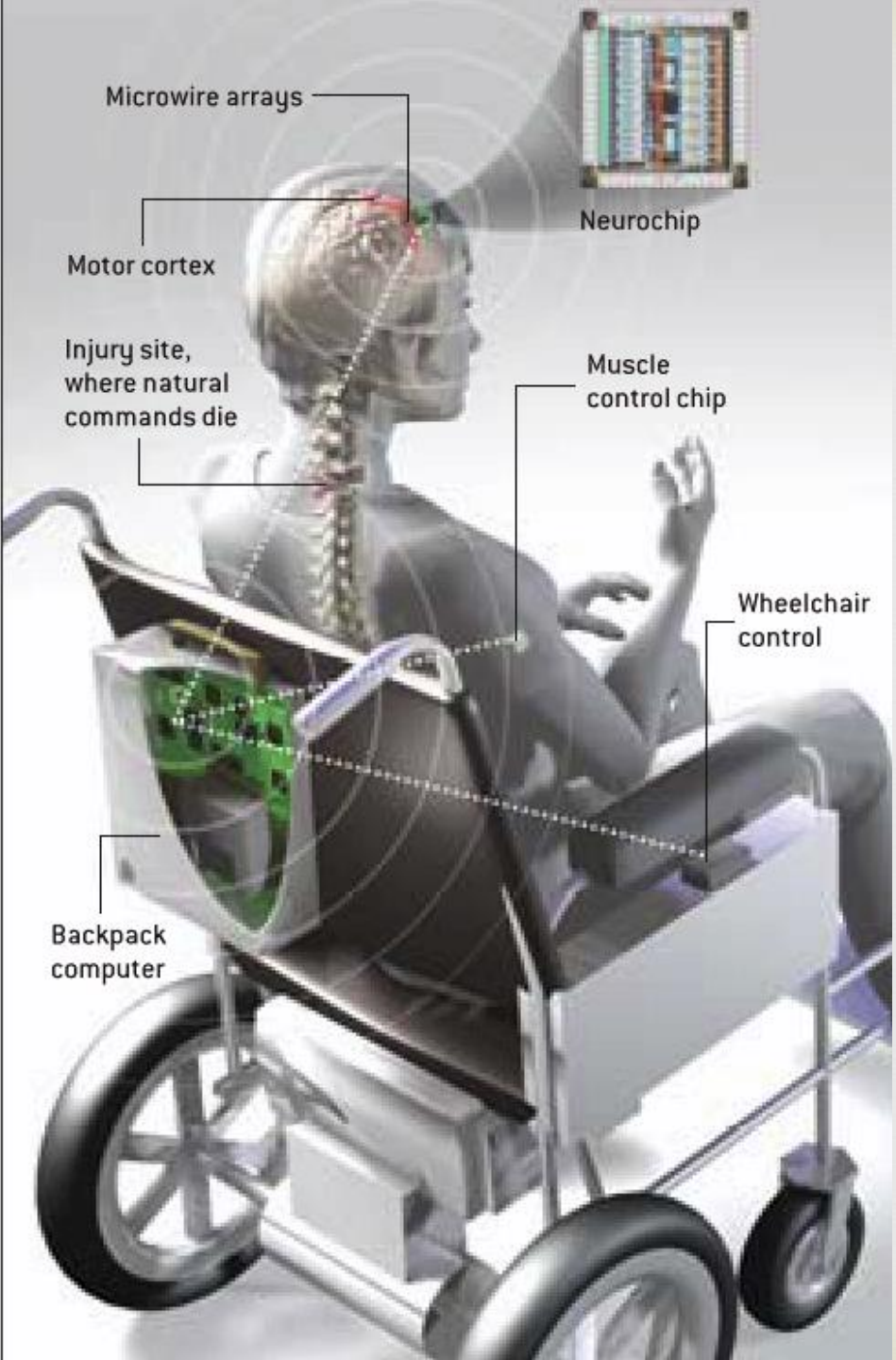
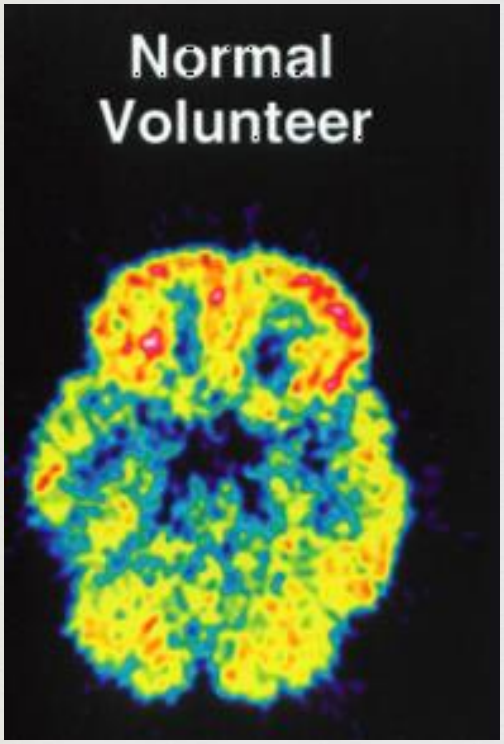
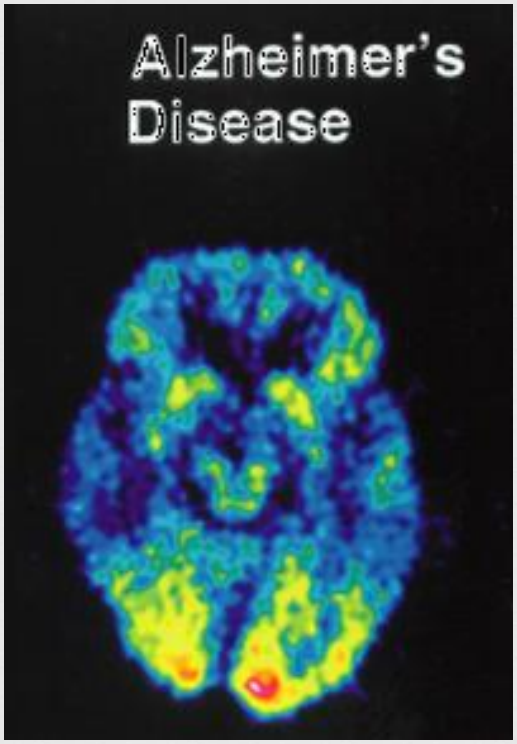


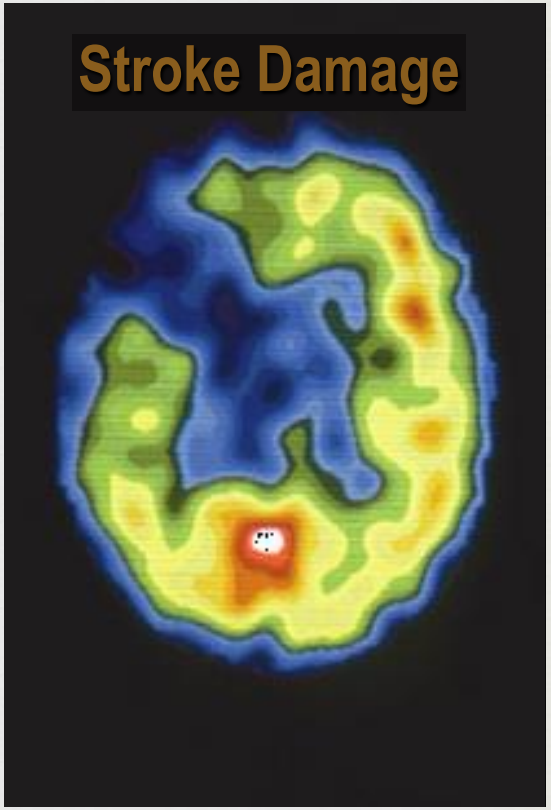
By Miguel A. L. Nicolelis and John K. Chapin

People with nerve or limb injuries may one day be able to command wheelchairs, prosthetics and even paralyzed arms and legs by "thinking them through" the motions

Positron Emission Tomography - PET





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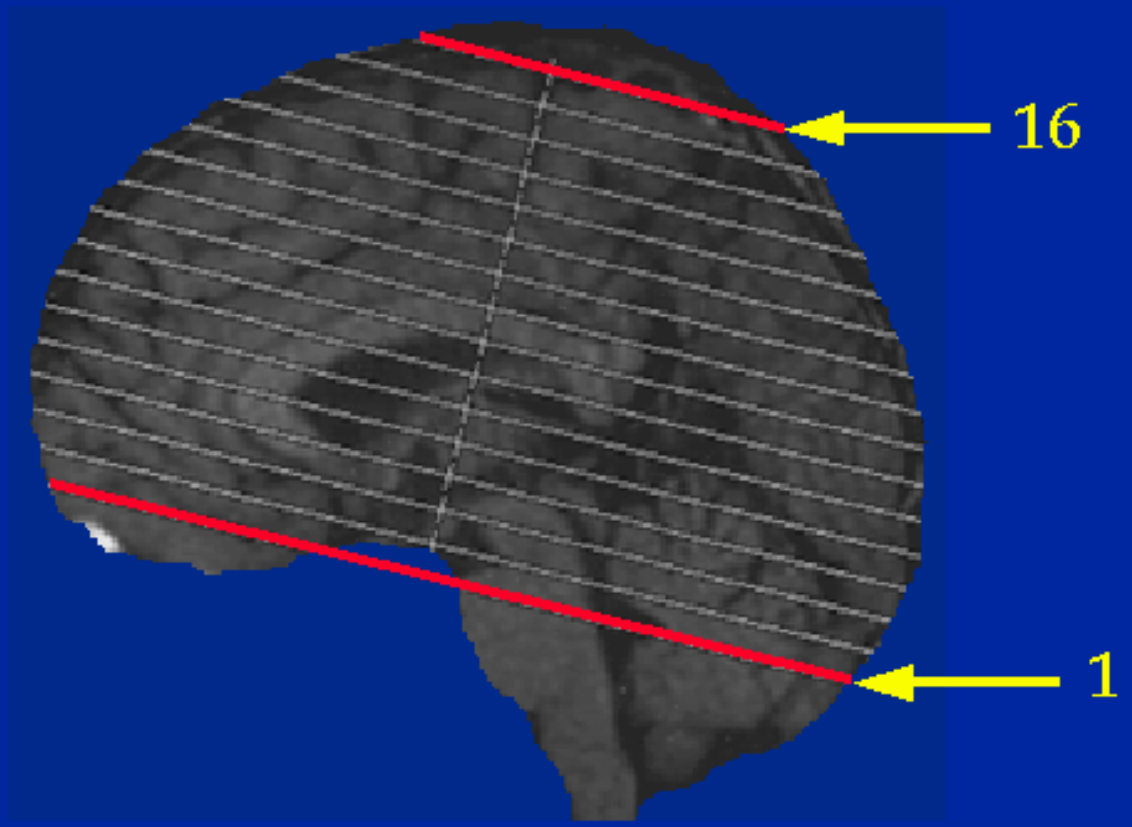
UNITY INOVA
3 TESLA

