MEG 教育講習課程 II
Topic 2: 事件關聯磁場分析

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國立中央大學
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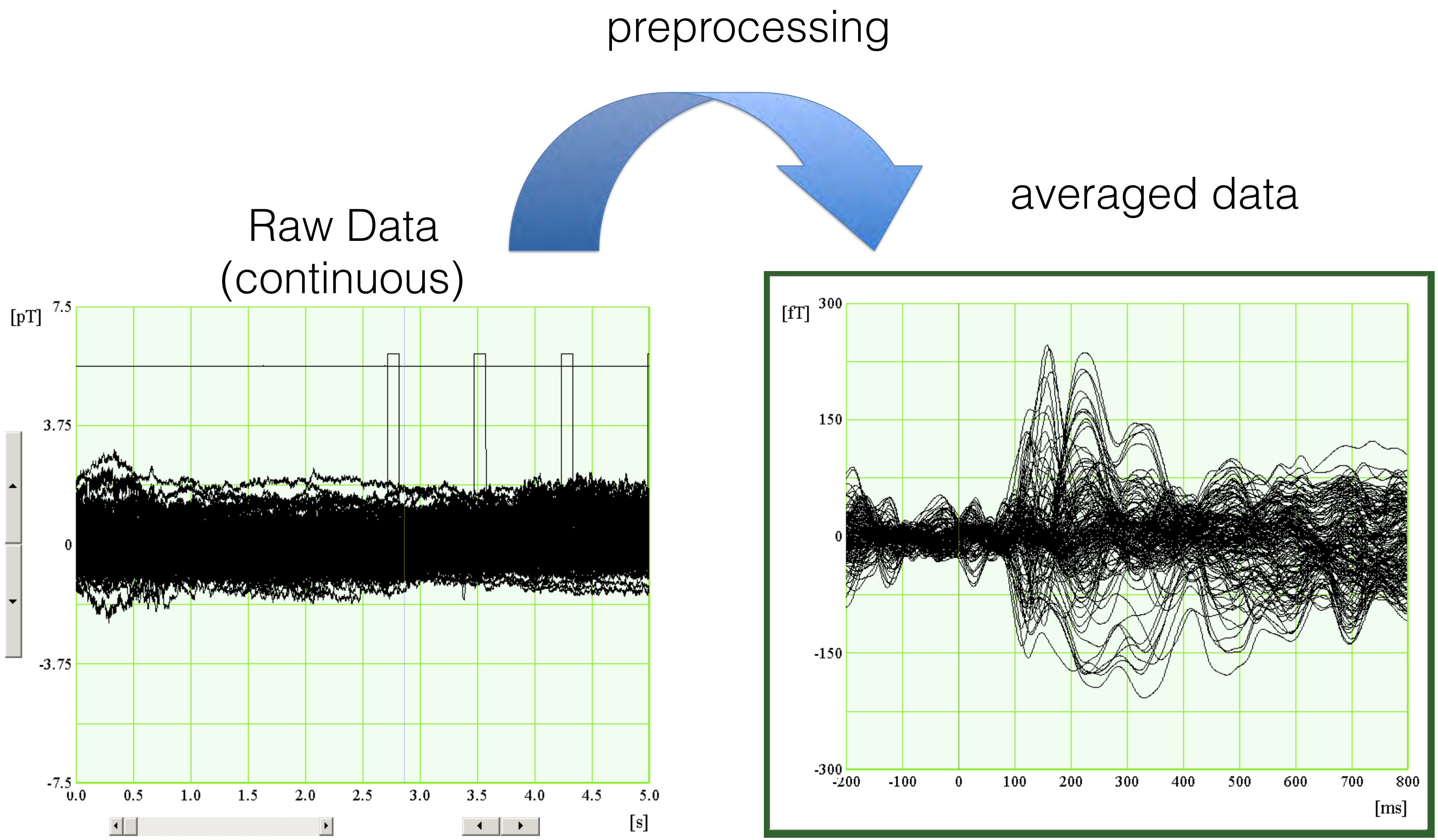
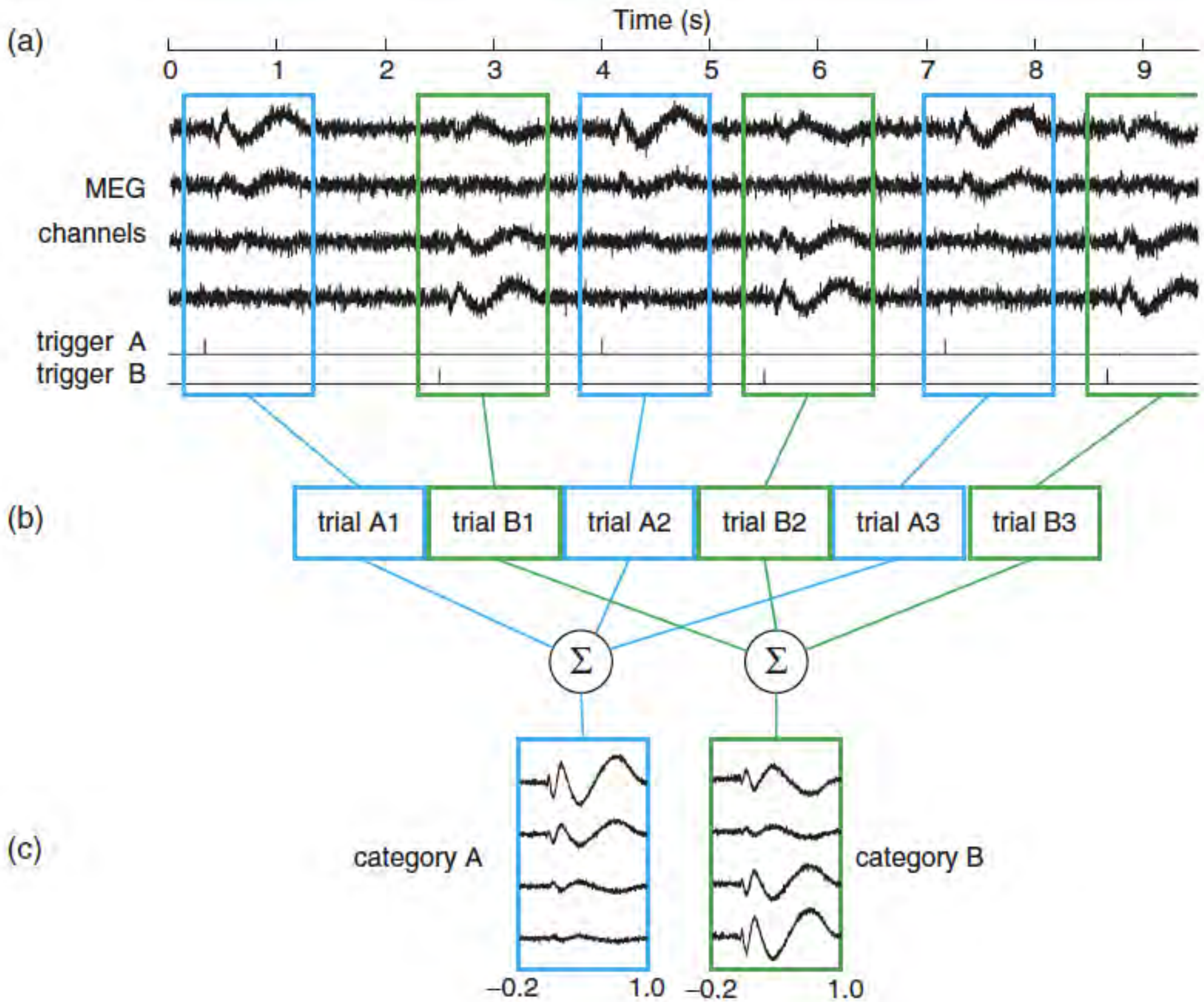
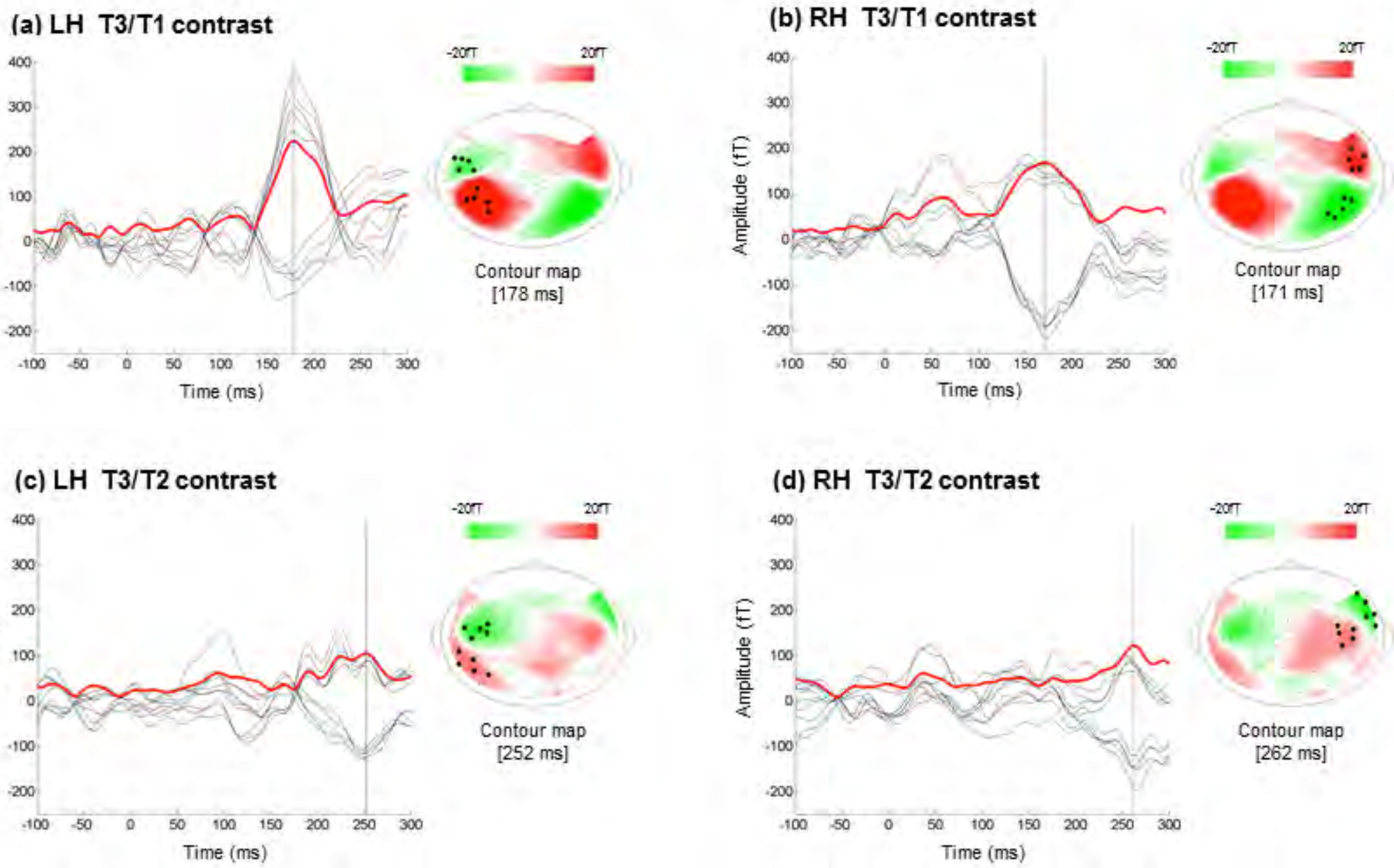
科技部年輕學者養成計畫
TAIWAN MOST Young Scholar Fellowship


