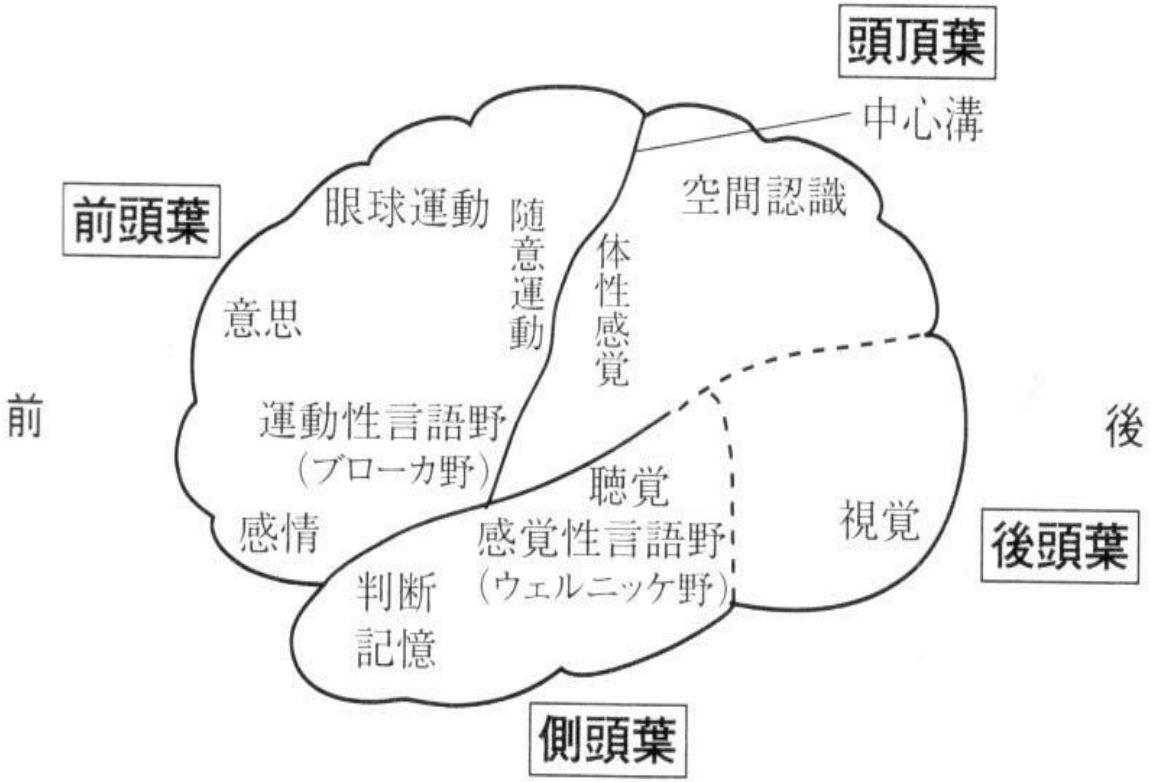
FeRCリサーチ部会
脳波の研究をしています

九州工業大学・生命体工学研究科・
人間知能システム工学専攻
行動評価システム研究所・理事
夏目季代久

[連絡先] natume@brain.kyutech.ac.jp