Orientation of Plane Lines

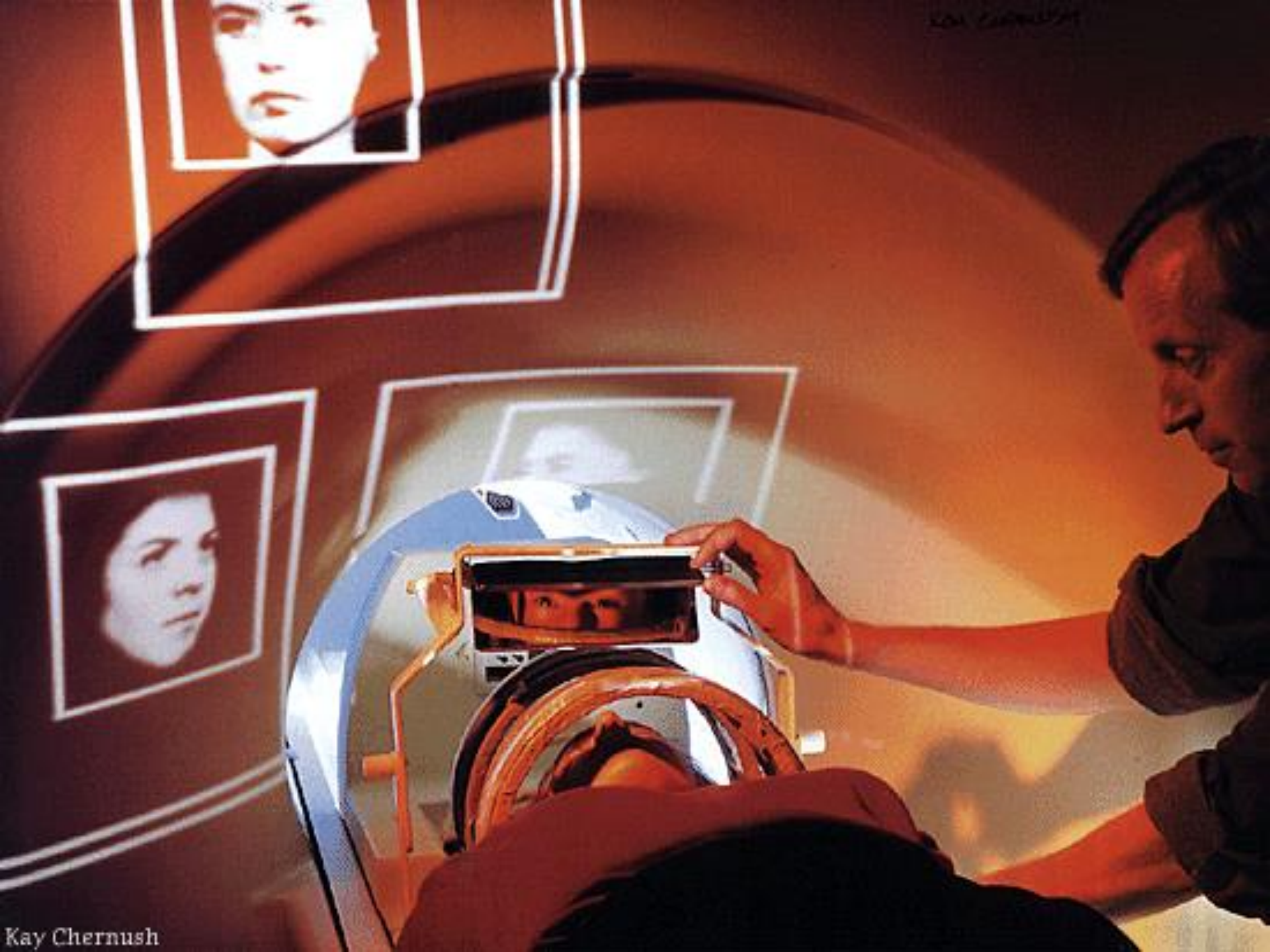


Data from Hirsch, J., et al

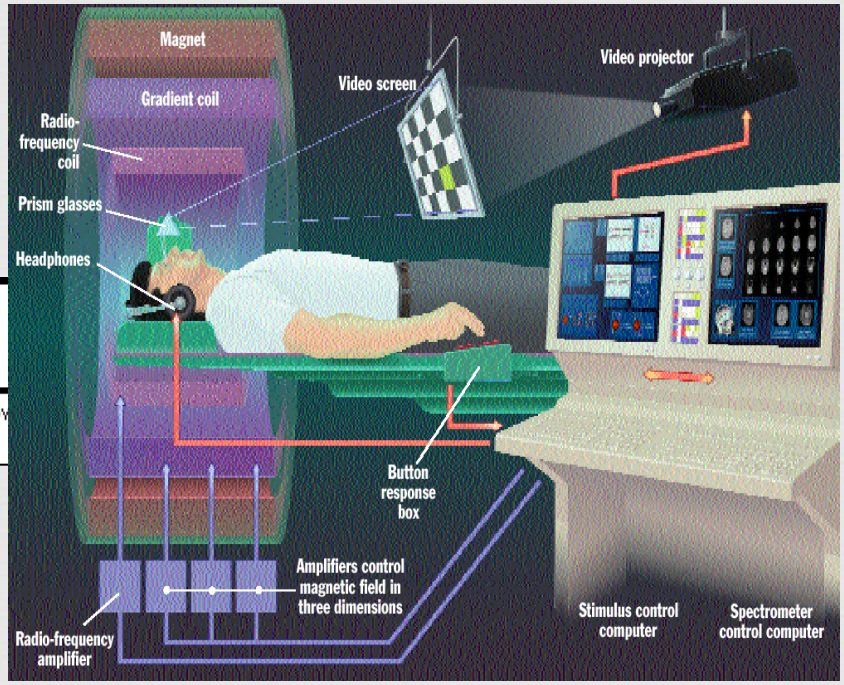
דימות סטרוקטוראלית CT, MRI לעומת דימות פונקציונאלית fMRI, PET

דימות פונקציונאלית מאפשרת "תצפית" בפעילות המוחית בהינתן מטלה מסוימת

היתרון תצפית גם במוח בריא


Kay Chernush

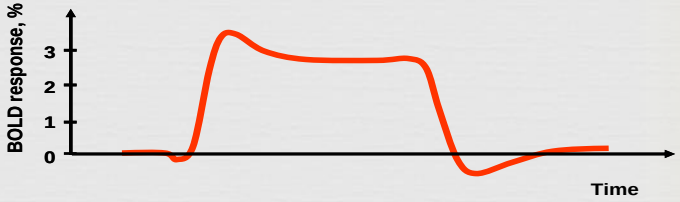
fMRI methods



Neuronal activity

Local blood flow increases overcompensating for oxygen consumption

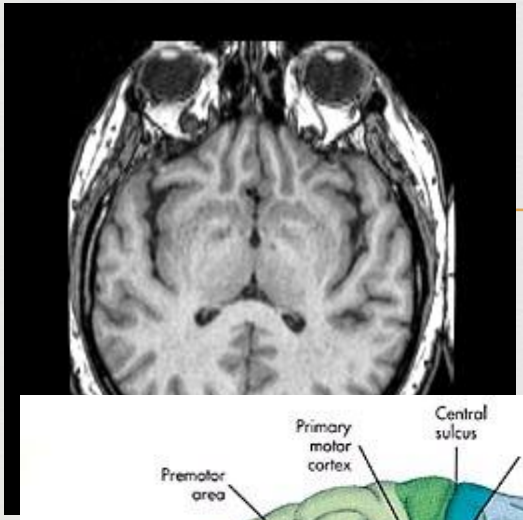
Larger BOLD-fMRI signal

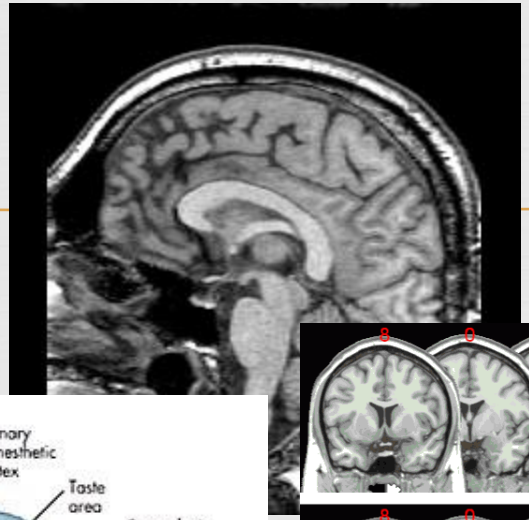


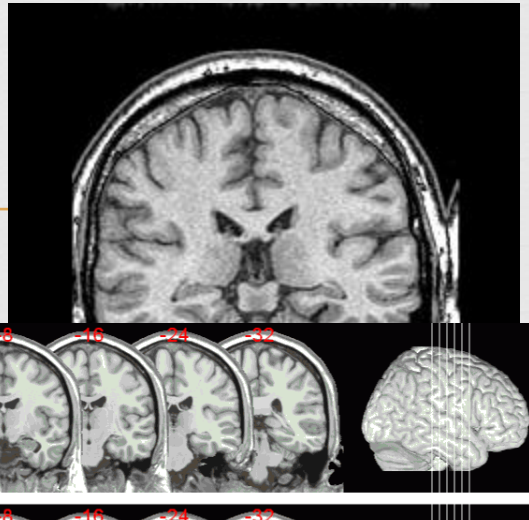
Axial

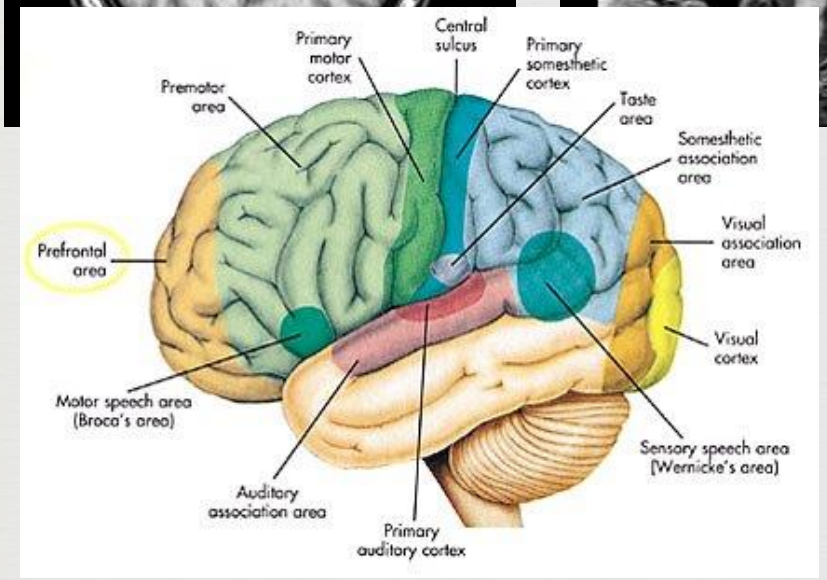
Sagittal

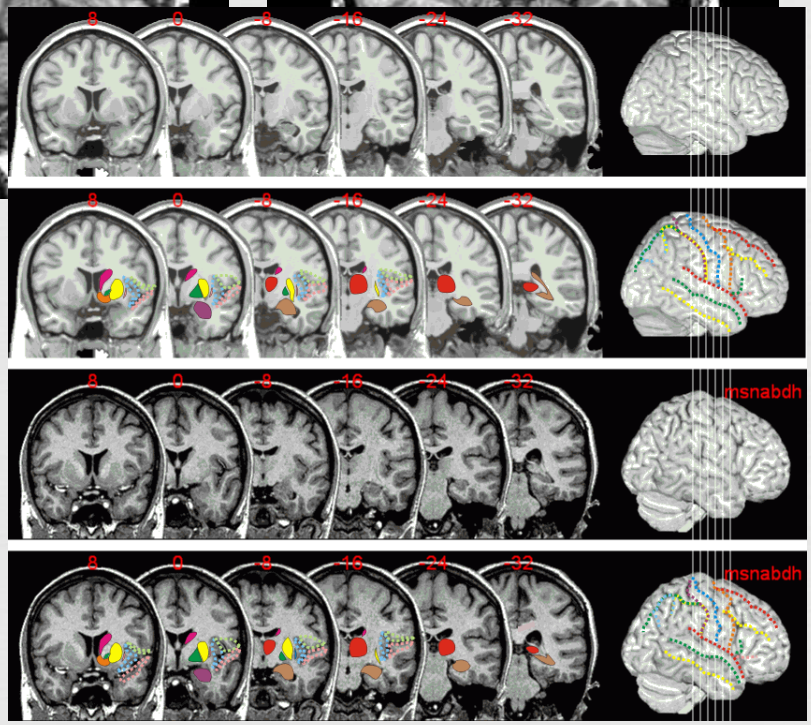
Coronal



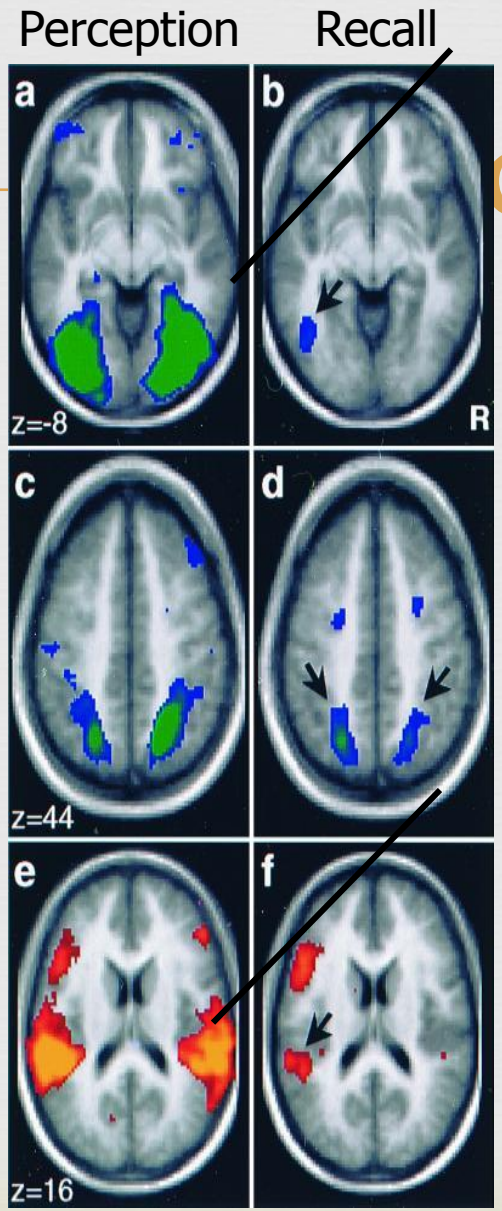








Wheeler et al, 2000



left fusiform gyrus

left STG

Picture vs. sound Recall:

A subset of the regions activated during the Perception of pictures and sounds were activated significantly during Recall of pictures and sounds

Regions involved in retrieval interact with sensory and motor regions that are reactivated depending on specific memory content

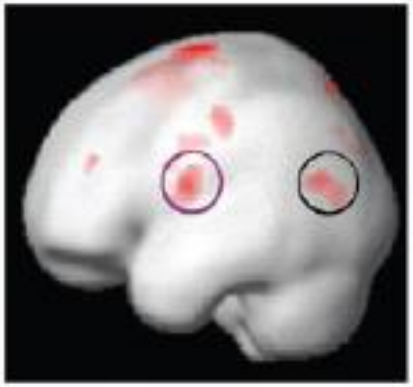
Recapitulation - cause or consequence of remembering?

