



# ***Neural Engineering Team Week.4***

***2022.11.04 6pm***

***Lee Seong Jin***

# 복습!!!

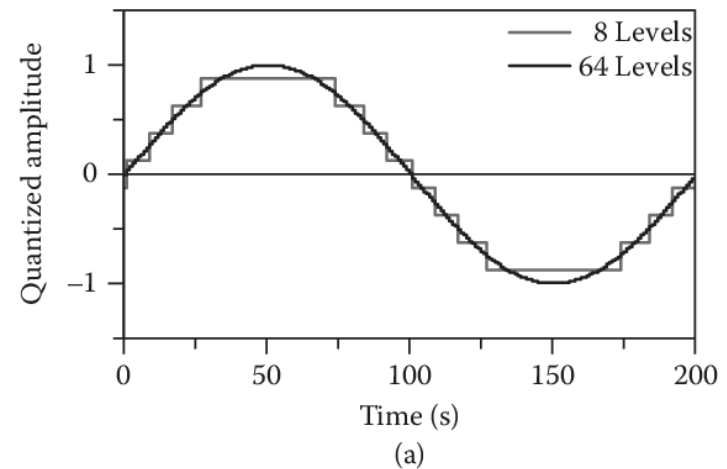
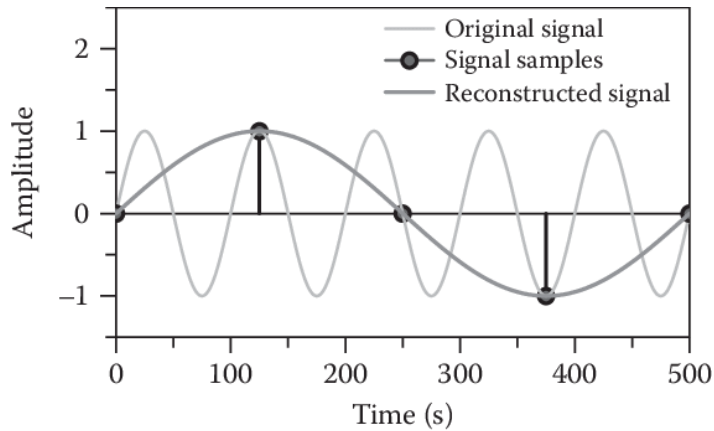
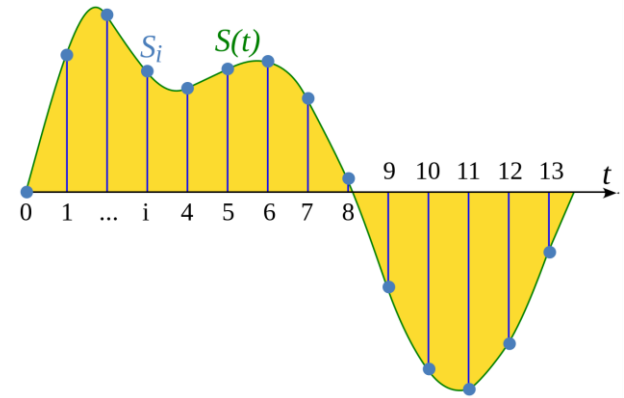
Analog signal