http://www.brain.kyutech.ac.jp/~natume/

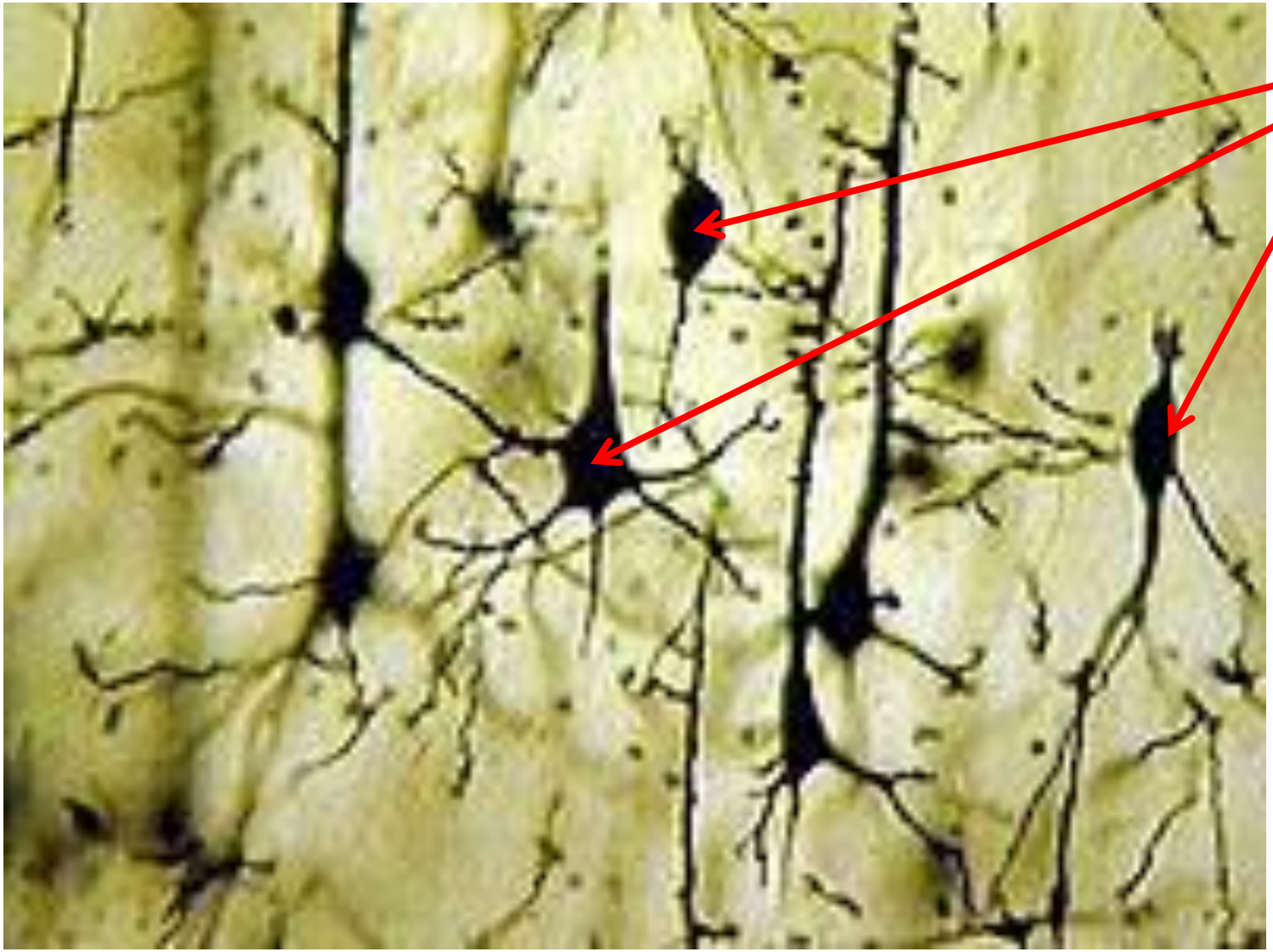
脳とは何か？



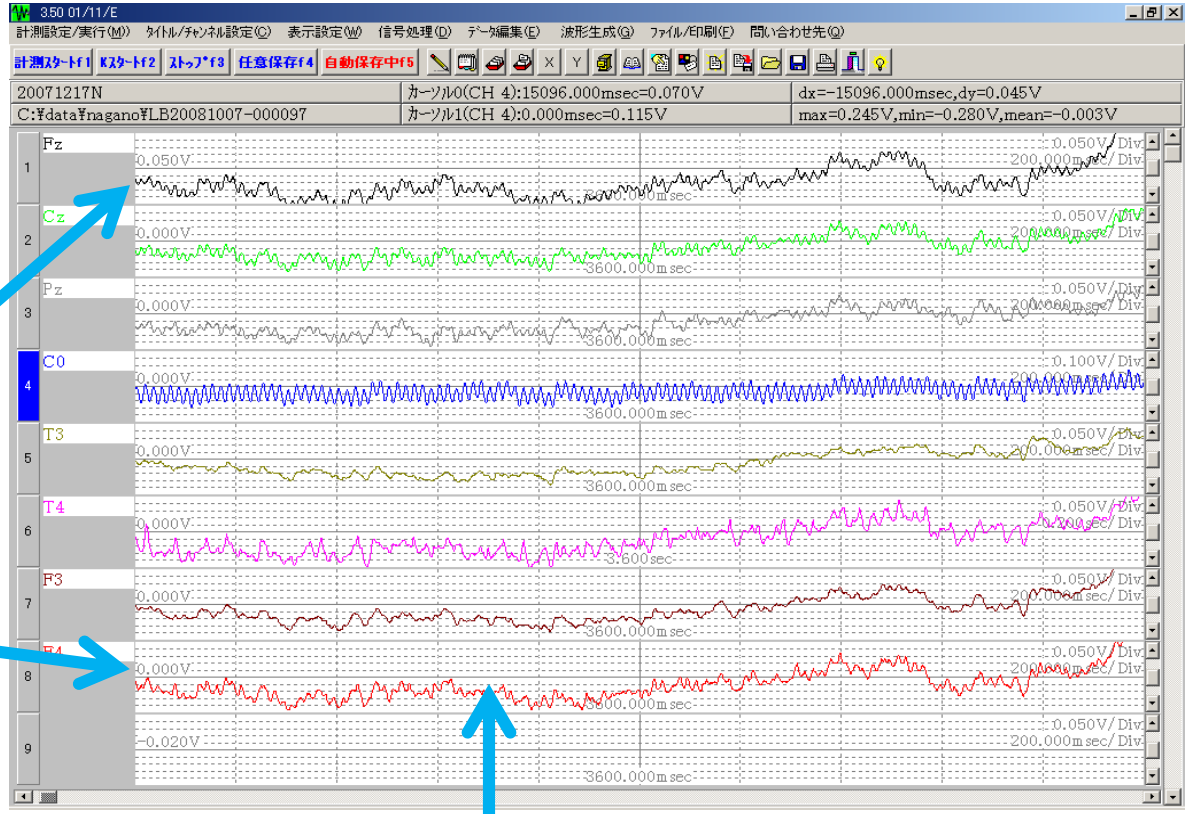
注．実線は脳にある溝を表す。破線は後頭葉、頭頂葉、側頭葉の境界を示す