דימות פונקציונאלית מאפשרת "לצפות" בשינויים בתפקוד המוח כתוצאה מתרגול, מחלות נוירולוגיות. פסיכיאטריות, זקנה, ADHD

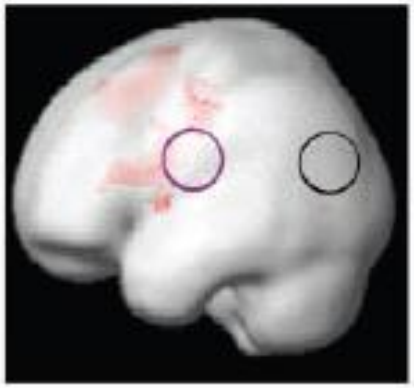
השלכות של טיפול (תרופתי או פסיכולוגי) אמון קוגניטיבי, טראומה ועוד.

A Children with no remediation

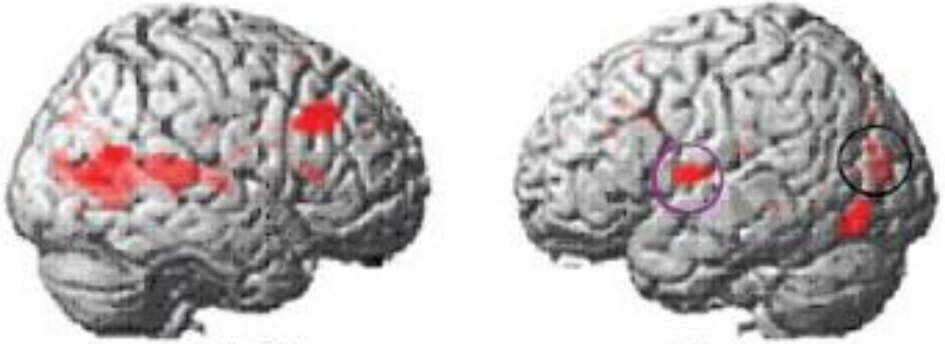
Normal reading children
while rhyming



Dyslexic reading children
while rhyming
before remediation



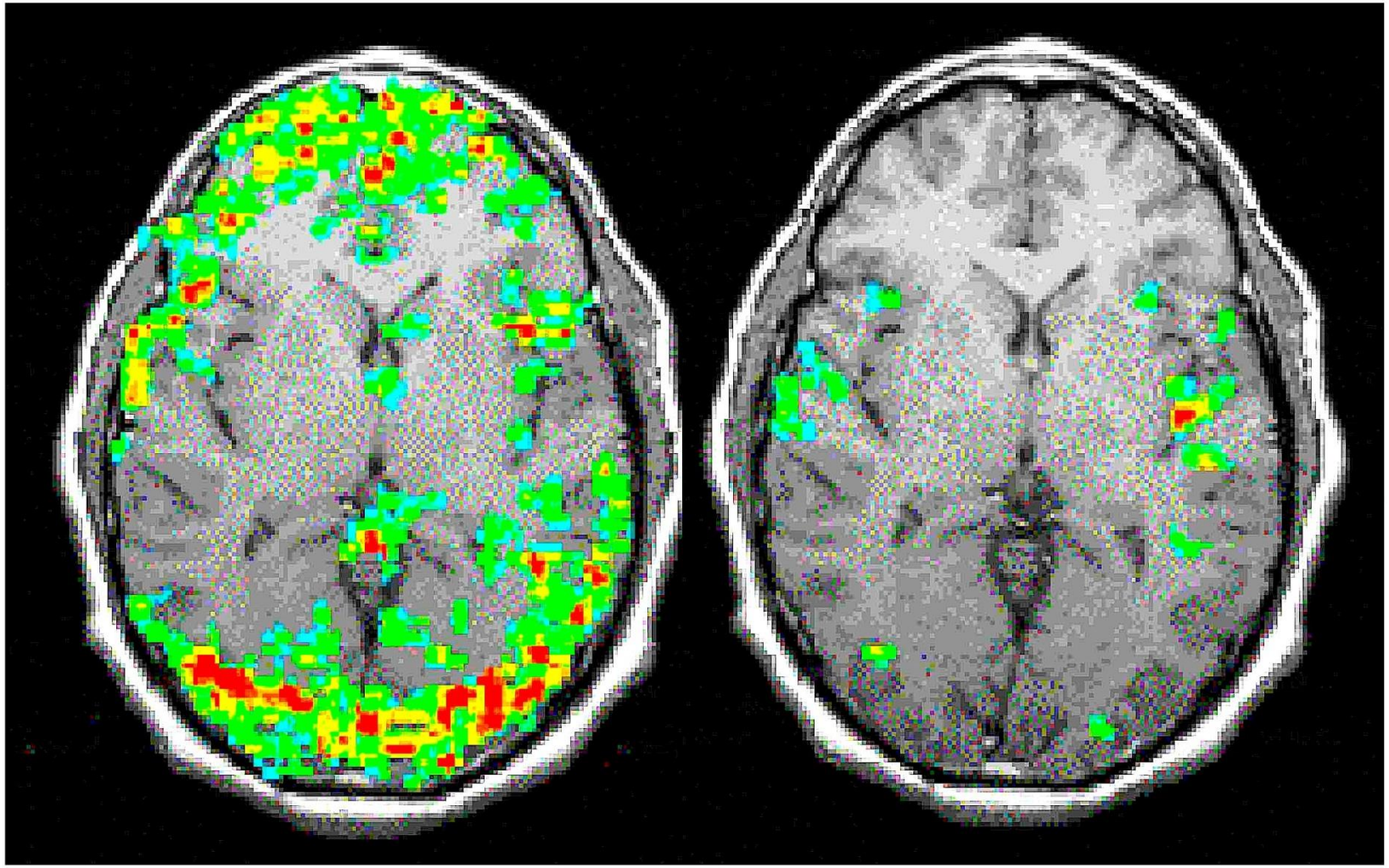
B Dyslexic children
increases after remediation



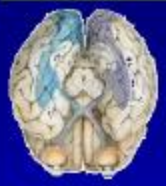
Right Left

Temple et al. (2003)

Scheider & Chein - architectural model for automaticity.

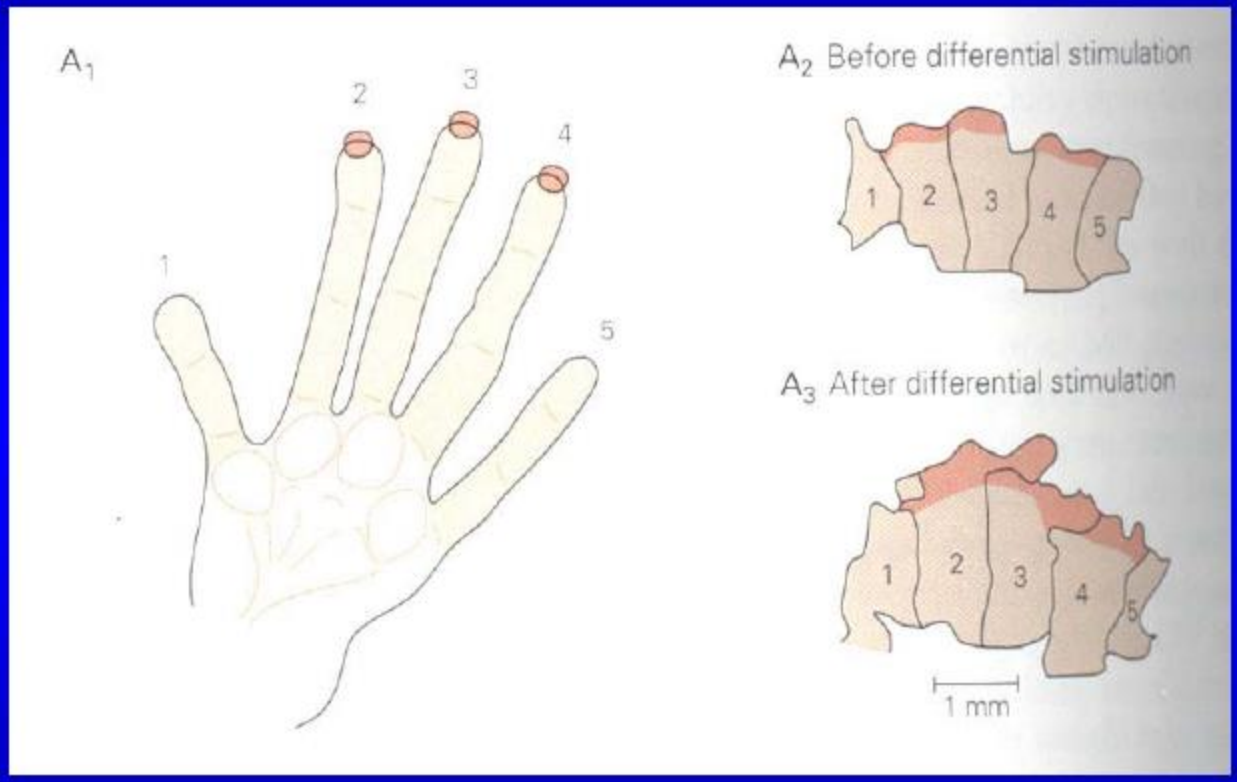


Novel task --- Automatic task

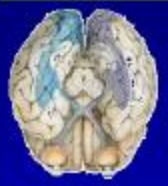


Influence of motor training

Michael Merzenich (1995)



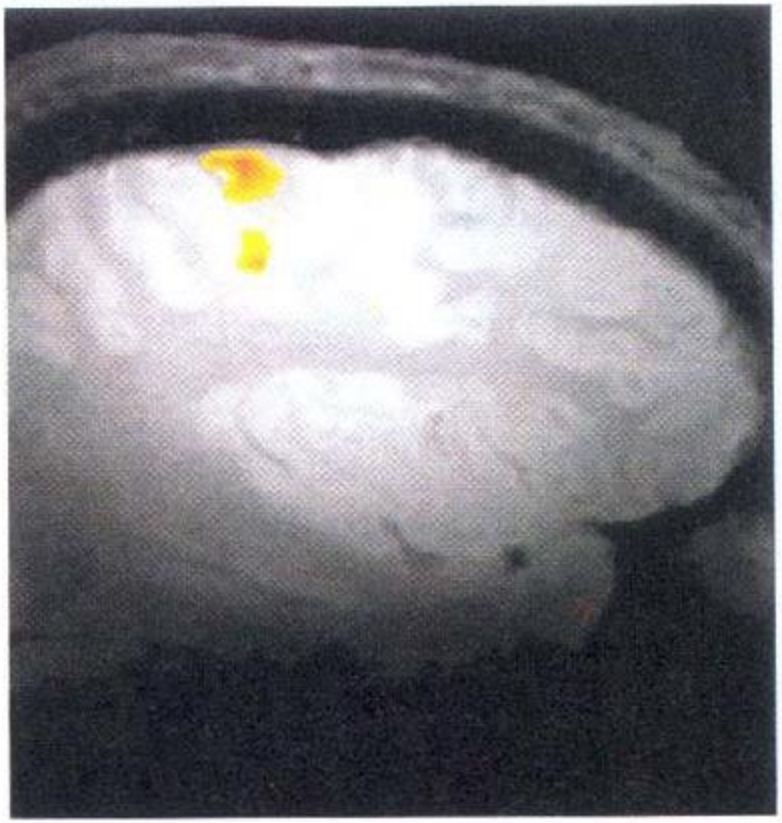
Intensive training leads to an enlargement of the cortical representation of the trained body parts