Sampling



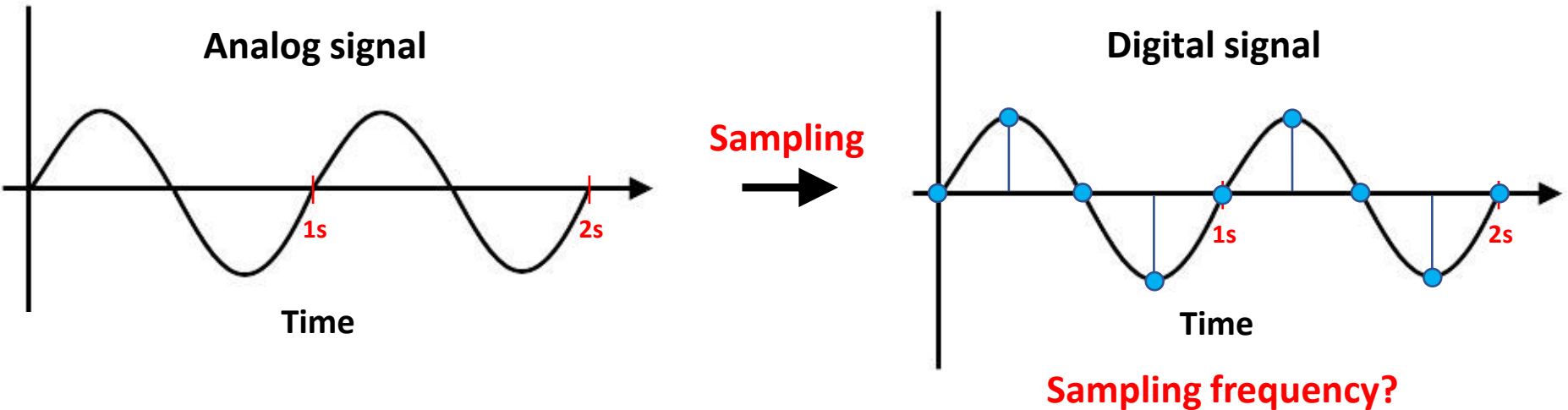
Digital signal



Sampling frequency : 1s를 몇 개의 point로 sampling 했냐?

# 복습!!!

- Sampling frequency : 1s를 몇 개의 point로 sampling 했냐?



21명의 피험자에게 3초간 'O' 20번, 'X' 80번을 보여주는 총 100번의 Event를 가함  
이 때 Sampling frequency는 200Hz 였고, 64개 채널(전극) 사용하여 EEG 기록

EEG의 shape은?

$21 \times 64 \times 300 \times 200$  : 피험자 수  $\times$  채널 수  $\times$  총 시간(s)  $\times$  Sampling frequency

↓

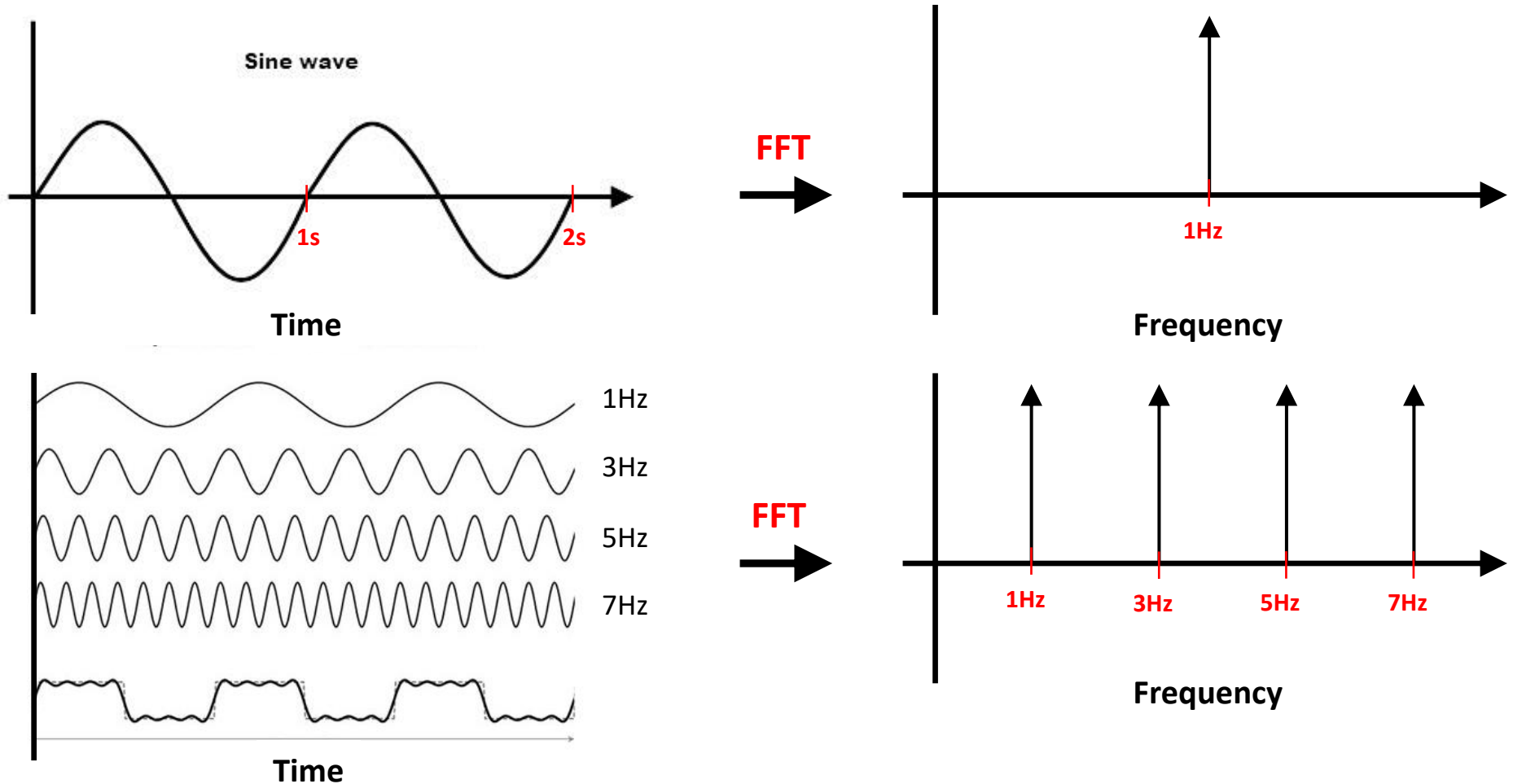
$21 \times 64 \times 100 \times 3 \times 200$  : 피험자 수  $\times$  채널 수  $\times$  Trial 수  $\times$  시간(s)  $\times$  Sampling frequency