preprocessing
Raw Data
(continuous)
averaged data
[pT]
7.5
3.75
0
-3.75
-7.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
[s]
[fT]
300
150
0
-150
-300
-200
-100
0
100
200
300
400
500
600
700
800
[ms]

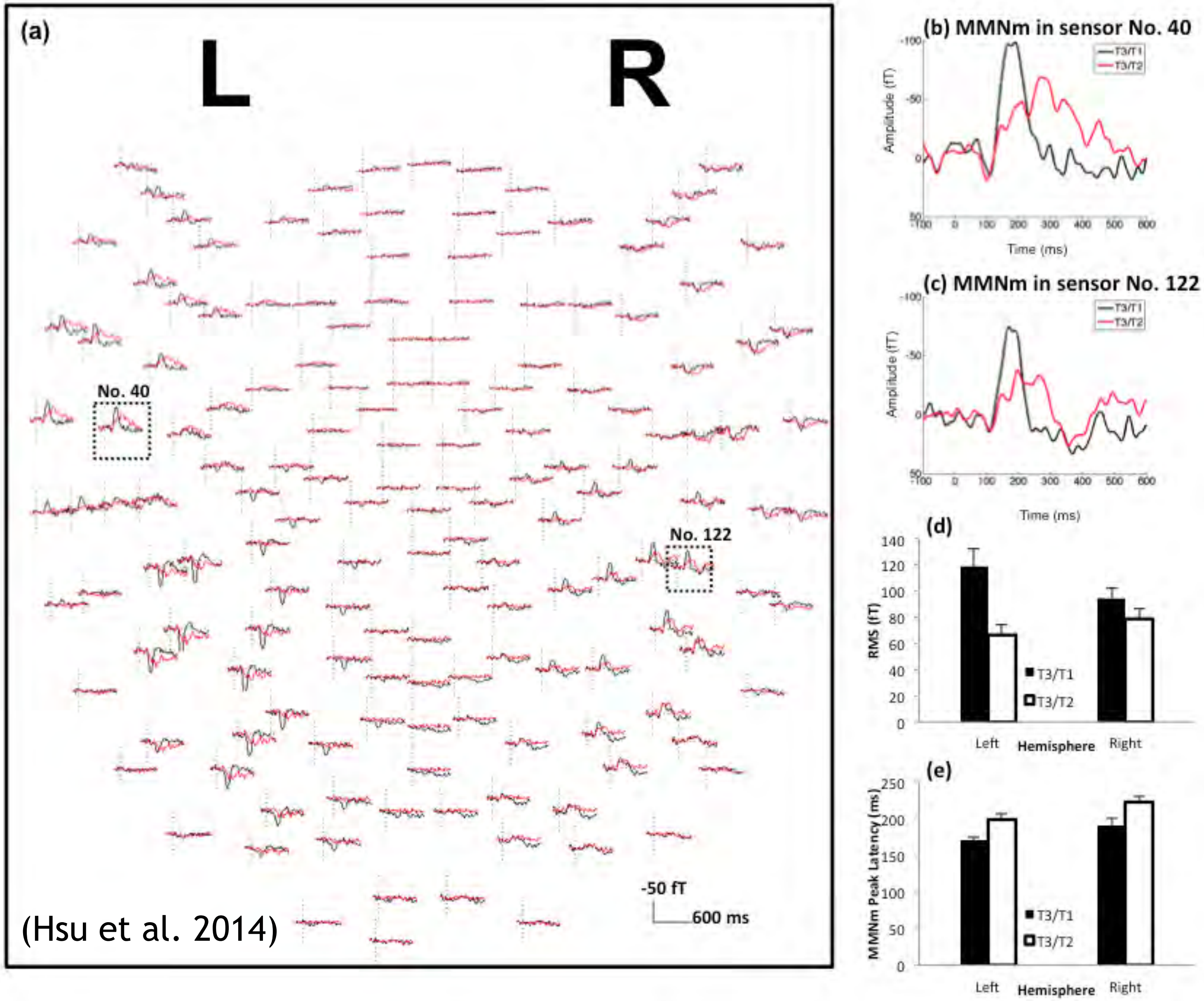


(a)
Time (s)
0
1
2
3
4
5
6
7
8
9
MEG
channels
trigger A
trigger B
(b)
trial A1
trial B1
trial A2
trial B2
trial A3
trial B3
Σ
Σ
(c)
category A
category B
–0.2
1.0
–0.2
1.0

A conventional approach for analyzing MMN/MMNm responses is to estimate difference waves by subtracting the activities to the standard from those to the deviant. Therefore, based on the cluster-level statistics, we selected 10 sensors in the left and right hemispheres to do the following analysis. The mismatch waveforms were obtained by subtracting the magnetic field to the standard T3 from those to the large deviant T1 and to the small deviant T2 respectively. Figs. 6a–d show overlays of the mismatched waveforms for the T3/T1 and T3/T2 contrasts in 10 selected sensors (color filled sensors) in the left and right hemispheres of a participant. The sensors were selected based on the findings in the present cluster-level analysis and that in Phillips et al. (2000) that the MMNm response had a magnetic pattern of the polarity inversion across the lateral sensors during the time window from 150 to 300 ms. Accordingly, different sets of sensors were selected over the two hemispheres for each contrast and each participant. The red lines indicate the root mean square (RMS) field strengths that were calculated from the selected sensors. The MMNm latency was defined as the time point that the RMS waveform reached the highest peak amplitude in the 150- to 300-ms interval. The MMNm amplitude was measured by averaging the RMS across a 20-ms time window that centered at the MMNm peak latency. The MMNm amplitudes and latencies were subjected to repeated-measures analyses of variance (ANOVAs) with the contrasts (T3/T1 and T3/T2 contrasts) and hemispheres (left and right) as within-subject factors.