Influence of motor training (early musical training)

B

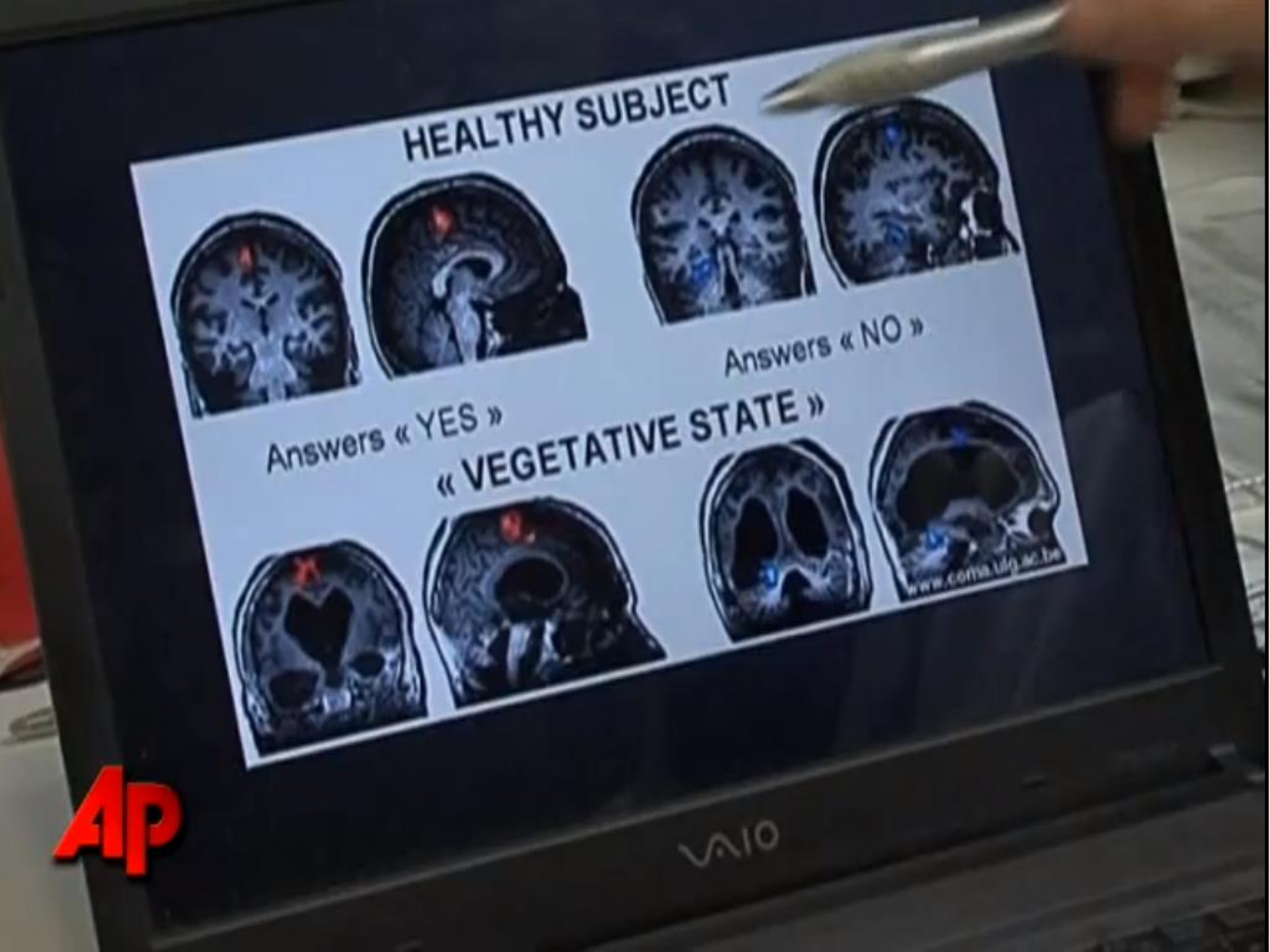
Control

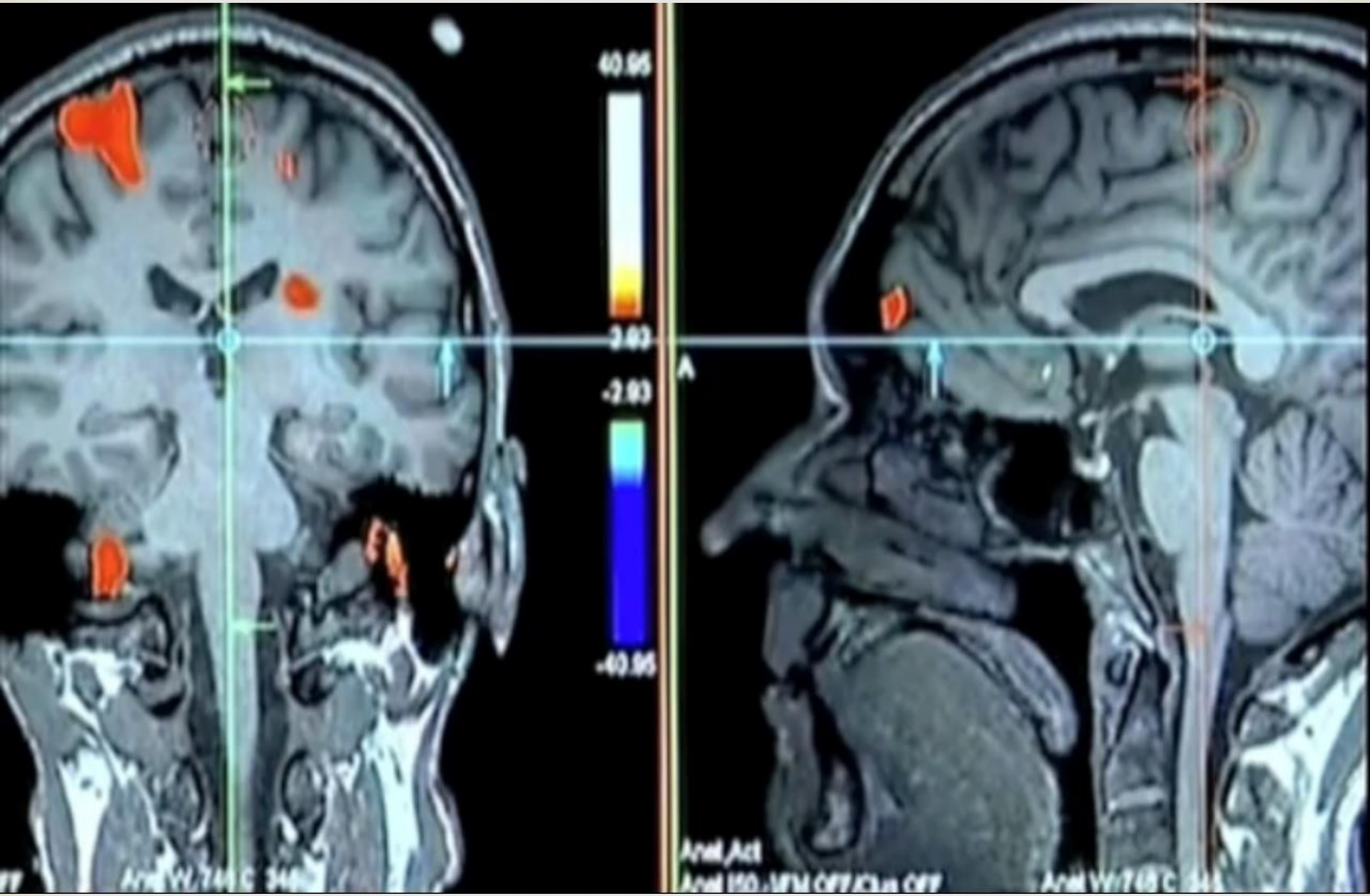


Trained

ממשק מוח ואתיקה

- התפתחויות טכנולוגיות – יישומים בחקר המוח
- קריאת מחשבות
- הכתבת מחשבות
- בחירה חופשית


HEALTHY SUBJECT
Answers « YES »
Answers « NO »
« VEGETATIVE STATE »
www.coma.ulg.ac.be
VAIO


40.96
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-40.96
A

רוצה לחיות?

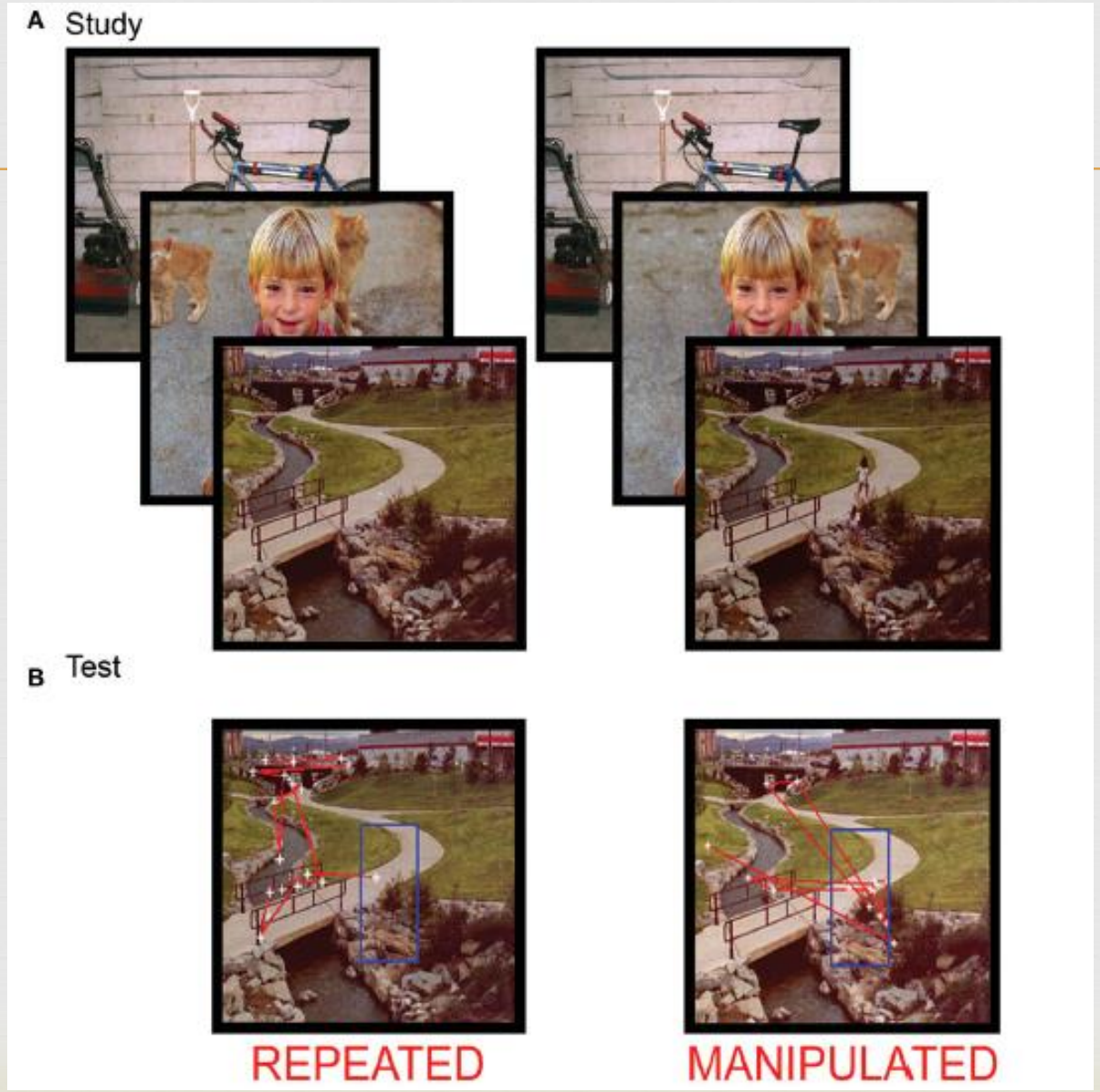
מתן תרופות לשיכוך כאבים?