図4－2－2　ヒトの大脳皮質の機能分担

脳は多数の神経（ニューロン）からなる

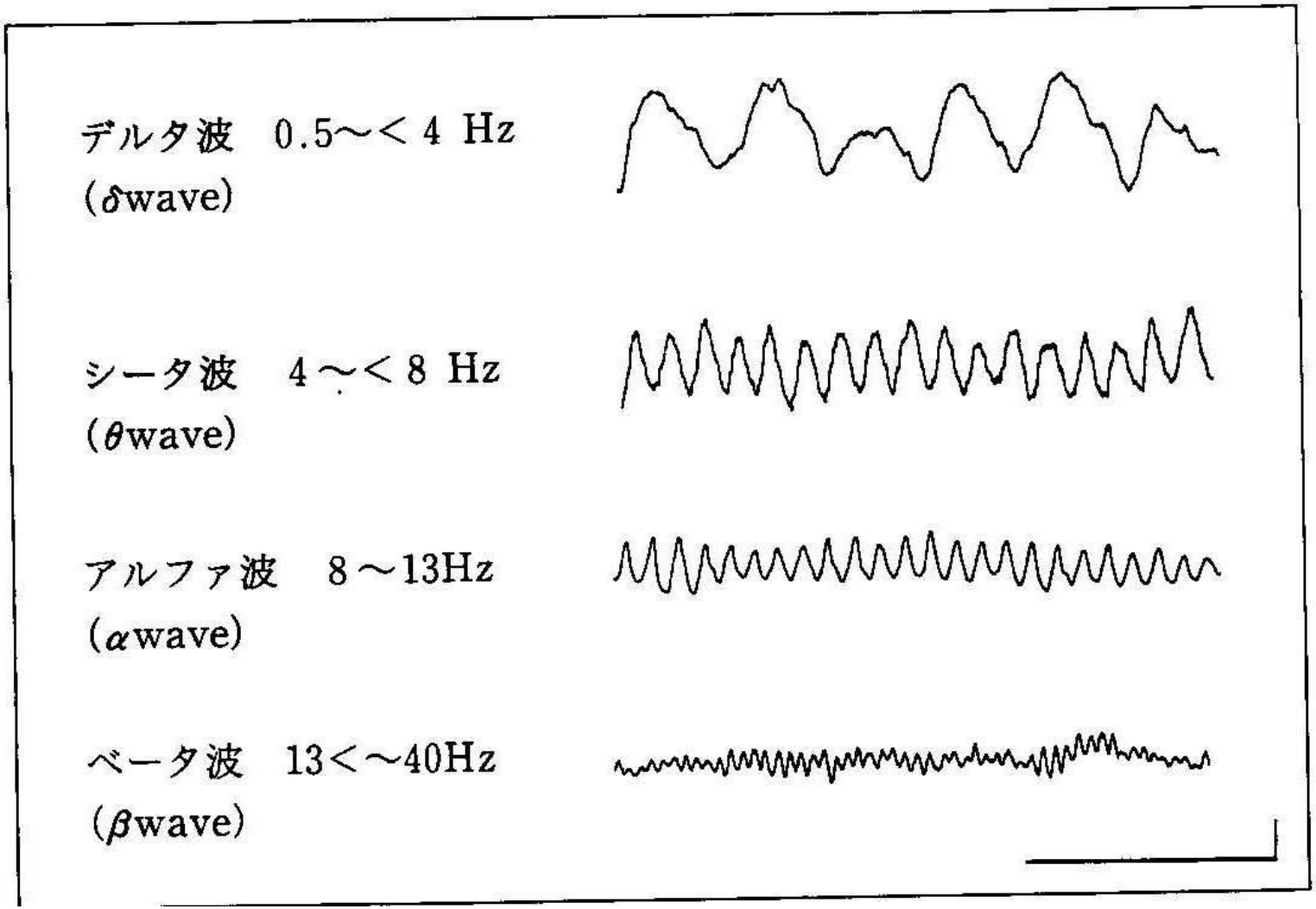


脳の電気信号リズム
…それが脳波



この変動が脳の電気信号

脳波の種類



市川忠彦、「新版　脳波の旅への誘い」(2006)