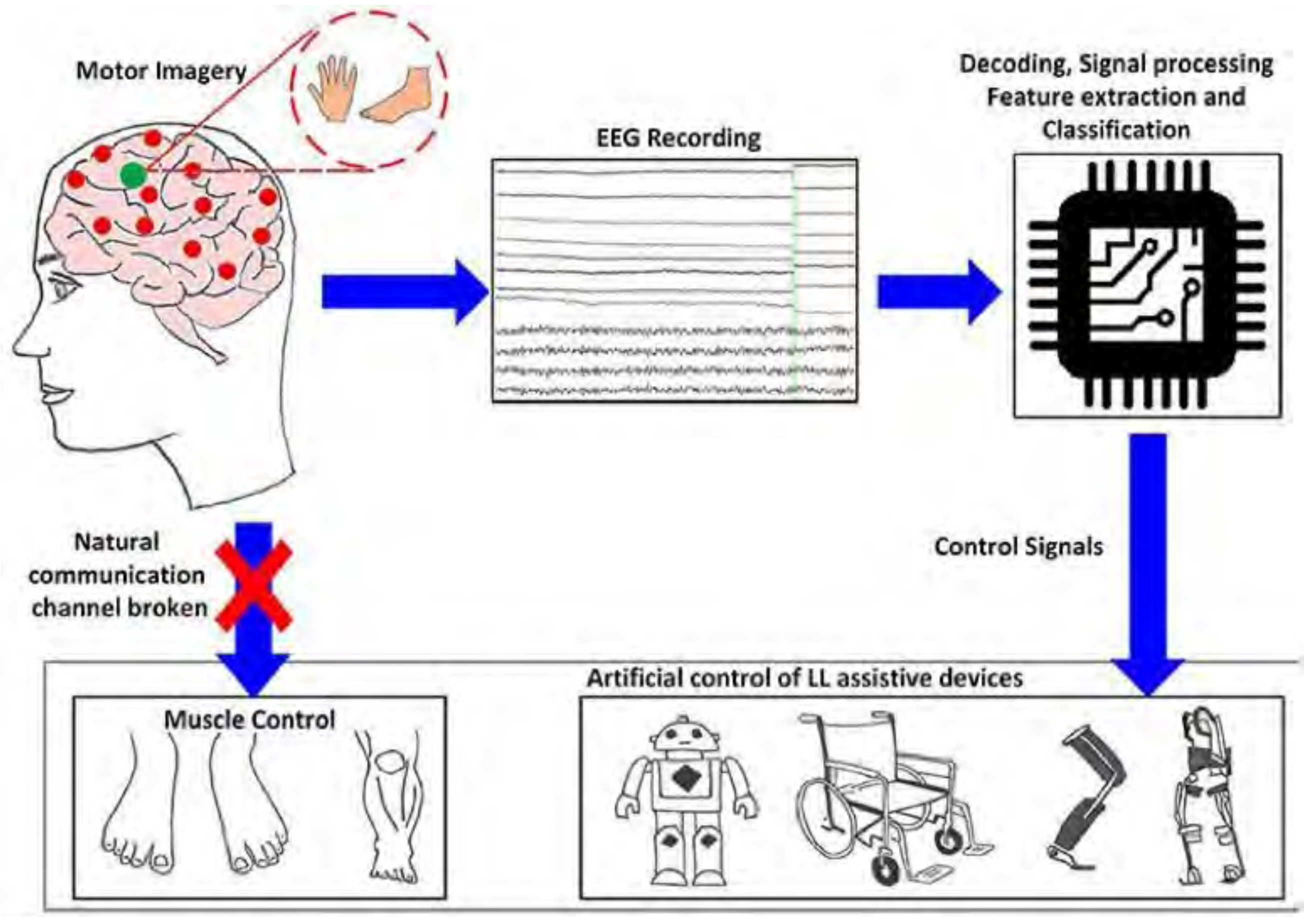


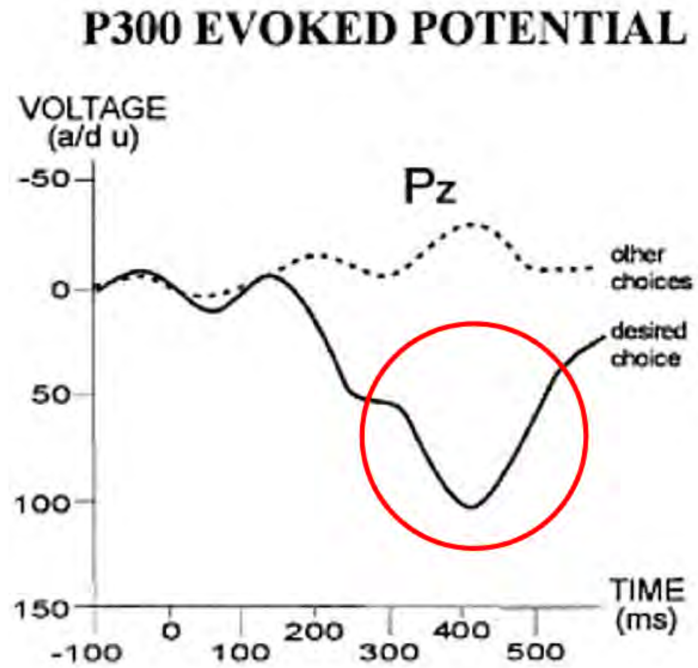
(Hsu et al. 2014)

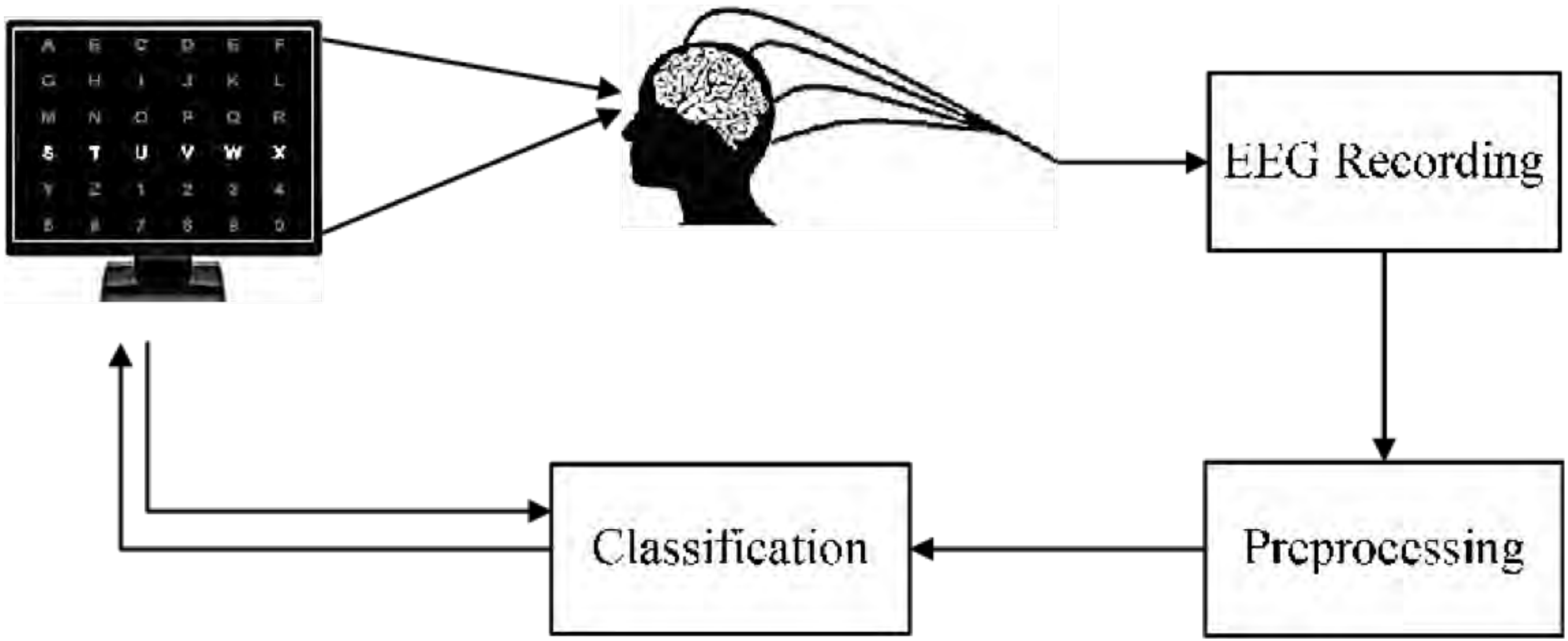

(a)
L
R
No. 40
No. 122
-50 fT
600 ms
(Hsu et al. 2014)
(b) MMNm in sensor No. 40
Amplitude (fT)
Time (ms)
(c) MMNm in sensor No. 122
Amplitude (fT)
Time (ms)
(d)
RMS (fT)
T3/T1
T3/T2
Left
Hemisphere
Right
(e)
MMNm Peak Latency (ms)
T3/T1
T3/T2
Left
Hemisphere
Right

Application of BCI using EEG/MEG

- Real-time analyses
  - e.g., using brain waves to spell words
    - https://www.youtube.com/watch?v=5i6zRZL64v0
    - https://www.youtube.com/watch?v=XIr2cRKFolY
    - https://www.youtube.com/watch?v=wKDimrzvwYA
    - https://www.youtube.com/watch?v=yBker7B0X1A&t=226s