שימוש ב fMRI בקריאת מחשבות

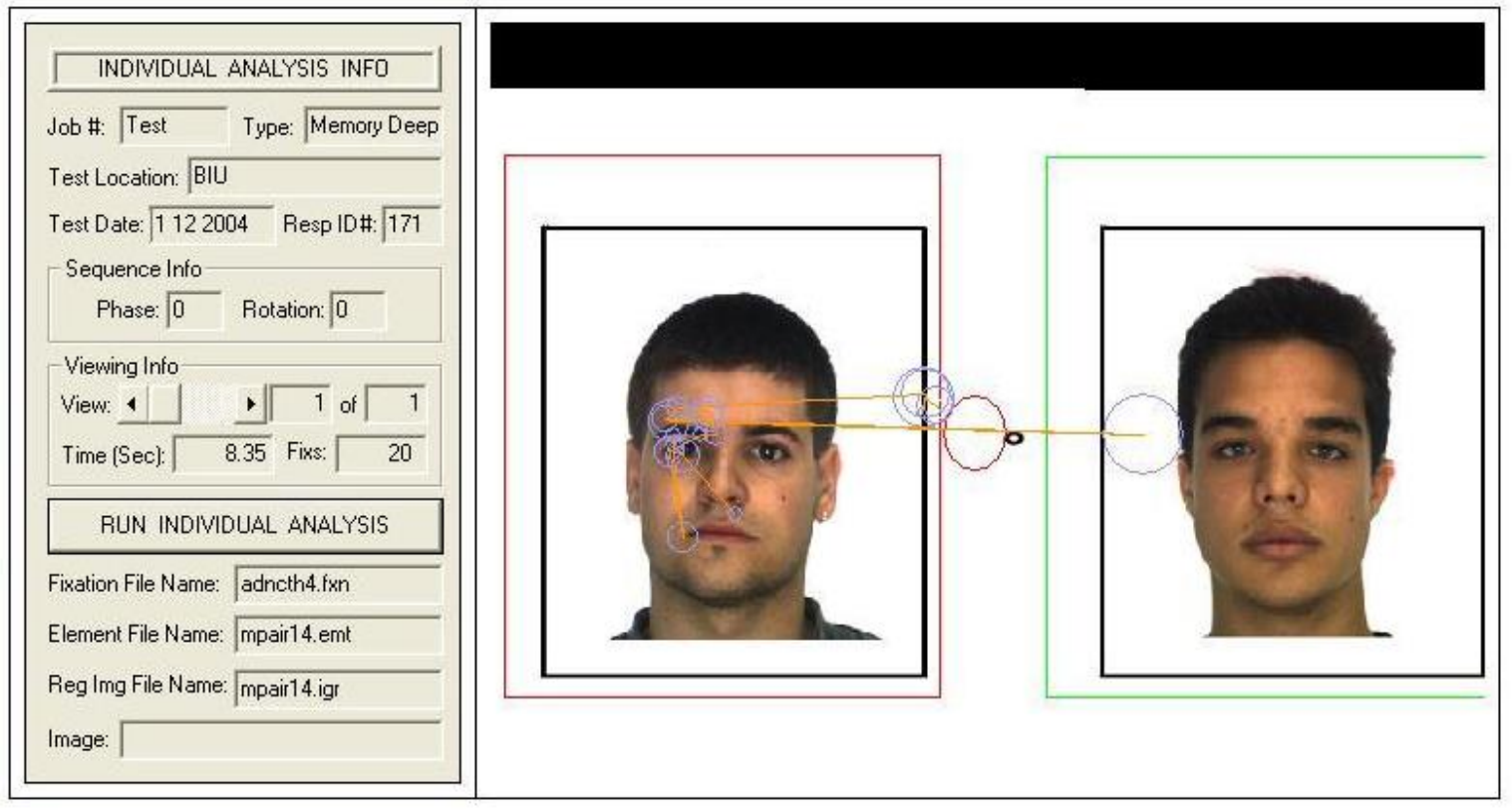
- דעות גזעניות
- העדפת מכונית
- דפוס פעילות של הסתרת מידע אי אמירת כל האמת
- נטייה לתוקפנות אלימות
- נטיות הומסקסואליות

Eye Tracker

Hannula et al. (2010)



Eye Movements Data: M_Ignore



Althoff and Cohen (1999)

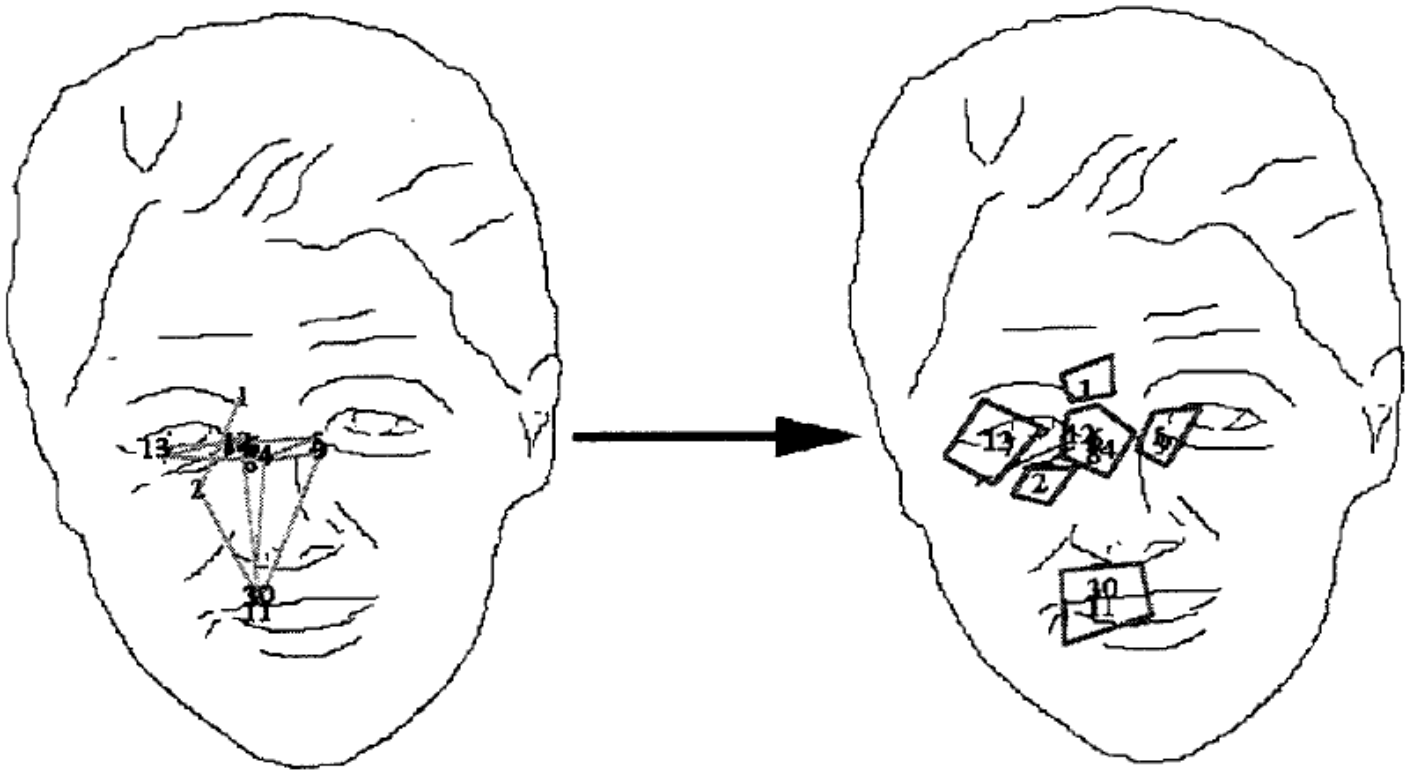


Figure 1. Line drawing of example famous face (Bill Clinton) with one participant's eye movements superimposed, illustrating clustering of eye movements into viewer-determined regions of interest.