各脳波はどのような時に見られるか？

δ波・・・睡眠時

θ波・・・記憶・学習・集中した時

α波・・・目を閉じた時、リラックスした時

β波・・・脳が働く時

γ波・・・物を視覚認識した時

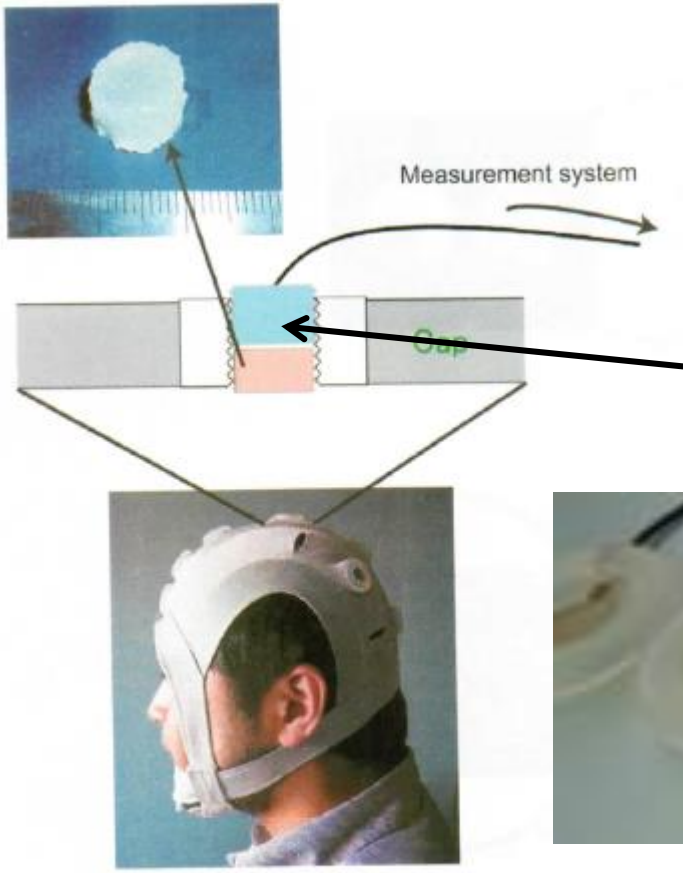
てんかん波・・・病気の脳波、けいれん発作時

インタークロス社の
ドライ電極（横型）

（http://www.intercross.co.jp/）

インタークロス（株）との脳波計の開発

ゲル電極（国立リハビリテーションセンター開発）



銀皿電極

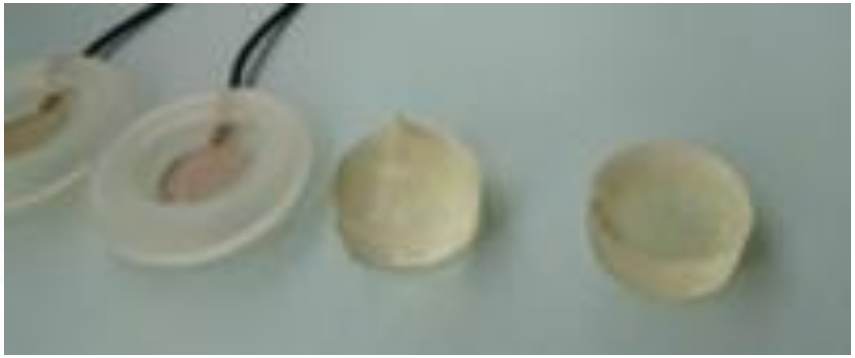


FIGURE 1 | Photograph of the originally developed head-mounted cap, which has 12 electrode sockets. One of the electrode sockets on the cap is enlarged to explain how the solid-gel is used. The solid-gel chip is loaded in the through-hole; the hole is then plugged with an electrode plate. The diameter of the chip was approximately 12 mm, and the height was approximately 7 mm.