↓

$21 \times 64 \times 60000$  : 피험자 수  $\times$  채널 수  $\times$  Trial 수  $\times$  Sampling point 수 (점의 개수)

# 복습!!!

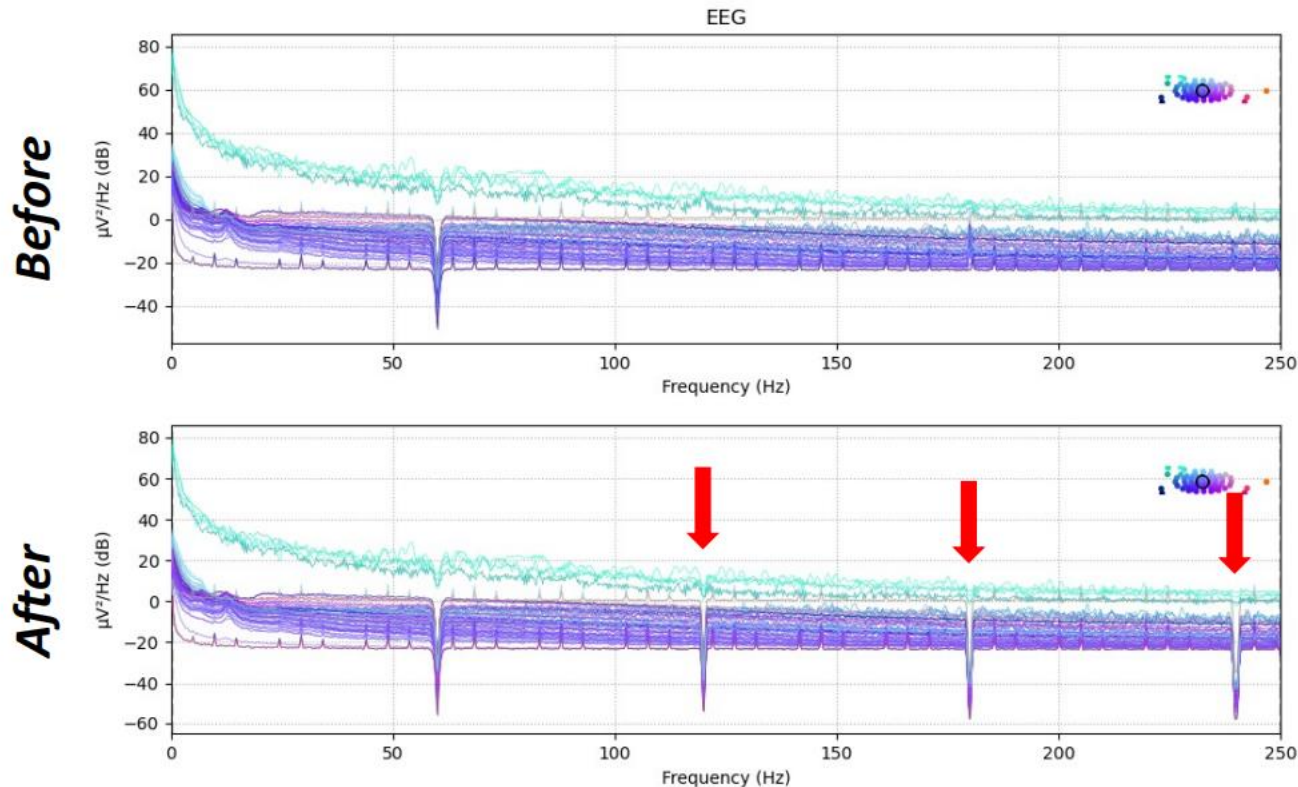
- 진동수(주파수 : Frequency) : 1s 동안 진동한 횟수
- 1s에 1번 왕복 운동 (진동) : 1Hz
- FFT (Fast Fourier Transform) : Signal을 Time domain에서 Frequency domain으로 변환