ממשק מוח ואתיקה

- התפתחויות טכנולוגיות – יישומים בחקר המוח
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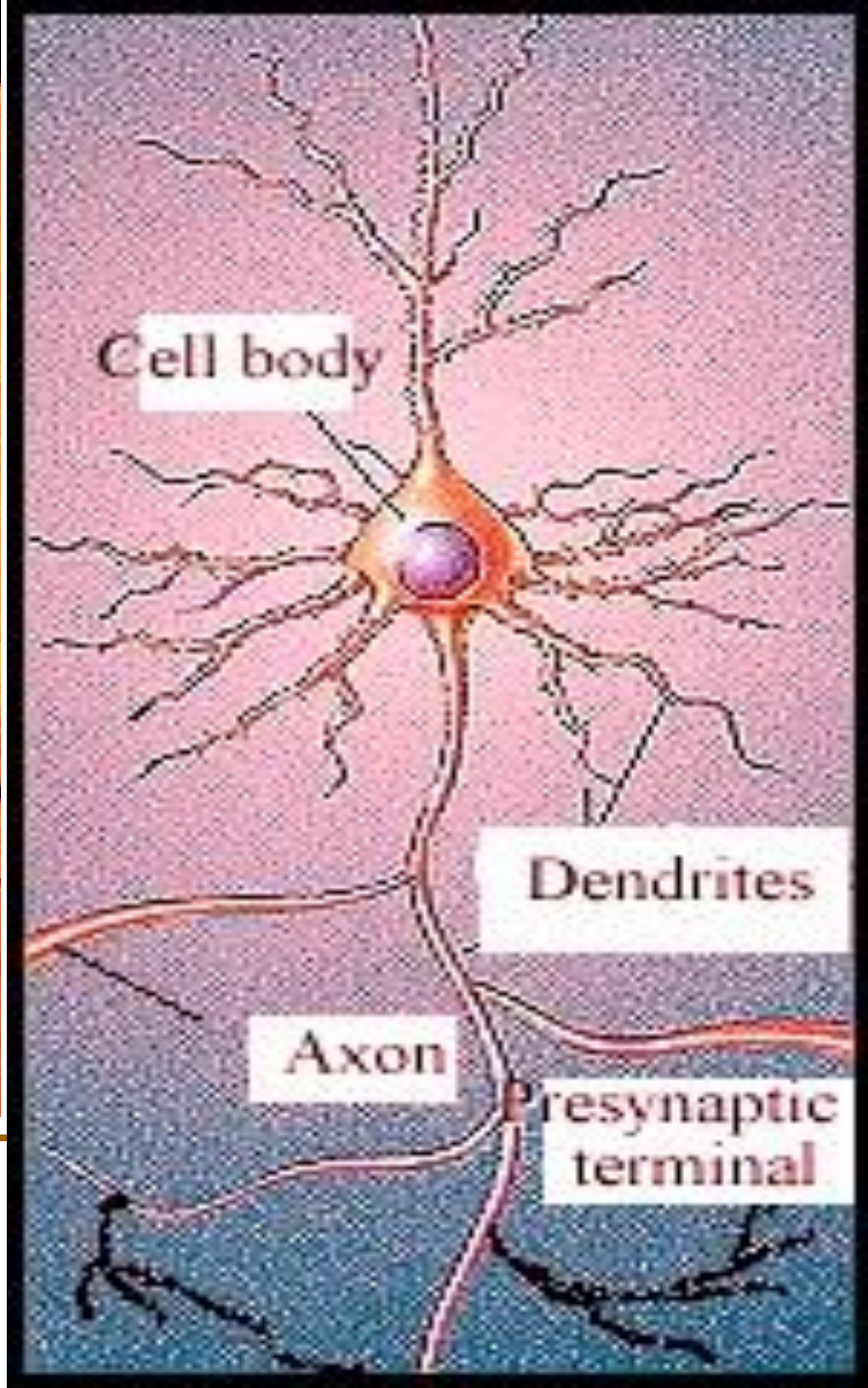
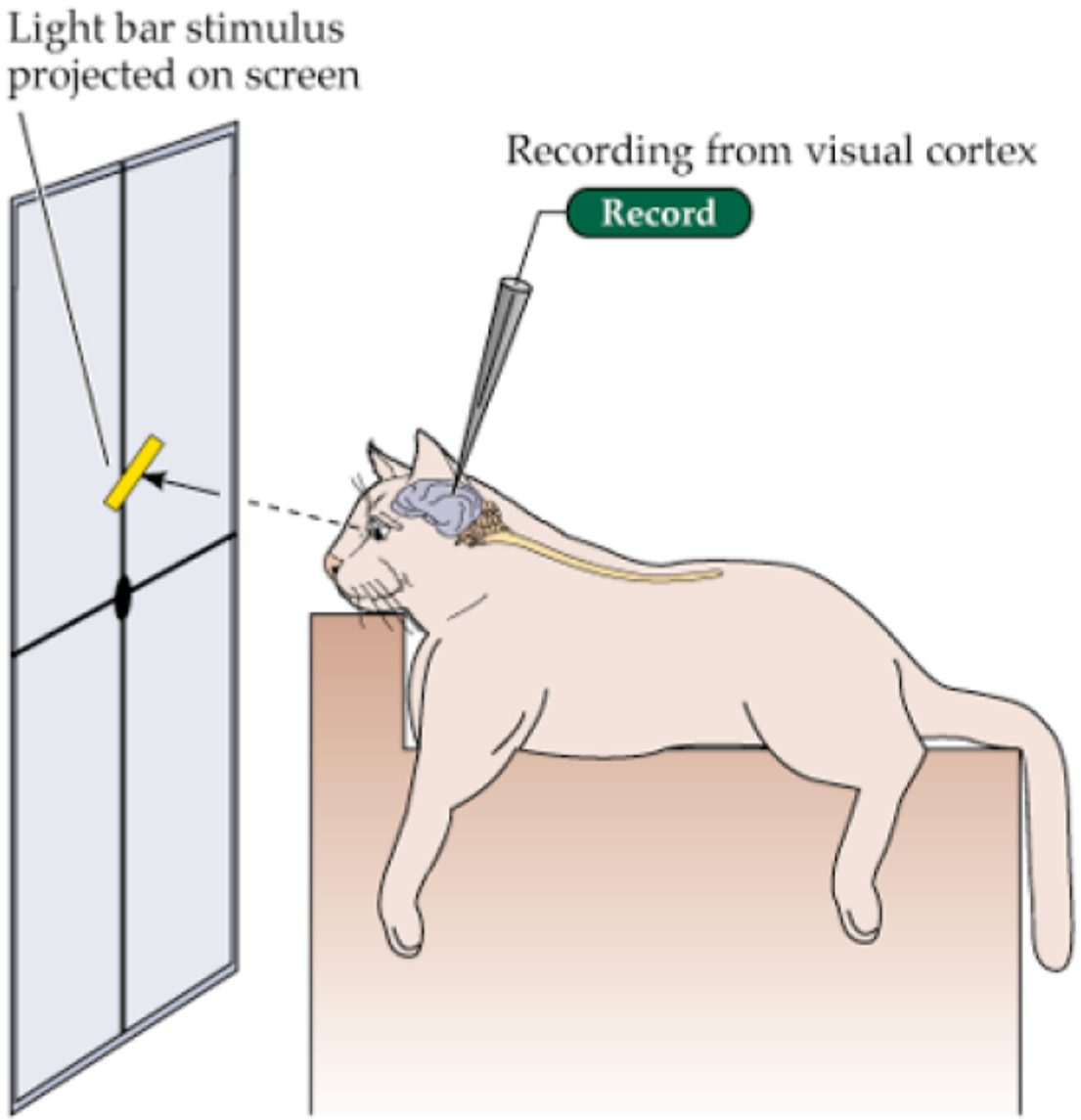
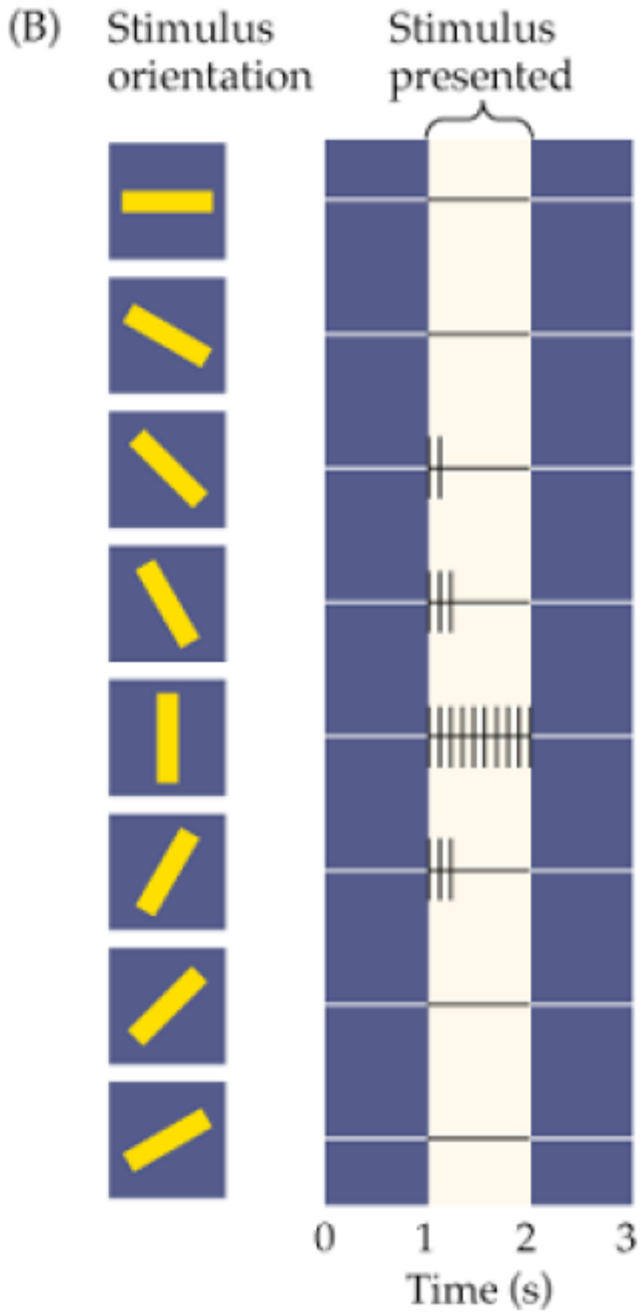
A microelectrode records the firing of individual cells in a monkey's visual cortex.

Fritz Goro, Life Magazine © Time Inc.

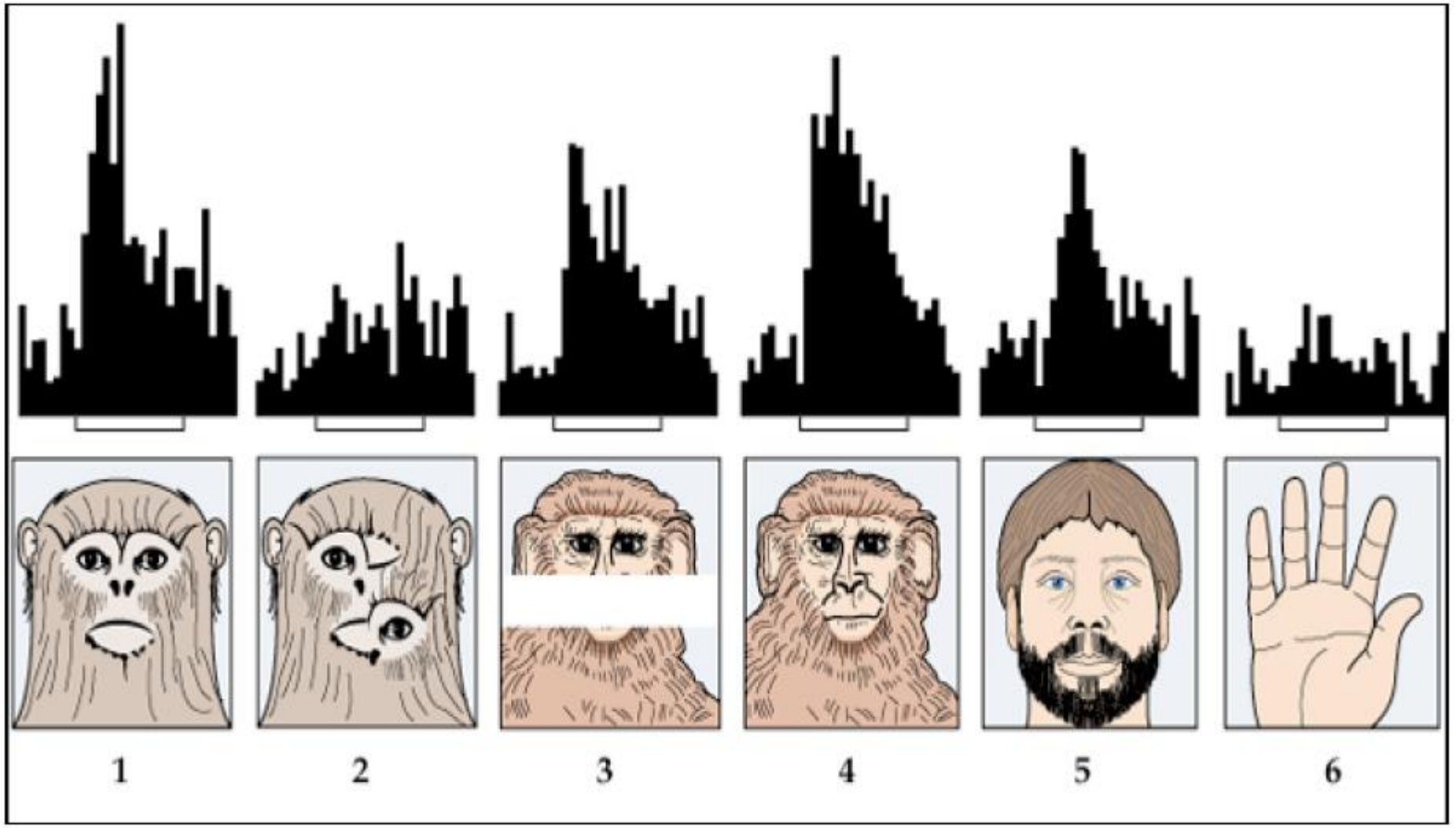


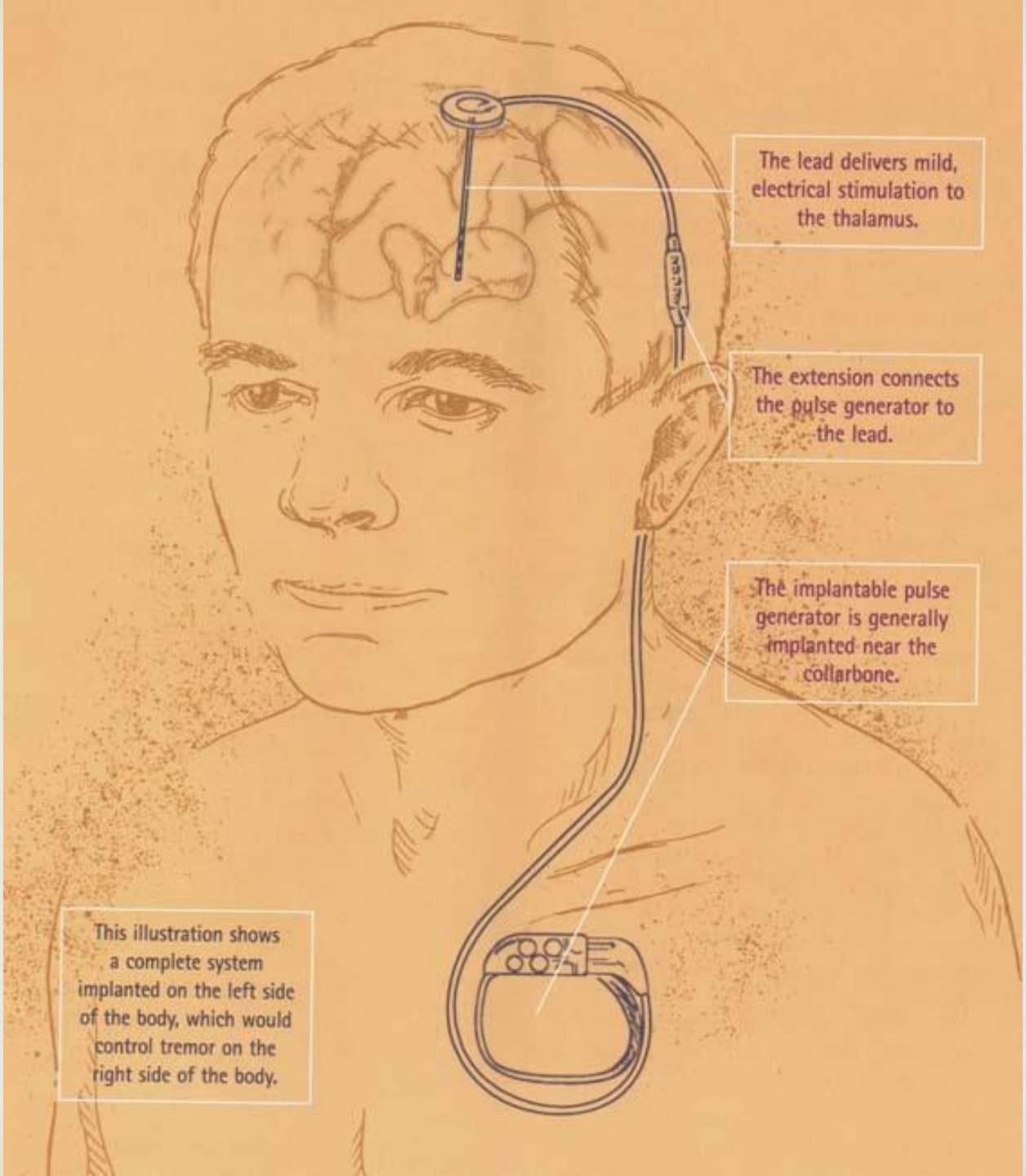
Evidence for response selectivity of neurons in cortex