（Toyama et al., 2012）

Emotiv

（**EMOTIV EPOC+**；Emotiv Systems
http://emotiv.com/）

ブレインコンピュータ
インターフェース

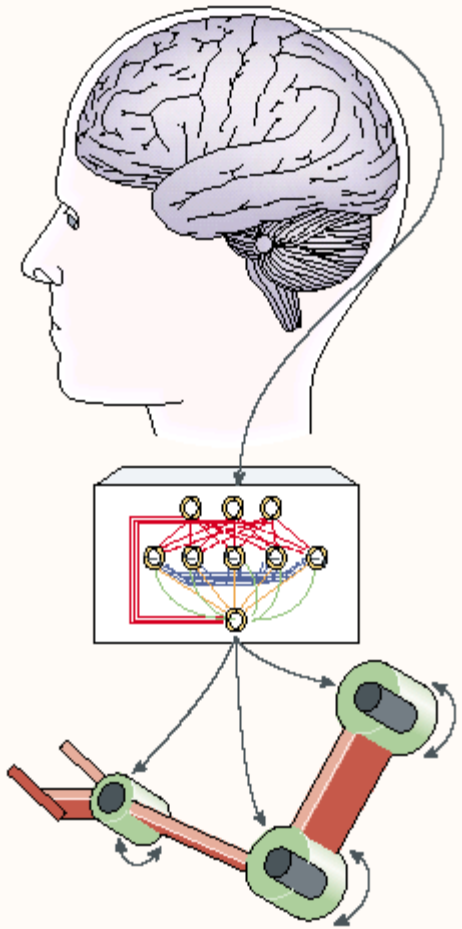
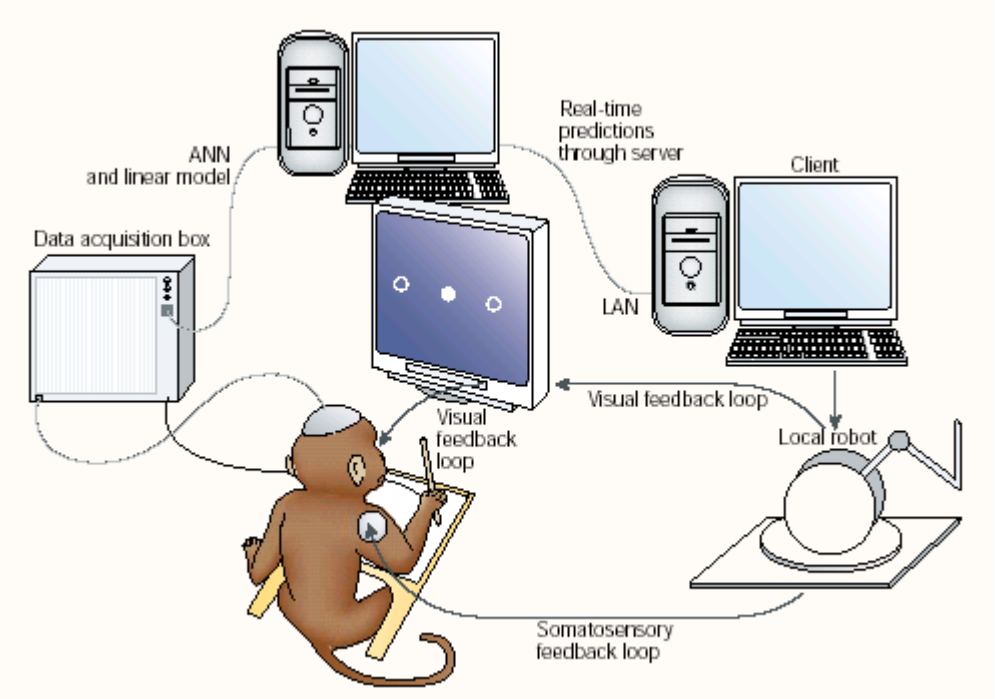
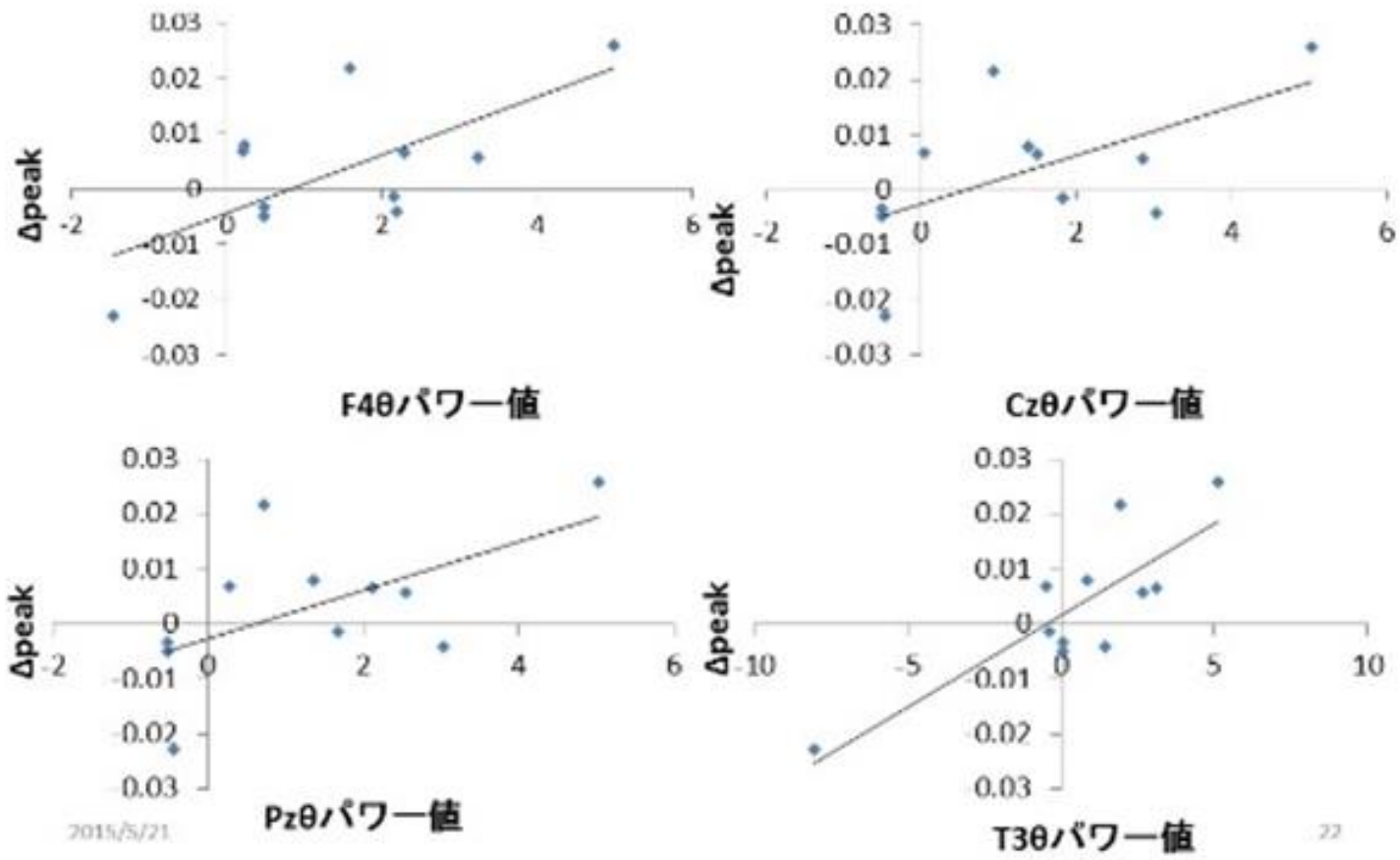


Figure 1 | **Schematic representation of a cortical neuroprosthetic device.** In the general design shown, intracranial recordings are used to sample the extracellular activity of a few hundred neurons in frontal and parietal cortical areas that are involved in the planning of arm and hand movements. The combined activity of these neuronal populations is processed, in real time, by a series of simple mathematical models designed to extract motor-control parameters from the raw brain signals. The outputs of these models are used to control the movements of a robot arm that has been designed to allow the patient to enact fundamental upper limb movements.



Nature(2003)