# 복습!!!

## <Filtering>

- Filtering : 필요로 하는 Signal을 제외한 불필요한 noise를 제거해주는 방법
- EEG의 경우 0.5Hz 이하, 100Hz 이상의 frequency 성분을 제거해주는 것이 일반적임  
→ Low-Pass Filtering, High-Pass Filtering
- 전원 노이즈(60Hz 성분) 또한 제거 → Notch Filtering (Band-Stop Filtering)

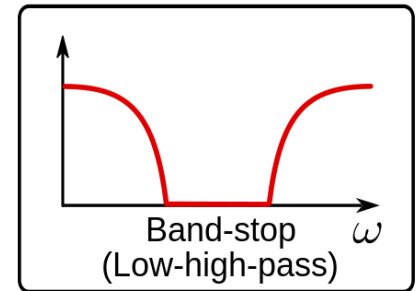
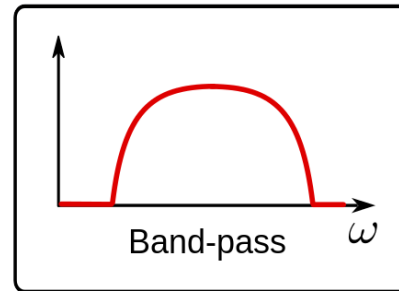
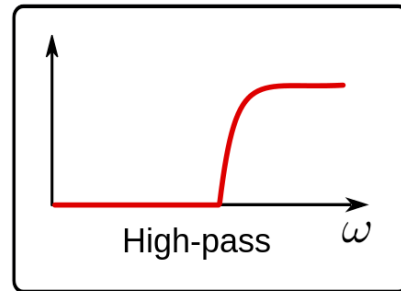
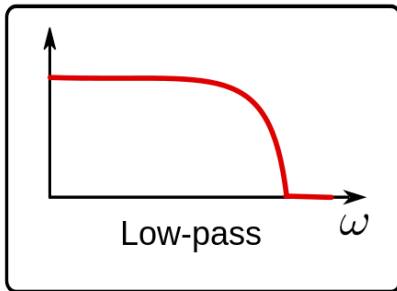