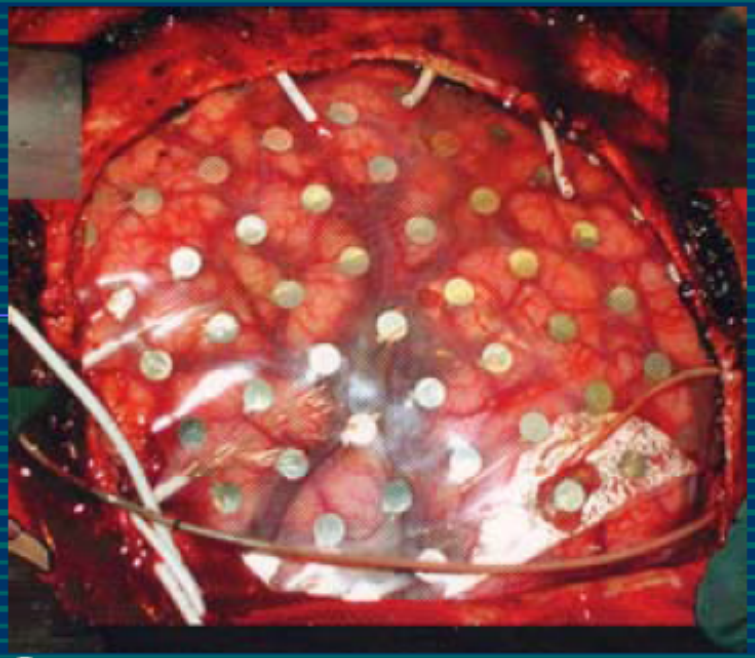


‘Grandmother Cells’ in Temporal Lobe: Increased activity in response to faces




The lead delivers mild, electrical stimulation to the thalamus.
The extension connects the pulse generator to the lead.
The implantable pulse generator is generally implanted near the collarbone.
This illustration shows a complete system implanted on the left side of the body, which would control tremor on the right side of the body.

Ojemann et al. 1989
Dept Neurosurgery, Univ Washington



Cortical Stimulation Mapping

Studies of patients undergoing direct cortical stimulation during presurgical treatments for intractable epilepsy. Electrical current applied directly to the cortex results in temporary functional lesions/disruption , and the patterns of deficits observed have been found highly predictive of post-surgical outcome.

Ojemann et al. [1989] described 117 patients' naming errors observed in extensive regions of language-dominant cortex (frontal, temporal, and parietal), even well outside classically defined language areas.

Electric current stimulates laughter Fried et al. (1998) in Nature

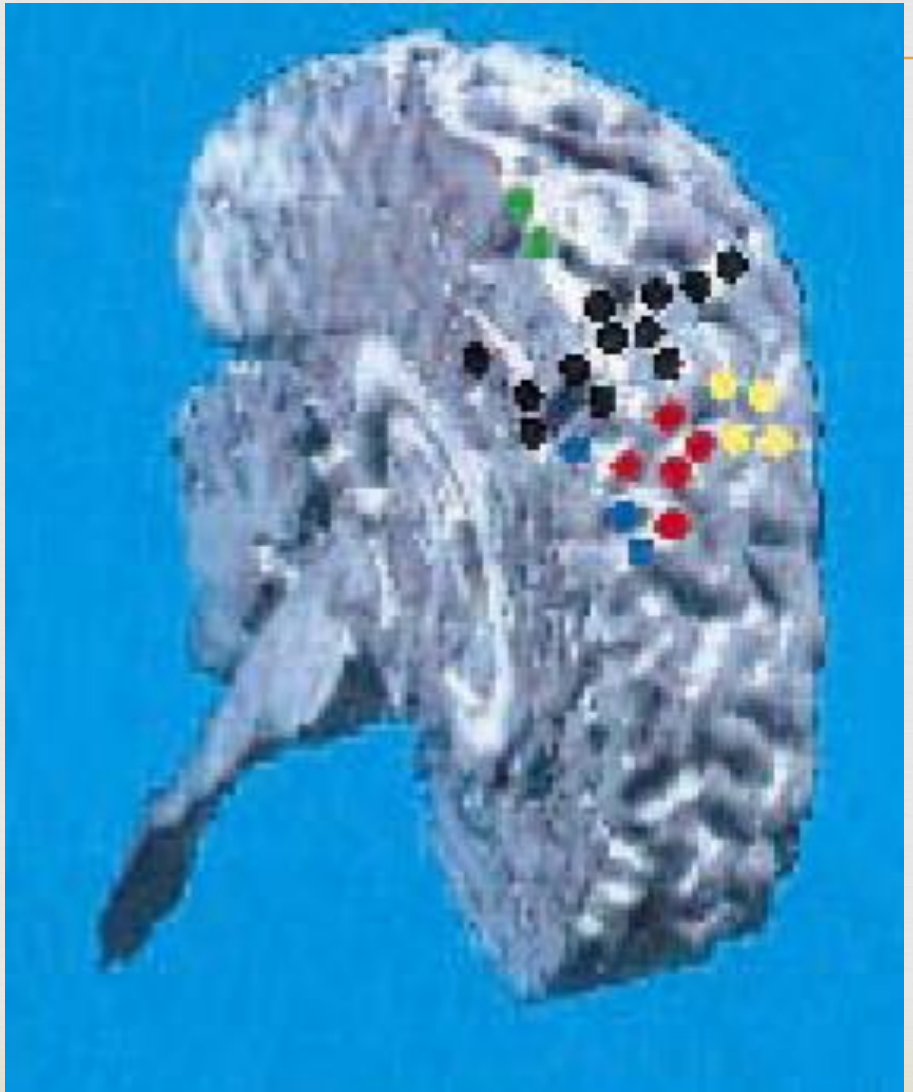


Figure 1 Magnetic resonance imaging three-dimensional surface reconstruction of left hemisphere of patient A.K., depicting sites where electrical stimulation evoked behavioural responses. Constant current electrical stimulation (1–12 mA, 0.3 ms duration, biphasic rectangular pulses), below the threshold of after-discharge, was applied at 50 Hz in a bipolar fashion for a duration of 5 s through adjacent contacts 1 cm apart on a subdural grid and strip electrodes implanted over the cortical surface of the left frontal lobe. No stimulation was performed at the right frontal lobe. Electrodes were implanted to identify the seizure focus, and electrical stimulation mapping was performed to plan the surgical resection of the focus. Informed consent was obtained in accordance with protocol approved by an internal review board. Key to colours: red, laughter; yellow, disruption or arrest of speech; blue, disruption or arrest of speech, naming and manual activity; black, motor movements involving the lower and upper extremities; green, tingling sensations in the right lower extremity. Reversal of the N20 potentials evoked by right posterior tibial nerve stimulation confirmed the location of the central sulcus at the anterior green circle.

התמכרות לגרייה עצמית של מרכזי עונג בבע"ח.
מה עם בני אדם?

Neurocognitive enhancement: what can we do and what should we do?

Martha J. Farah, Judy Illes, Robert Cook-Deegan, Howard Gardner, Eric Kandel, Patricia King, Eric Parens, Barbara Sahakian and Paul Root Wolpe

- שימוש לא מבוקר ברטאלין, פרוזאק.

ממשק מוח ואתיקה

- התפתחויות טכנולוגיות – יישומים בחקר המוח
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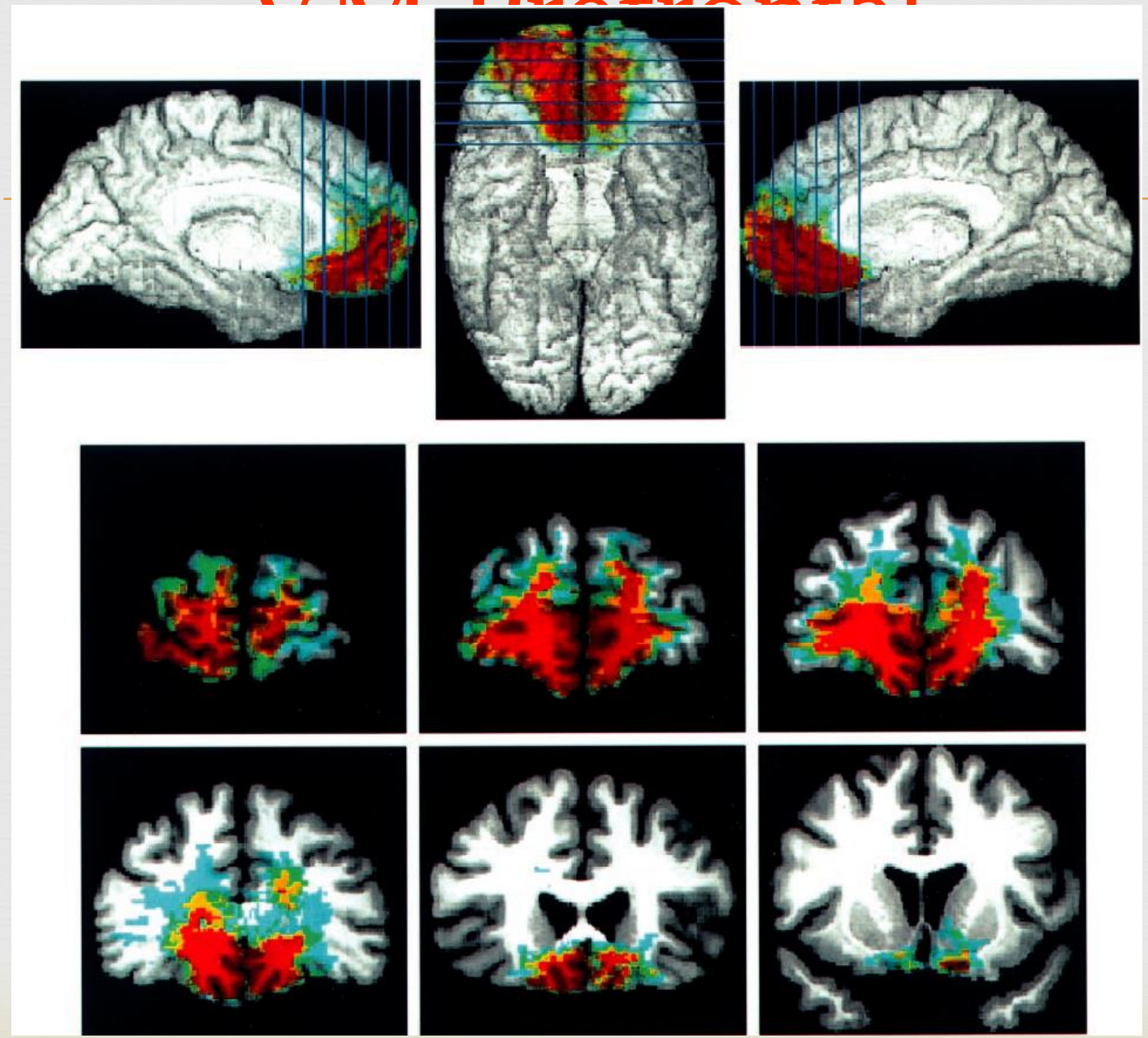
- הכתבת מחשבות
- בחירה חופשית

The Gambling Task

Damasio, AR., Tranel. D, & Damasio, H. (1991)