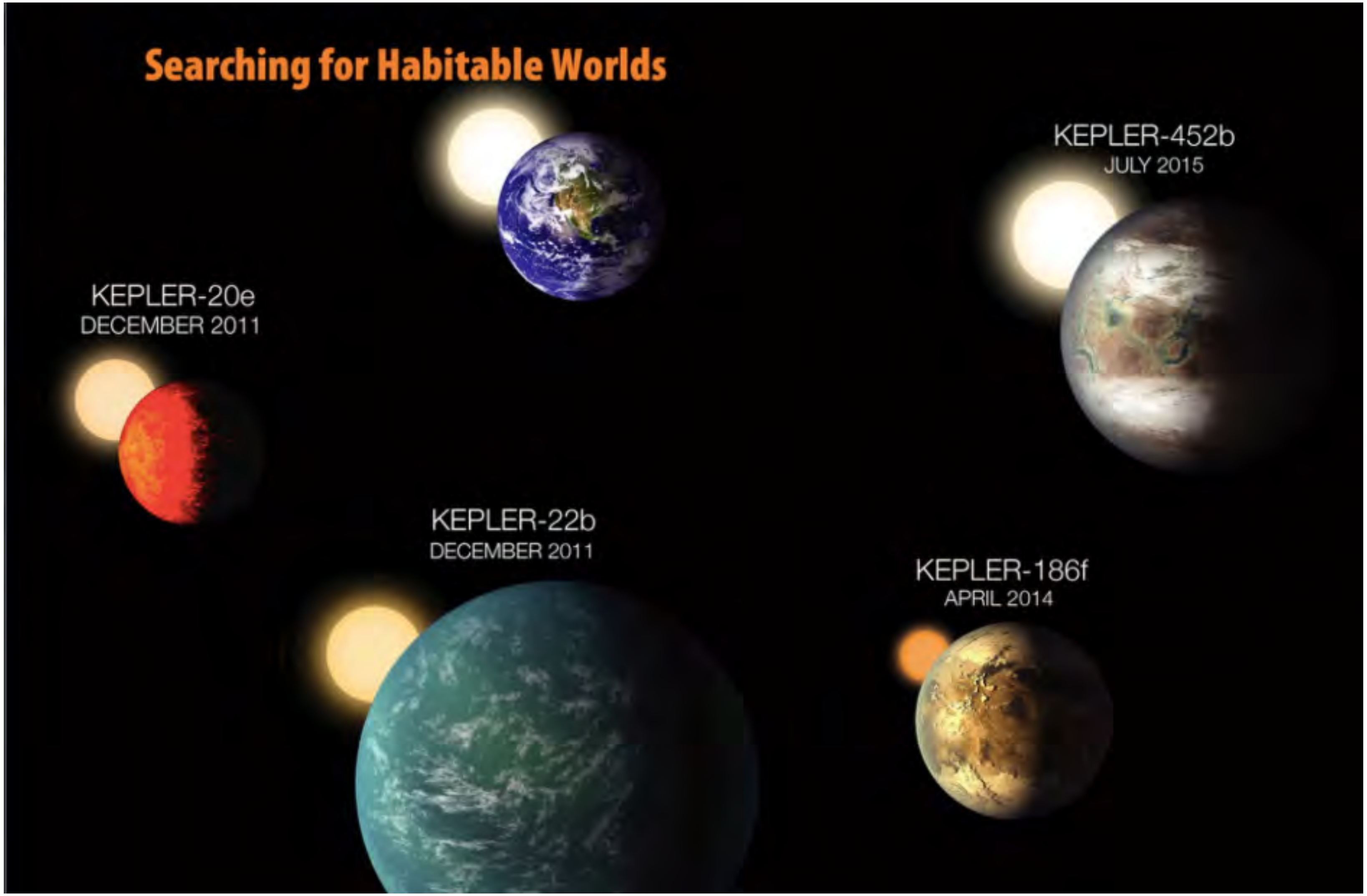

Motor Imagery
EEG Recording
Decoding, Signal processing
Feature extraction and
Classification
Natural
communication
channel broken
Control Signals
Artificial control of LL assistive devices
Muscle Control

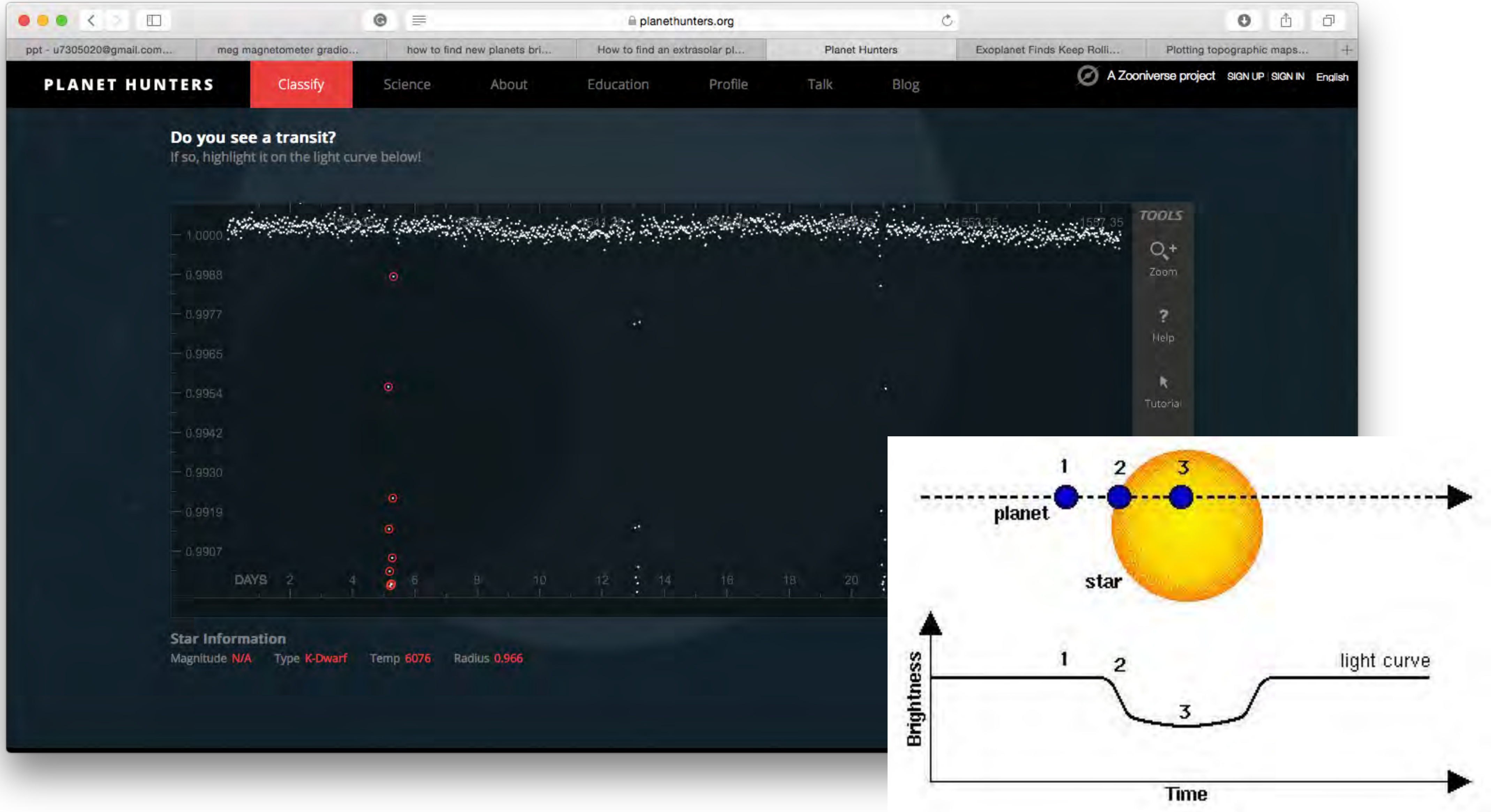

P300 EVOKED POTENTIAL
VOLTAGE
(a/d u)
Pz
-50
0
50
100
150
other
choices
desired
choice
TIME
(ms)
-100
0
100
200
300
400
500