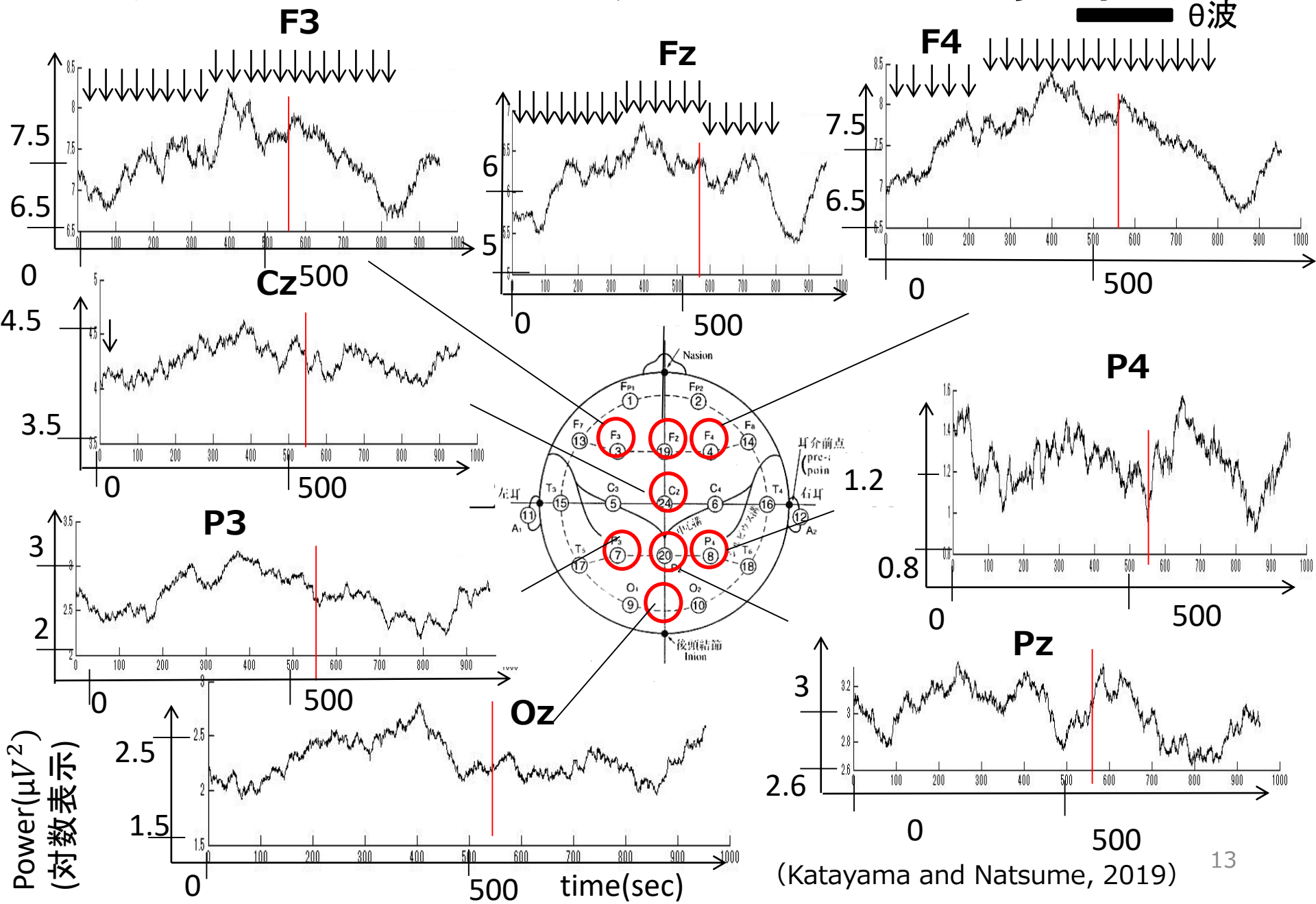
集中しているかどうかで脳波は変わる



(Nakano, and Natsume, 2010, Yamamoto, and Natsume, 2014)

飽きているかどうかで脳波は変わる

θ波

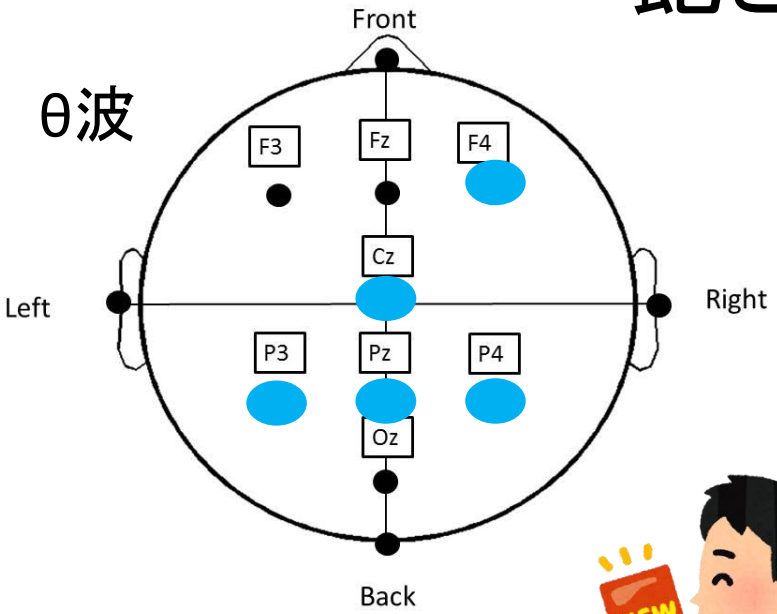


(Katayama and Natsume, 2019)