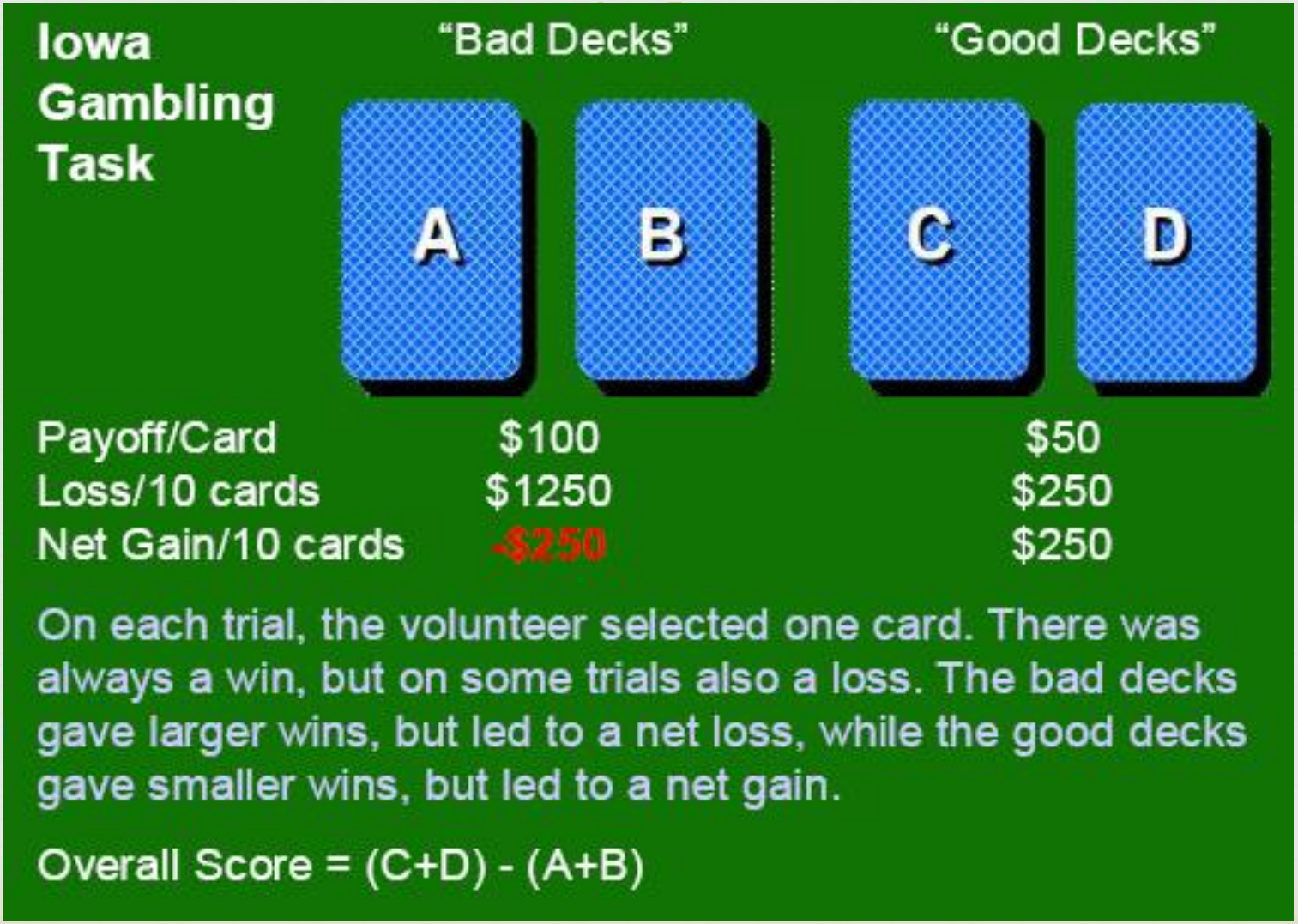
Every time the subject selects a card from deck A or B, s/he gets $100, and every time deck C or D is selected, the subject gets $50. However, in each of the four decks, subjects encounter unpredictable money loss (punishment). The punishment is set to be higher in the high-paying decks A and B, and lower in the low-paying decks C and D. In decks A and B the subject encounters a total loss of $1250 in every 10 cards. In decks C and D the subject encounters a total loss of $250 in every 10 cards.

VM Prefrontal



The Gambling Task

Damasio, AR., Tranel. D, & Damasio, H. (1991)



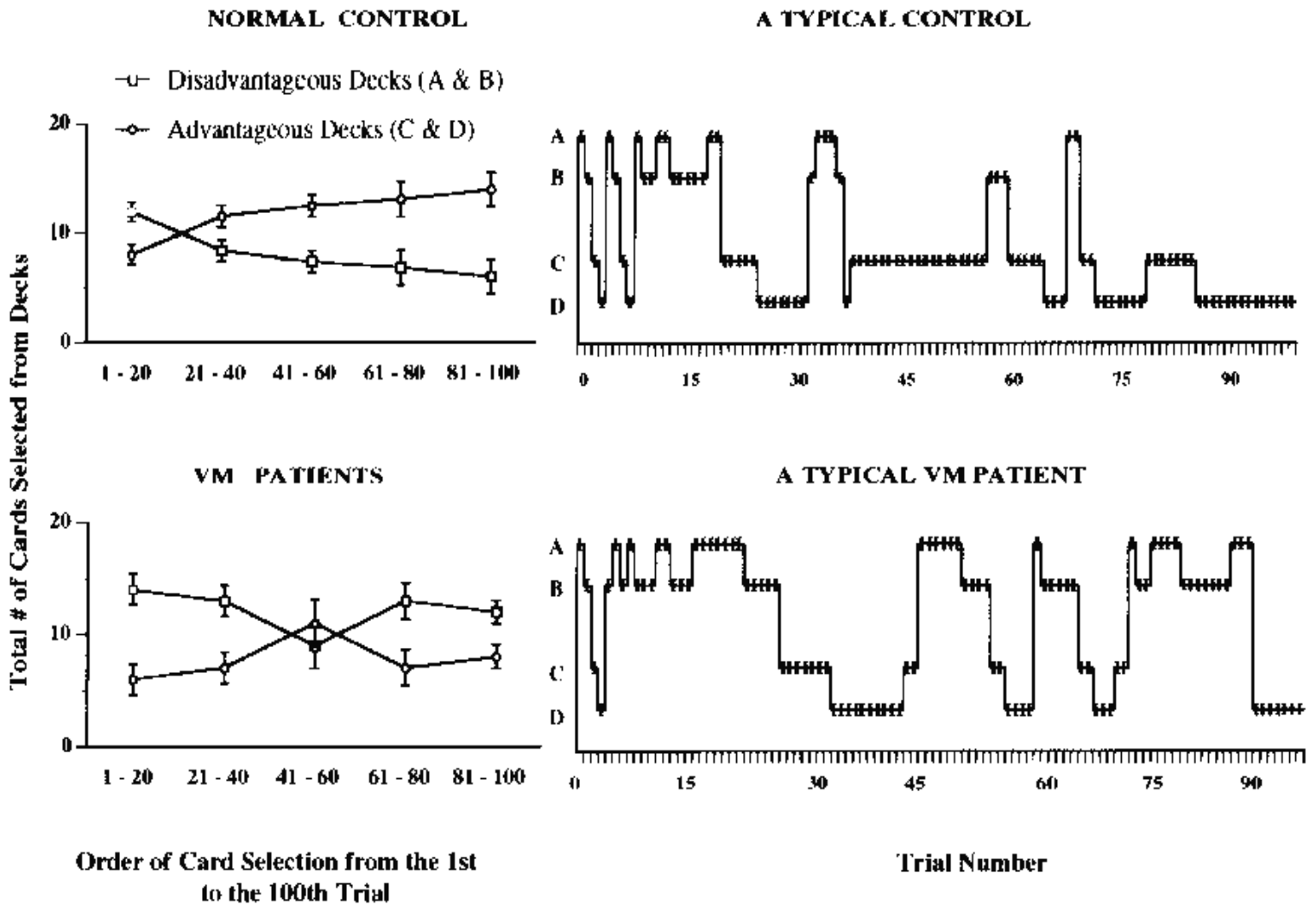
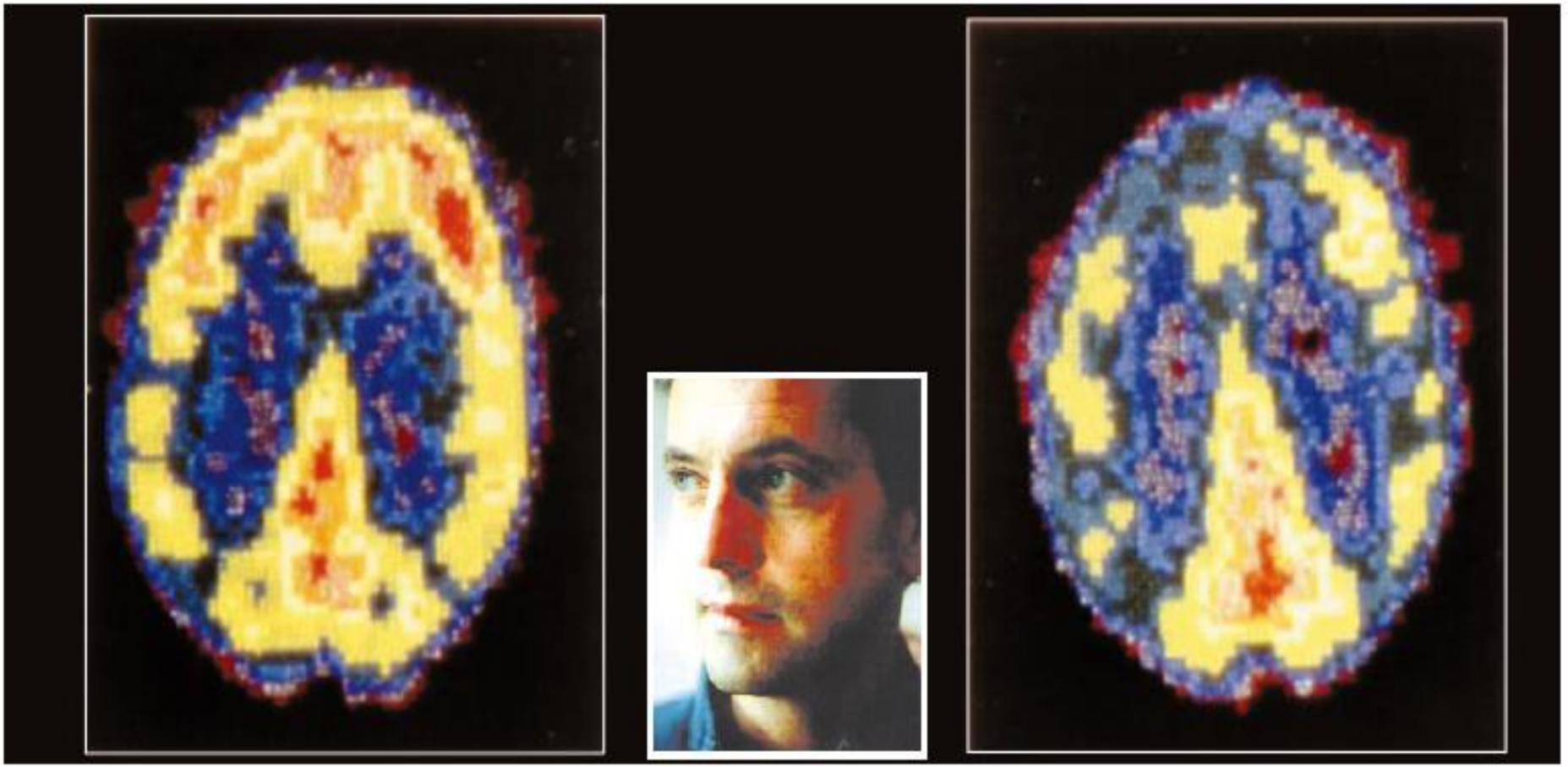


Figure 2. (Left panels) Card selection on the gambling task as a function of group (normal control, VM patients), deck type (disadvantageous versus advantageous), and trial block. Normal control subjects ($n = 82$) shifted their selection of cards towards the advantageous decks. The VM frontal patients ($n = 15$) opted for the disadvantageous decks. (Right panels) Profiles of card selections (from the first to the 100th selection) obtained from a typical control and a typical VM patient. Although the VM patient made numerous switches, he returned more often to the disadvantageous decks.

מוח של רוצח



Mind games: Adrian Raine with PET scans of a normal brain (left) and that of a murderer. But, given the uncertainties about diagnosis, the significance of such work to psychopathy remains unclear.

סיכום

- החשיבות להציף את הפוטנציאל המסוכן בחדירה למחשבותיו ודעותיו של אדם
- הסכנה בהשפעה על חשיבתו של האדם ללא ידיעתו והסכמתו
- מודעות למגבלות (לעיתים) של חוסר או צמצום בחירה חופשית
- ועדות אתיקה- בקרה לאיזון נכון בין מיצוי היתרונות של הידע ושמירה מניצולו לרעה.
- לאנשי המחקר מודעות רבה יותר דווקא למגבלות הכלים.
- חשיבות הגברת המודעות גם לאדם מן הרחוב.

תודה!