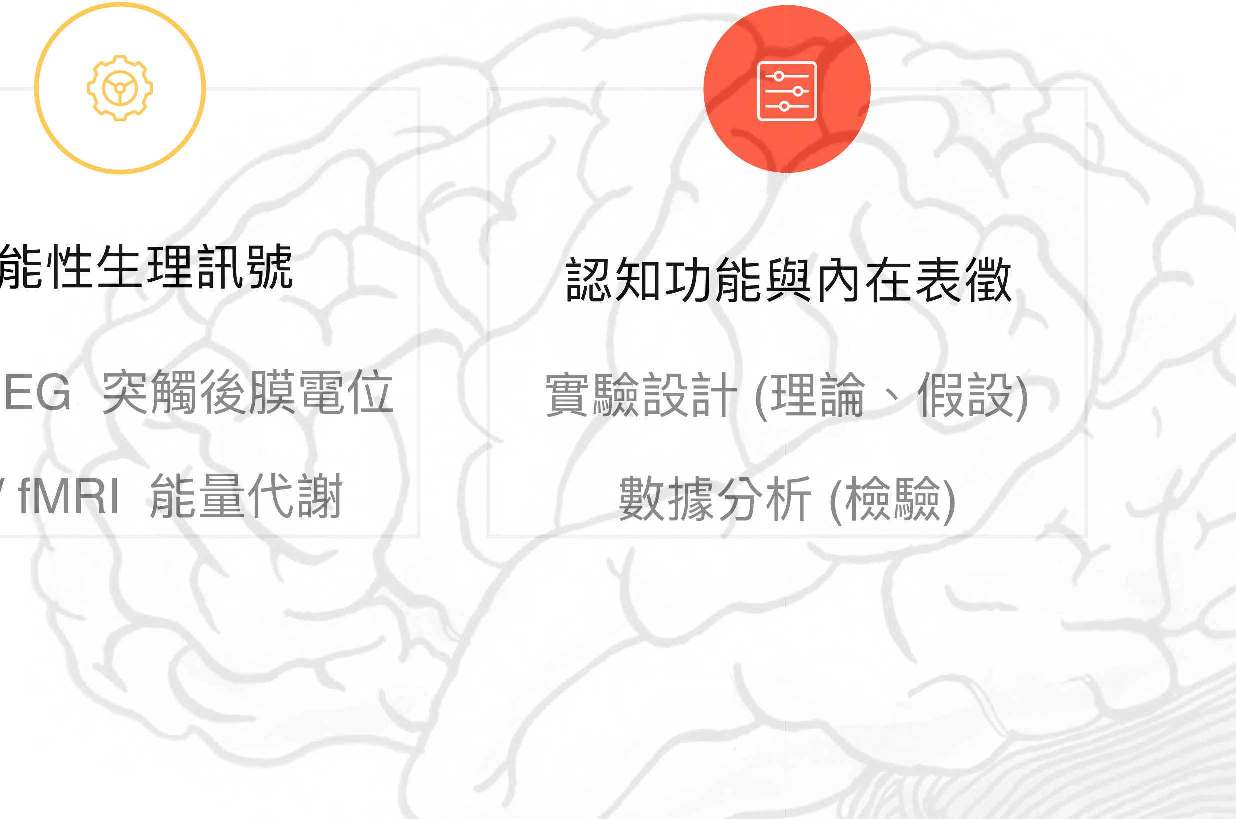
A B C D E F
G H I J K L
M N O P Q R
S T U V W X
Y Z 1 2 3 4
5 6 7 8 9 0
EEG Recording
Preprocessing
Classification

- EEG/MEG 的優點：Lots of data
  - channels x times x trials
    - e.g., 62 x 1000 x 1000 (one participant)
  - channels x times x trials x frequency
    - e.g., 157 x 1000 x 1000 x 100 (one participant)


Searching for Habitable Worlds
KEPLER-452b
JULY 2015
KEPLER-20e
DECEMBER 2011
KEPLER-22b
DECEMBER 2011
KEPLER-186f
APRIL 2014


planethunters.org
ppt - u7305020@gmail.com...
meg magnetometer gradio...
how to find new planets bri...
How to find an extrasolar pl...
Planet Hunters
Exoplanet Finds Keep Rolli...
Plotting topographic maps...
PLANET HUNTERS
Classify
Science
About
Education
Profile
Talk
Blog
A Zooniverse project
SIGN UP
SIGN IN
English
Do you see a transit?
If so, highlight it on the light curve below!
TOOLS
Zoom
Help
Tutorial
1.0000
0.9988
0.9977
0.9965
0.9954
0.9942
0.9930
0.9919
0.9907
DAYS 2 4 6 8 10 12 14 16 18 20
Star Information
Magnitude N/A
Type K-Dwarf
Temp 6076
Radius 0.966
1
2
3
planet
star
Brightness
1
2
light curve
3
Time

Cognitive Neuroscience



神經生理機制

中樞神經系統

生命展望 (life-span)

功能性生理訊號

EEG/MEG 突觸後膜電位

PET/ fMRI 能量代謝

認知功能與內在表徵

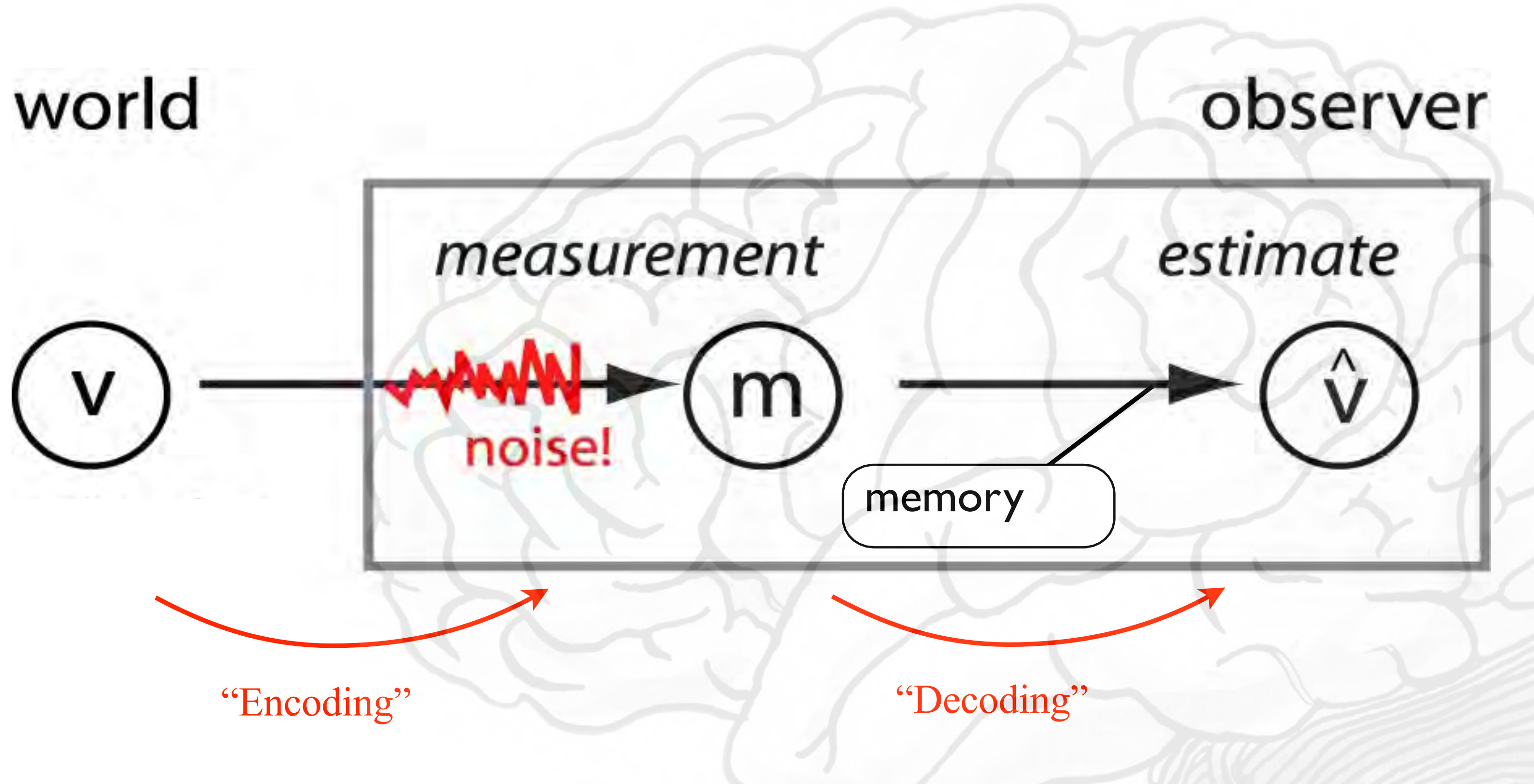
實驗設計 (理論、假設)

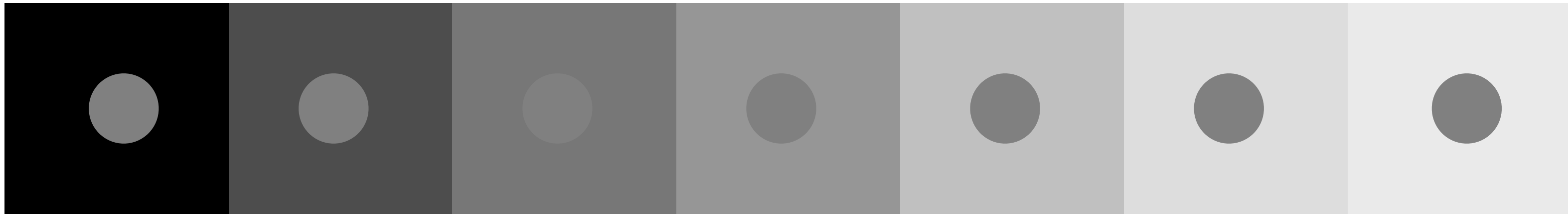
數據分析 (檢驗)

以MEG研究語言功能

Helmholtz (1866)