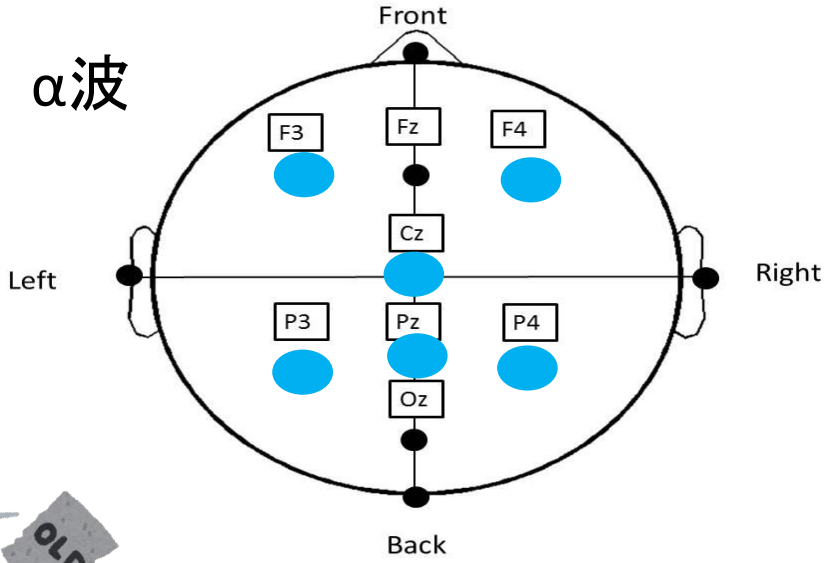
「飽き」脳波

（Katayama and Natsume, 2019）

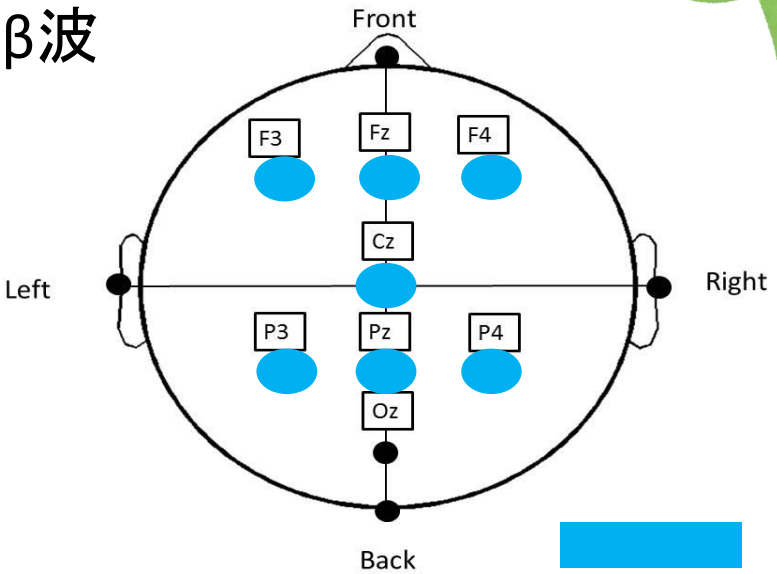
θ波



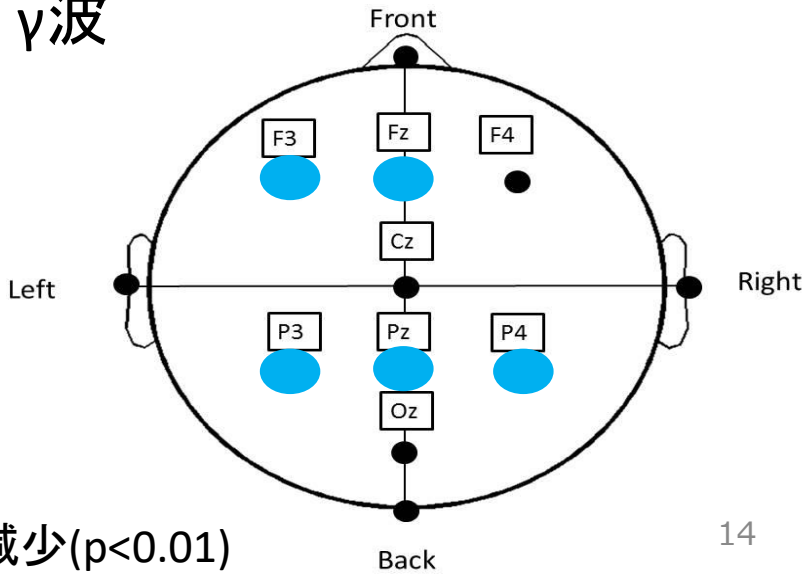
α波



β波



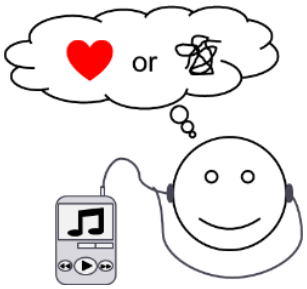
γ波

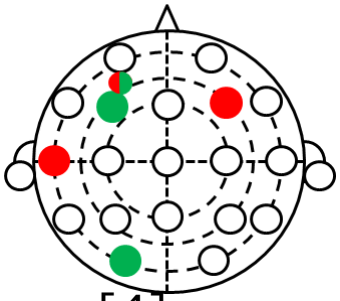


有意な減少($p<0.01$)

聞いている音楽が好きかどうかで脳波が変わる

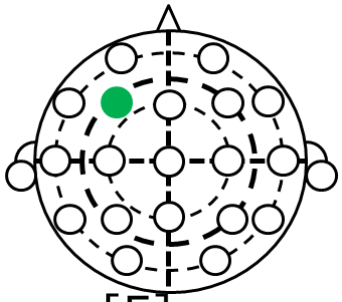
Listening





[4]

Thinking

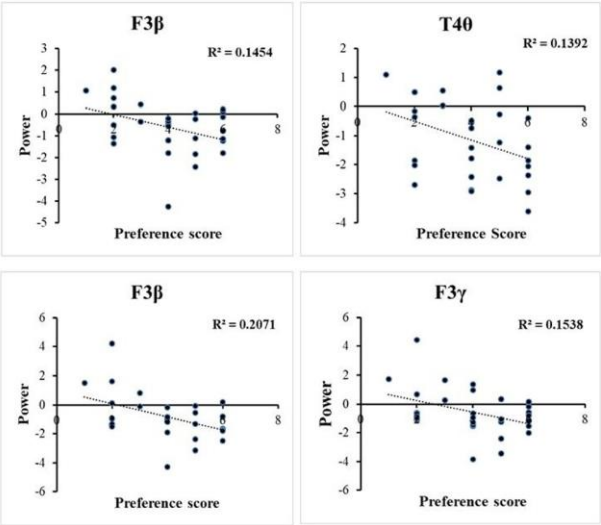


[5]