# 복습!!!

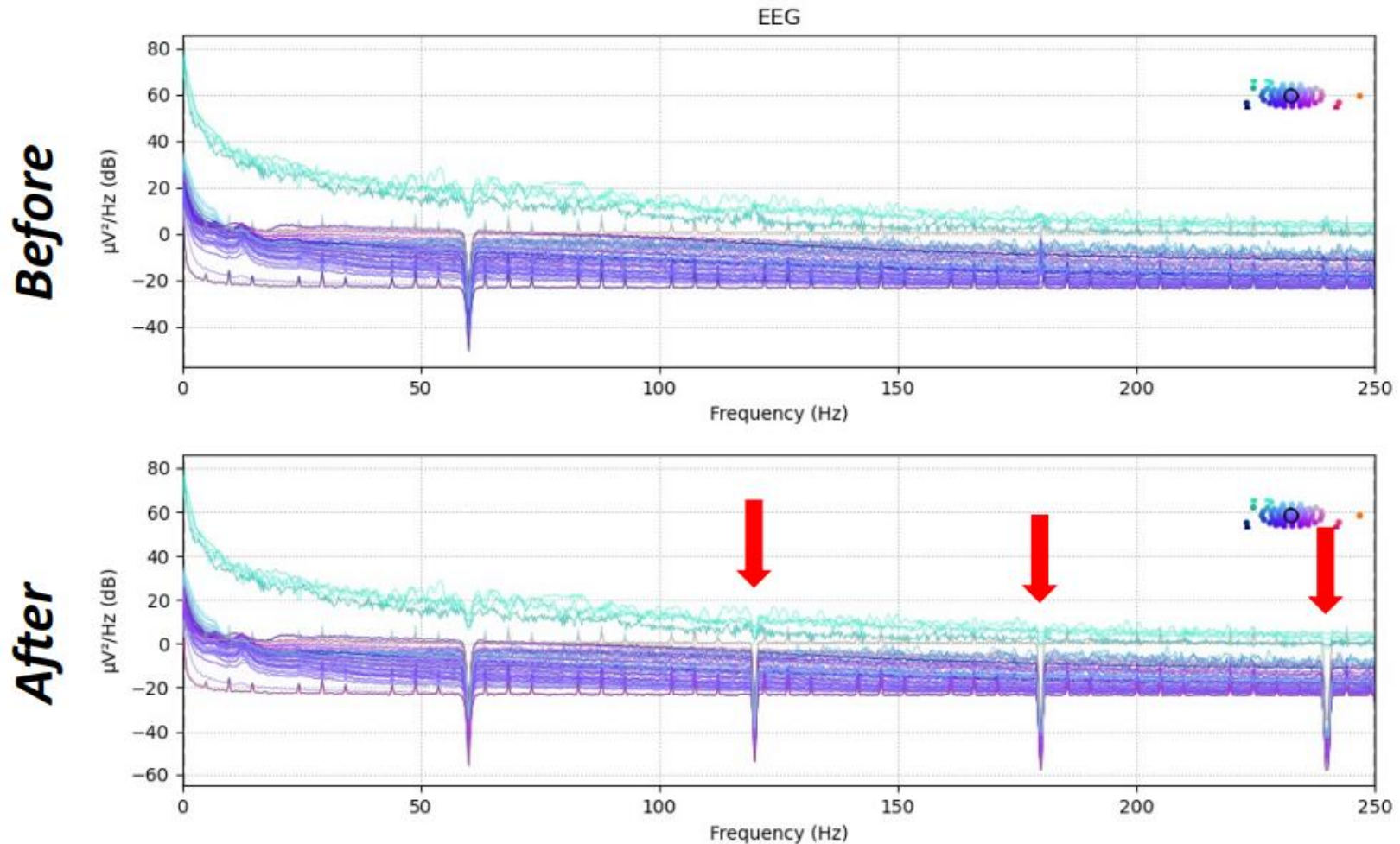
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➔ Low-Pass Filtering, High-Pass Filtering
- 전원 노이즈(60Hz 성분) 또한 제거 ➔ Notch Filtering (Band-Stop Filtering)