- Perception is our best guess as to what is in the world, given our current sensory input and our prior experience [paraphrased]

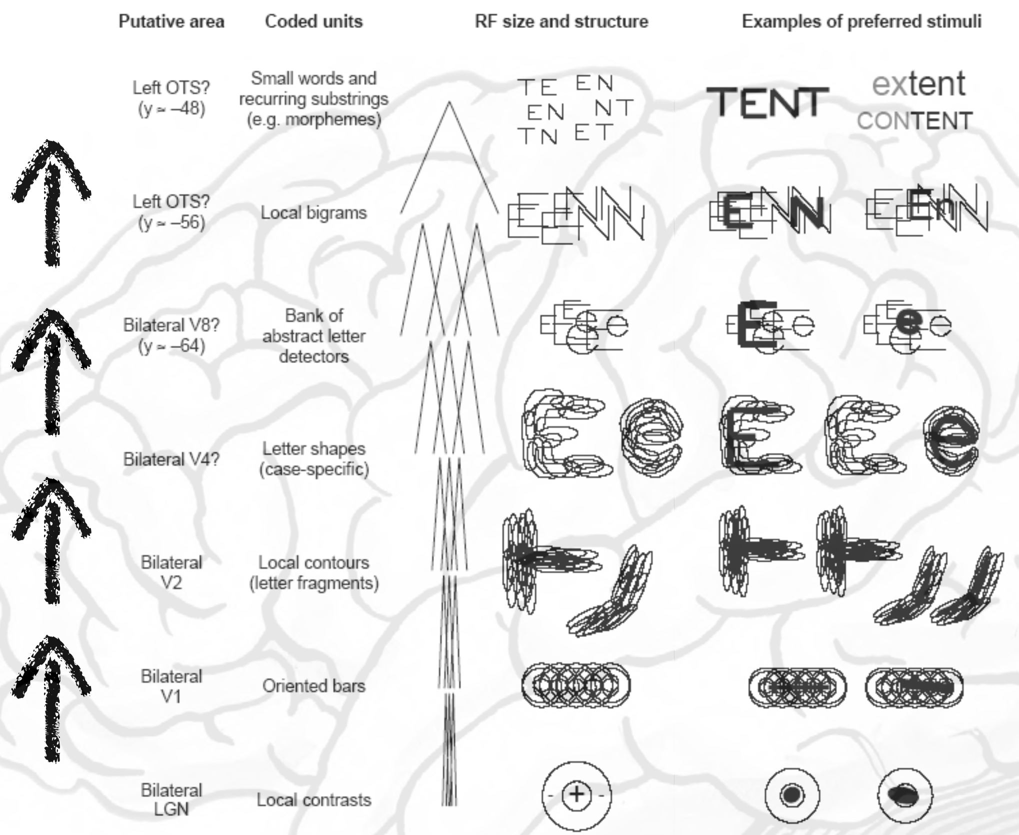




Encoding of Word Forms

Yuor brian is so pfweroul, taht it can raed scntenees wtih mxied up wrods as lnog as the fsrit and lsat letetrs are in the rgiht palce. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe.

adapted from Dehaene et al., 2005



Decoding of Linguistic Information

William J. Rapaport (1992)

- buffalo(s): noun，水牛
- Buffalo: noun，水牛城
- buffalo(s/ed): verb，恐嚇

“水牛城野牛所恐嚇的水牛城野牛，恐嚇(其他一些)水牛城野牛。”

Buffalo buffalo Buffalo buffalo buffalo buffalo Buffalo buffalo.

水牛城野牛 水牛城野牛所恐嚇的 恐嚇 水牛城野牛

如何設計一個語言學實驗？

- 建立研究假設：

  單語素雙字詞 (蚯蚓) 與雙音節合成詞 (火車)

  的辨識過程是否運用一樣的大腦機制？

- 將受試者分配到各種實驗情境之下
- 採取適當的統計分析

統計假設 (statistical hypotheses)

- 獨變項 (independent variable): 單語素 vs 合成詞
- 依變項 (dependent variable)：reading time
- 干擾變項 (nuisance/confounding variable)：word frequency

兩個測量值是否相等?	數個測量值是否相等?	某一個測量值等於零?
$H_0: \mu_1 - \mu_2 = 0$	$H_0: \mu_1 = \mu_2 = \mu_3$	$H_0: \beta = 0$
$H_1: \mu_1 - \mu_2 \neq 0$	$H_1: \mu_1 \neq \mu_2 \neq \mu_3$	$H_1: \beta \neq 0$

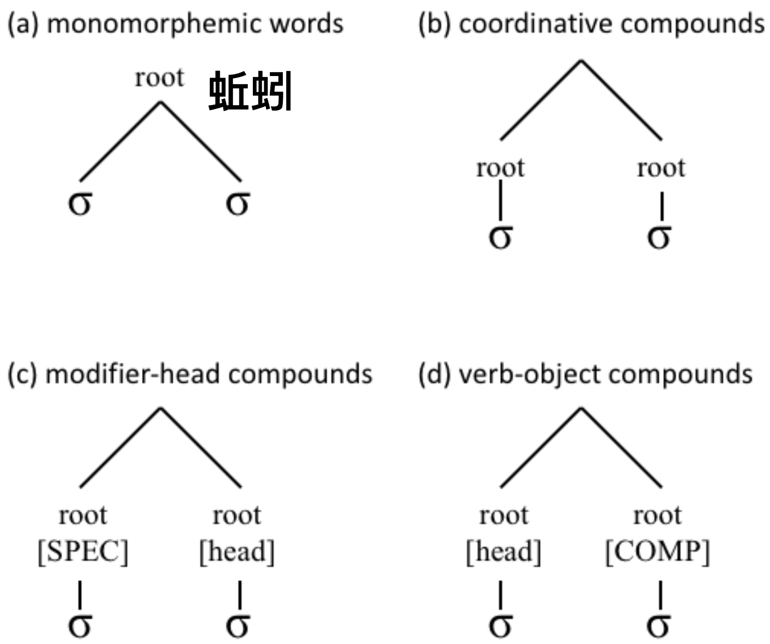
morphology: 詞彙和語句的建構規則

有限的單位
(limited inventories)
音位、詞素、詞彙

普遍語法
(universal grammer)

無限種說話內容
(infinite utterances)

現代漢語的構詞形式



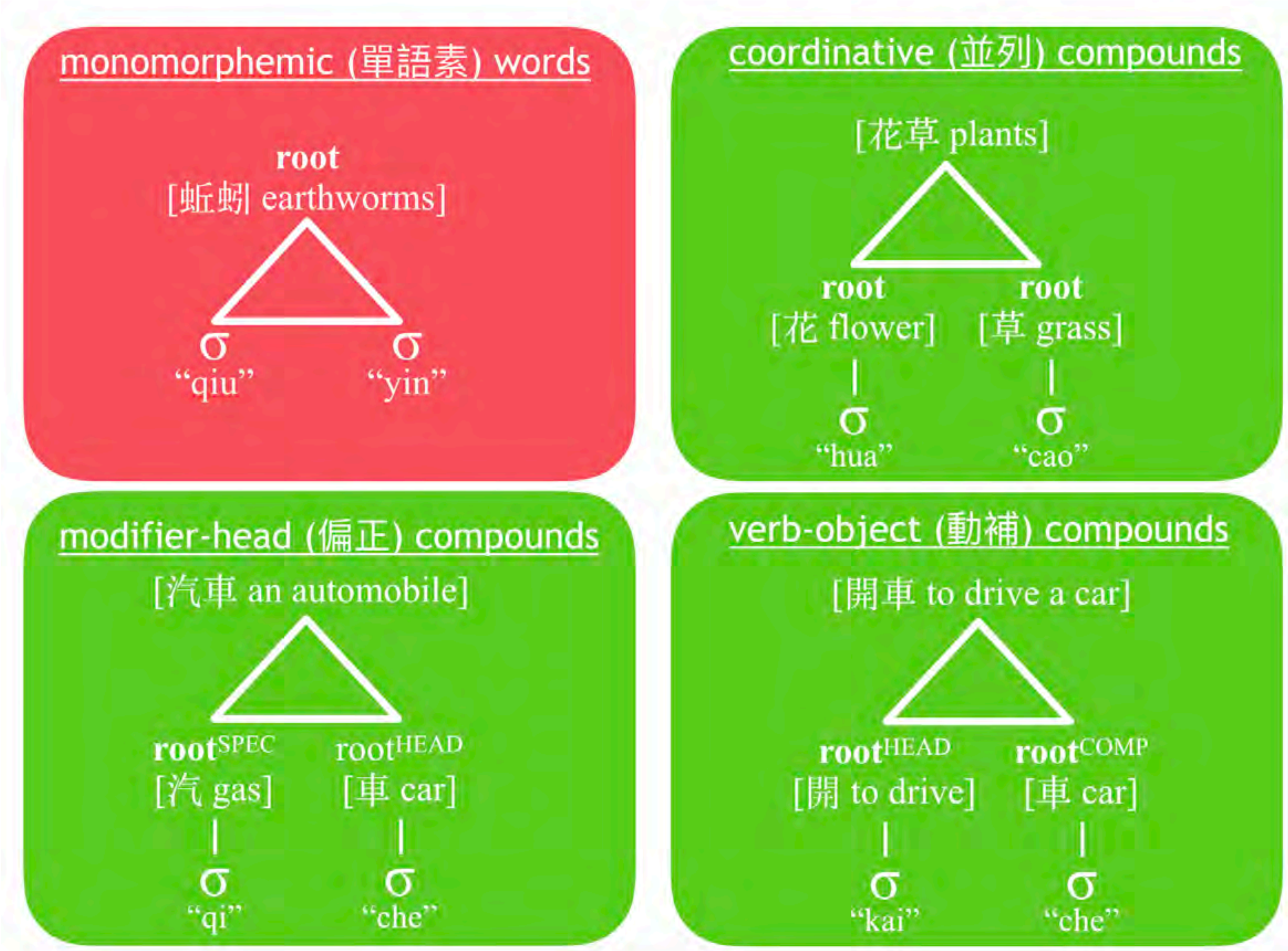
(b) Coordinative words (並列)
The two roots carry similar, related, or contrary meanings
N-N : 雷電, lei-dian ‘thunder-lightning: thunder’