β
γ

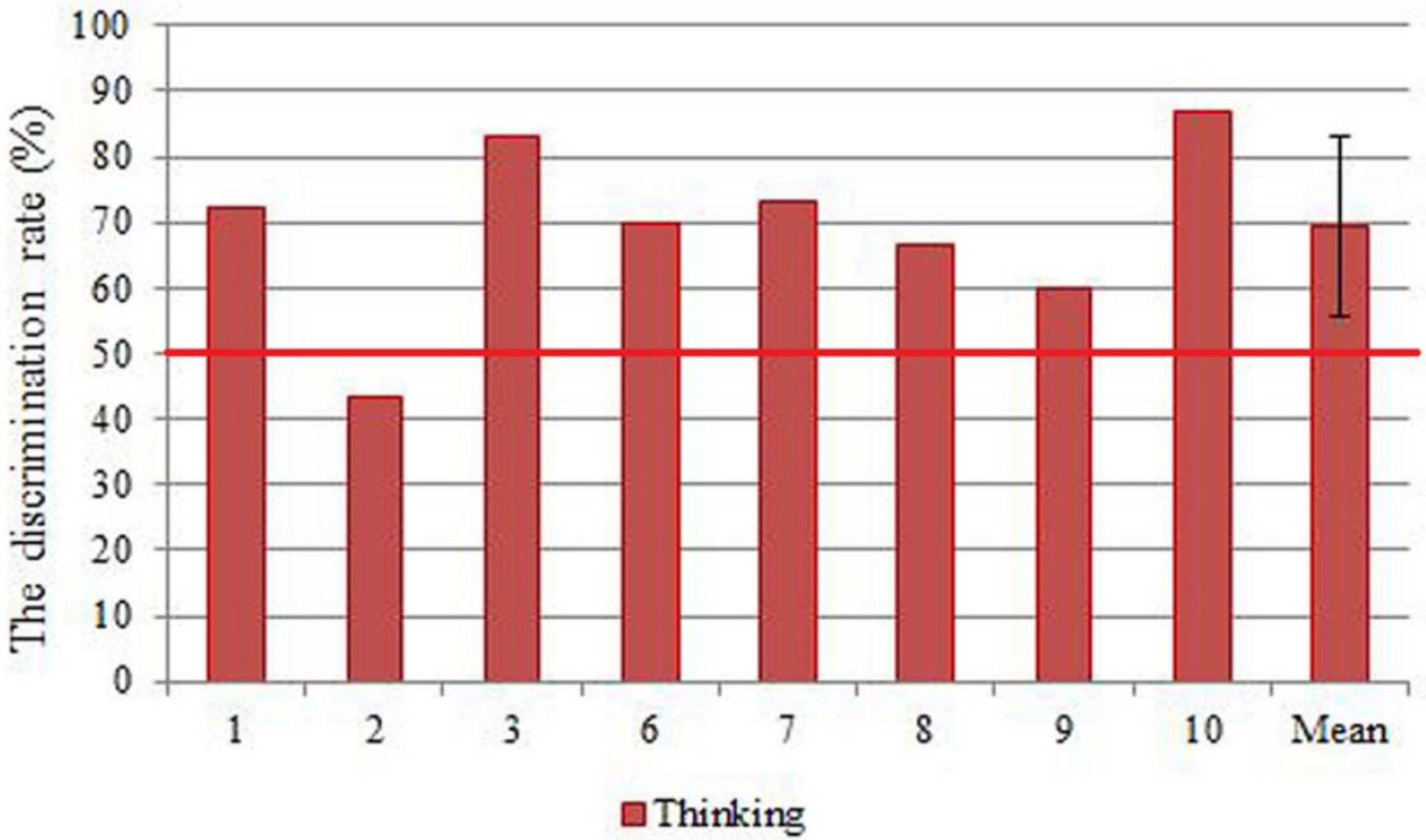
(a) Listening

(b) Thinking



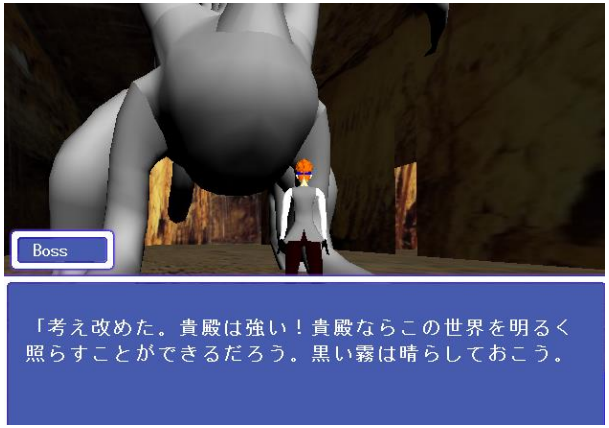
(Hadjidimitriou and Hadjileontiadis., 2012. Tsuji et al., 2019.)

機械学習による判別



(Tsuji et al., 2019)

研究室で開発した脳波ゲーム



eスポーツと脳波

- プレーヤーの状態検知

- プレーヤーのプレイアシスト

プレーヤーのメンタルを脳波によって調べる

このプレーヤーは今、
集中しているかな？
健康かな？居眠りして
いないかな？