# 복습!!!

## Notch Filtering (Band-Stop)

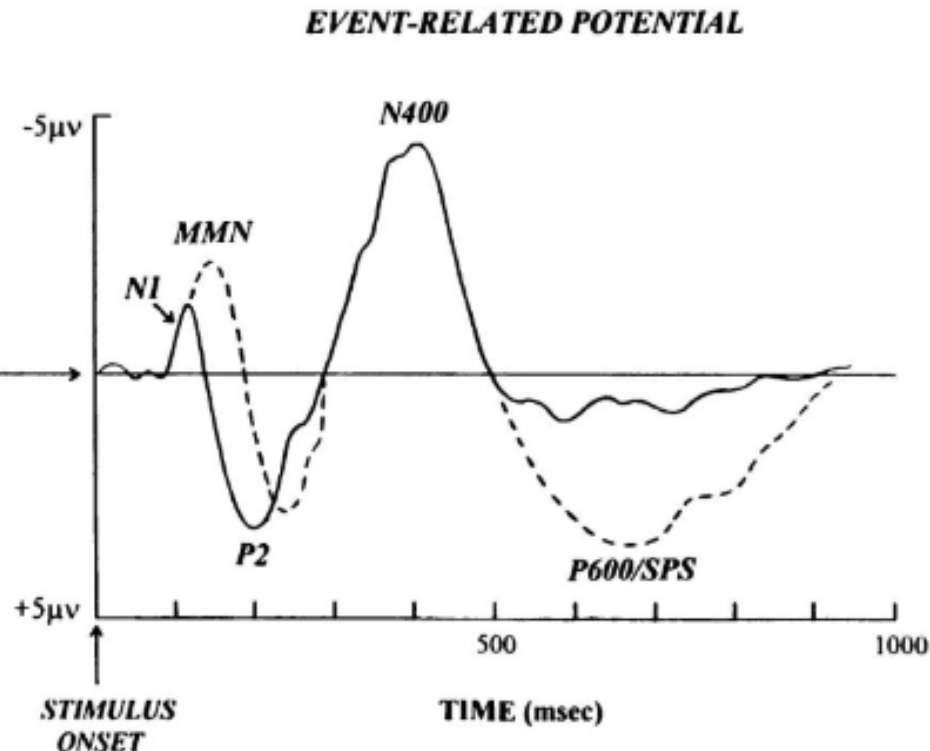


# 복습!!!

## ERP (Event Related Potential)

ERP(사건관련전위)

: 실험자가 피험자에게 가한 Event(자극)에 대해서 발생한 뇌파(EEG)



### Name

Positive peak voltage : P

Negative peak voltage : N

Sequence : P1, P2, P3... / N1, N2, N3...

Timing : P300, N170, N400 ...

### Waveform

① Peak voltage amplitude

② Latency

- Absolute latency

time interval between stimulus presentation and the point of maximal value (peak) of a defined component

- Relative latency (inter-peak latency)

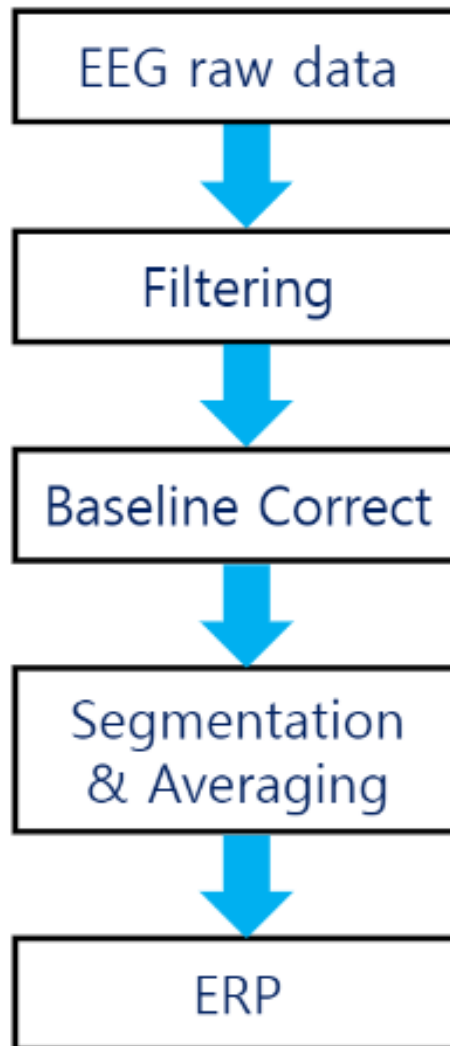
time interval between two components

③ Event code (=Trigger code)