(c) Modifier-Head words (偏正)
The first root modifies (or restricts) the second root
Adj-N: 汽車, qi-che ‘gas-car: an automobile’

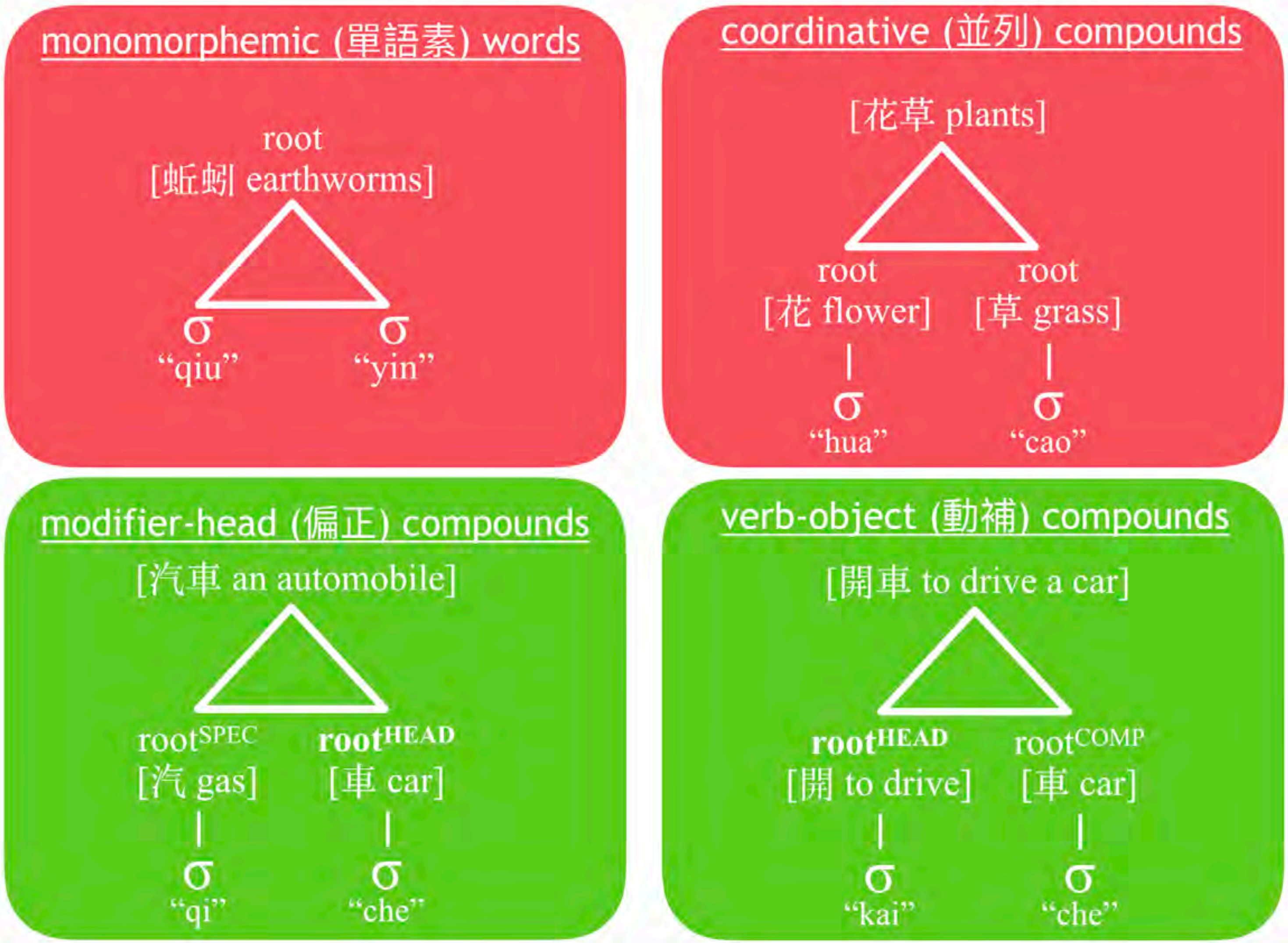
(d) Verb-Object words (動補)
The first root refers to the predicate., while the second root a thematically related object (theme, location, instrument, etc.).
V-N: 兜風, dou-feng ‘catch-wind: go for a drive’

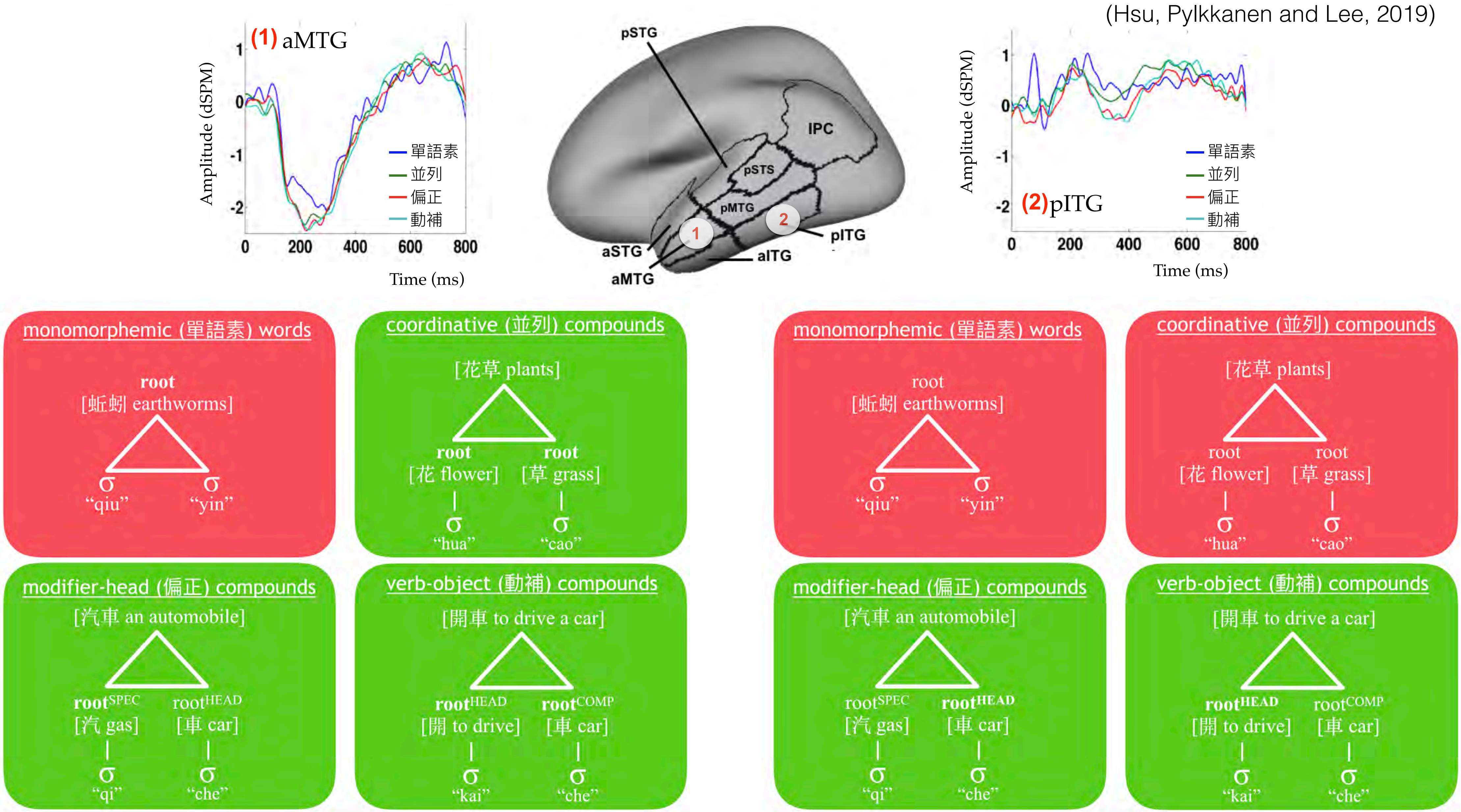
(Hsu, Pylkkanen and Lee, 2019)