**복습!!!**

## **Procedure of ERP acquisition**



# Data information

An 18-subject EEG data collection using a visual-oddball task, designed for benchmarking algorithms and headset performance comparisons

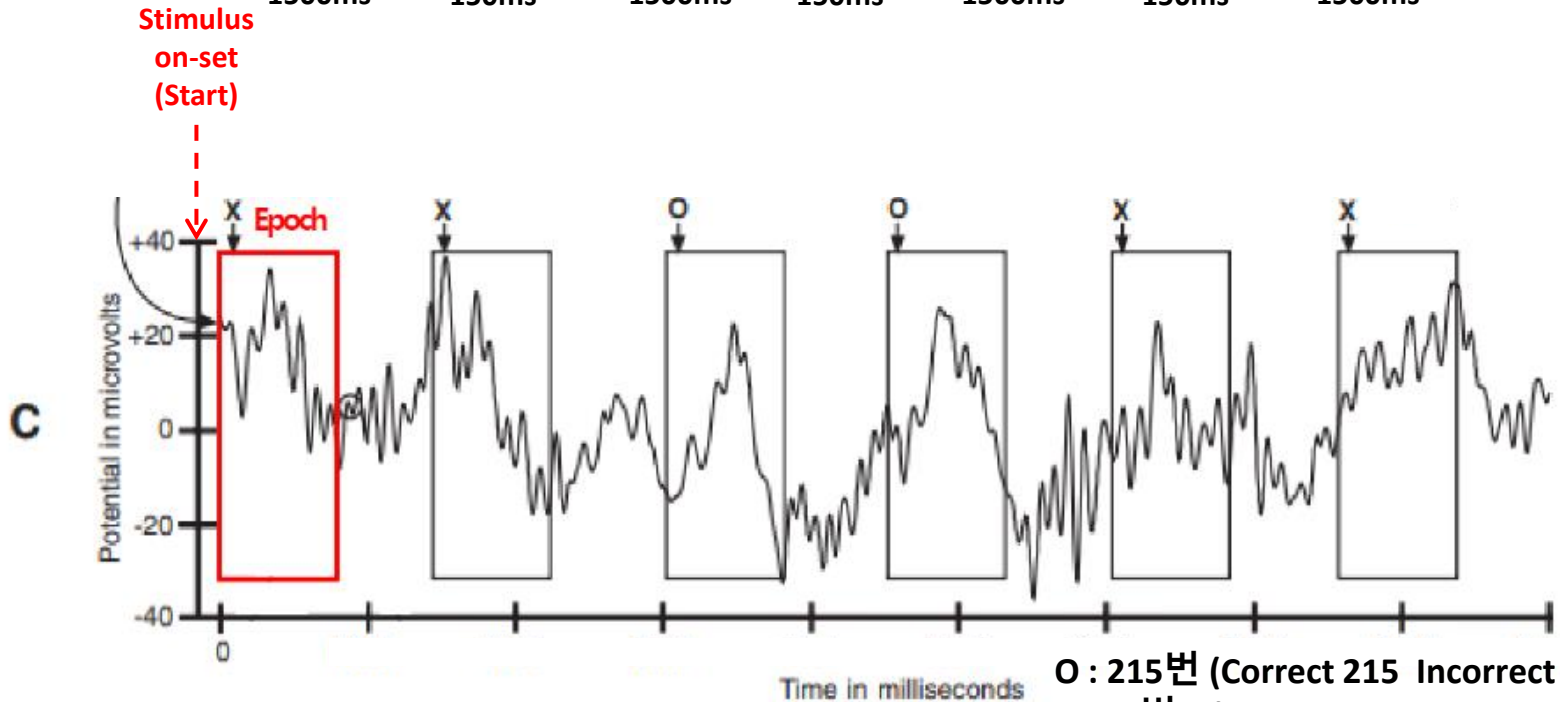
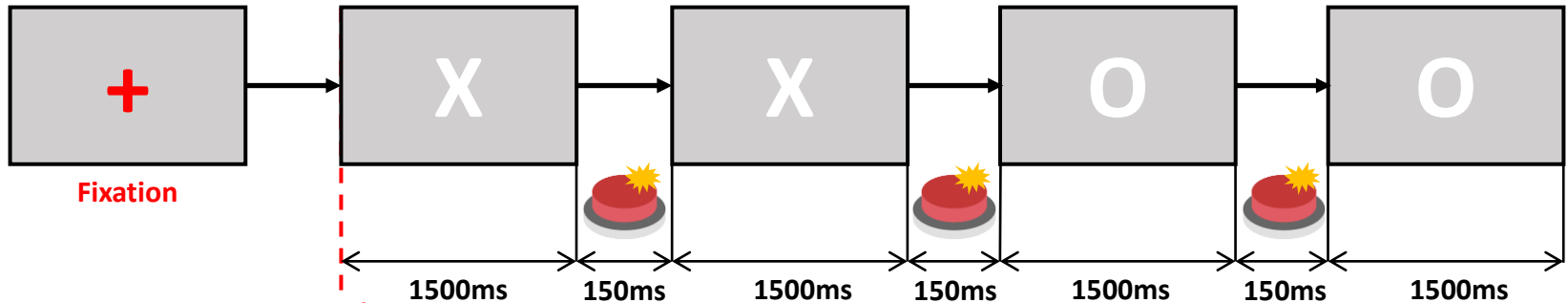
[Kay Robbins](#)<sup>a,\*</sup>, [Kyung-min Su](#)<sup>a</sup> and [W. David Hairston](#)<sup>b,\*</sup>