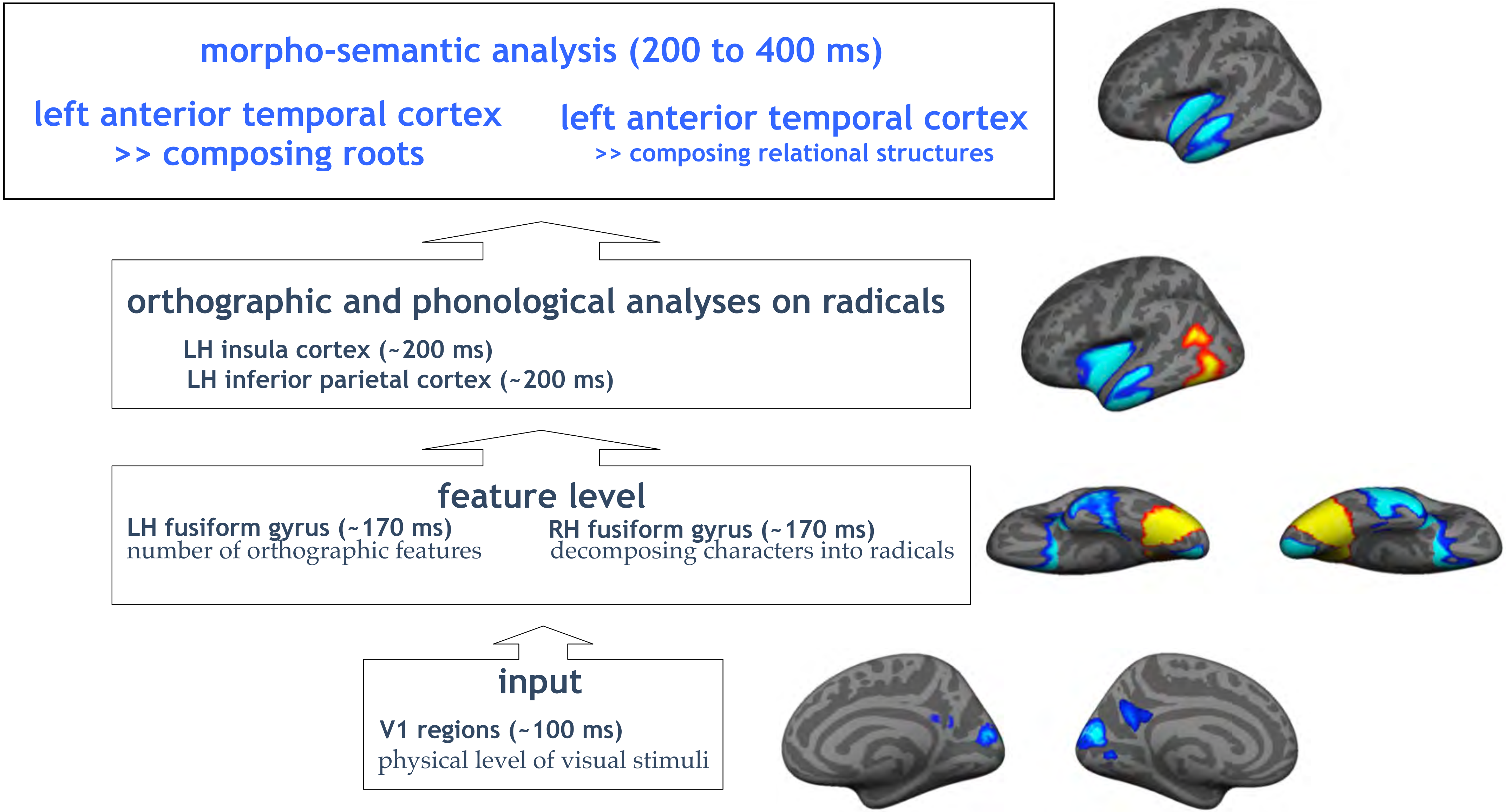
(a part of) 現代漢語的構詞形式



(a part of) 現代漢語的構詞形式




(Hsu, Pylkkanen and Lee, 2019)
(1) aMTG
Amplitude (dSPM)
Time (ms)
單語素
並列
偏正
動補
pSTG
pSTS
pMTG
IPC
aSTG
aMTG
aITG
pITG
1
2
(2) pITG
monomorphemic (單語素) words
root
[蚯蚓 earthworms]
σ “qiu”
σ “yin”
coordinative (並列) compounds
[花草 plants]
root [花 flower]
root [草 grass]
σ “hua”
σ “cao”
modifier-head (偏正) compounds
[汽車 an automobile]
root^SPEC [汽 gas]
root^HEAD [車 car]
σ “qi”
σ “che”
verb-object (動補) compounds
[開車 to drive a car]
root^HEAD [開 to drive]
root^COMP [車 car]
σ “kai”
σ “che”

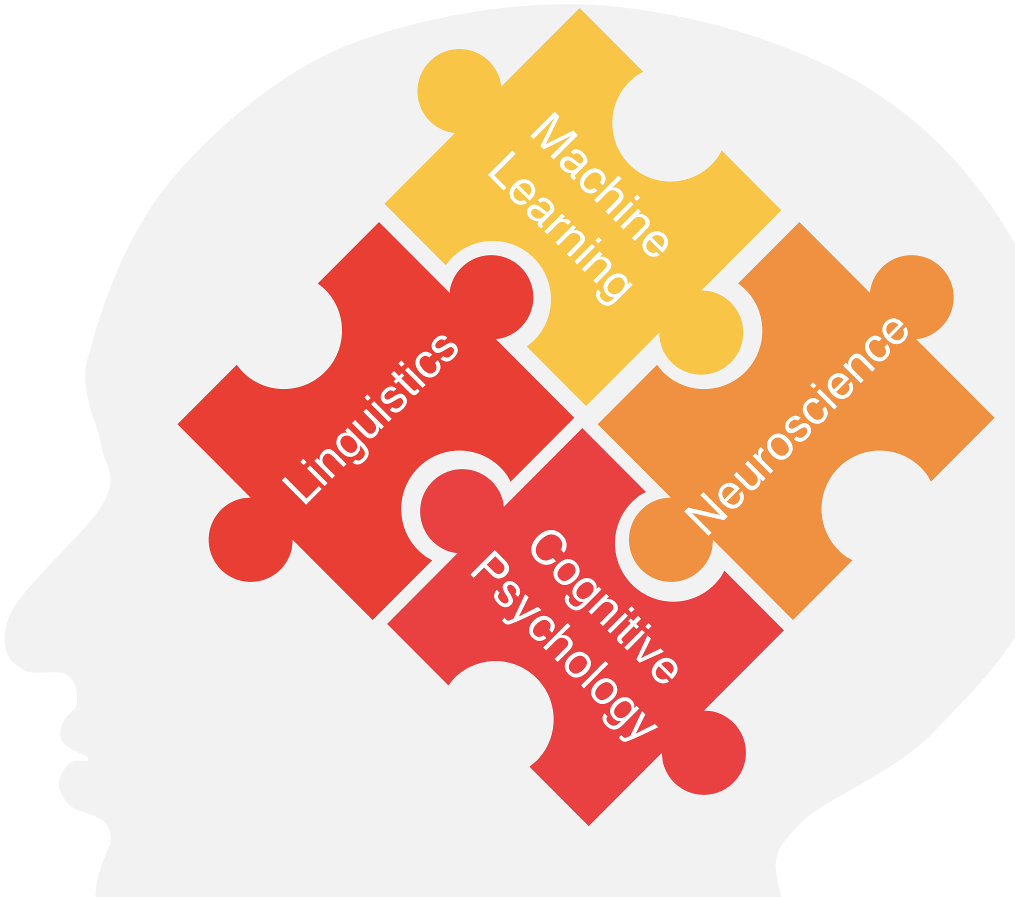

morpho-semantic analysis (200 to 400 ms)
left anterior temporal cortex
>> composing roots
left anterior temporal cortex
>> composing relational structures
orthographic and phonological analyses on radicals
LH insula cortex (~200 ms)
LH inferior parietal cortex (~200 ms)
feature level
LH fusiform gyrus (~170 ms)
number of orthographic features
RH fusiform gyrus (~170 ms)
decomposing characters into radicals
input
V1 regions (~100 ms)
physical level of visual stimuli

未來展望


從大腦活動解碼口語事件
構詞-文法介面
對詞彙學習之影響
整合訊號分析
與機械學習技術
建立創新的
心理詞彙理論
串連國際與在地社群

- 感謝聆聽！

～歡迎加入中央大學認知神經科學研究所～



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中央研究院
語言學研究所 大腦與語言實驗室

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