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- Type of data **EEG**
- Subjects **18**
- Sampling frequency **512Hz**
- Length **≅ 582s**
- Sampling points **297896** ( $512 \times 581.8281$ )
- Channels **64 (10-20 system)**
- Preprocessing **ICA - Artifacts Removing**  
**Filtering - 0.5Hz Low-pass, 50Hz High-pass**

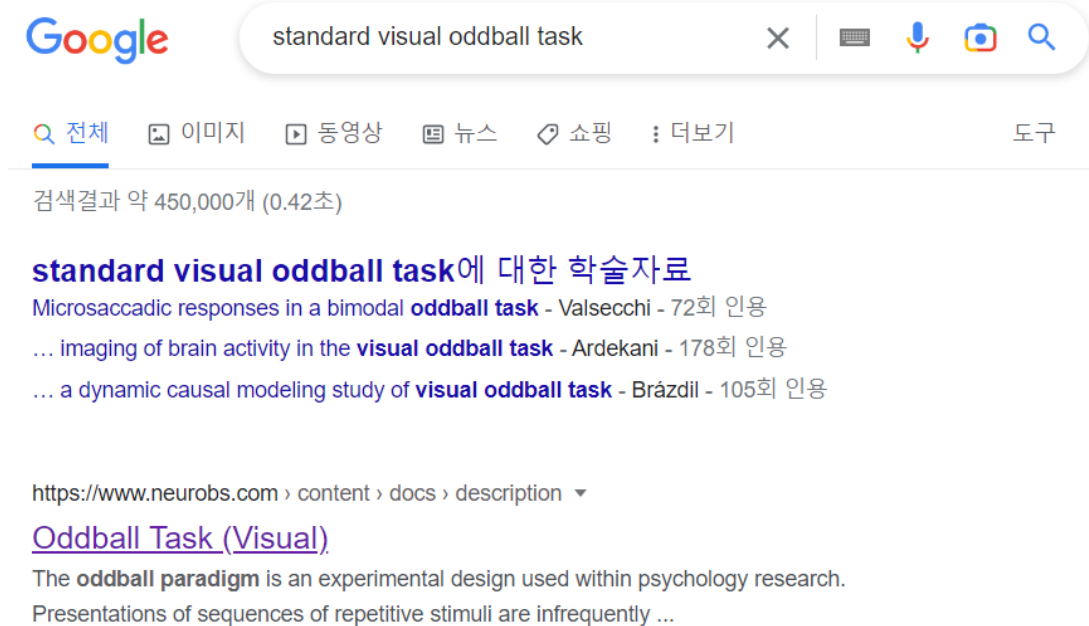
# Experiment

## <Standard Visual Oddball Task>



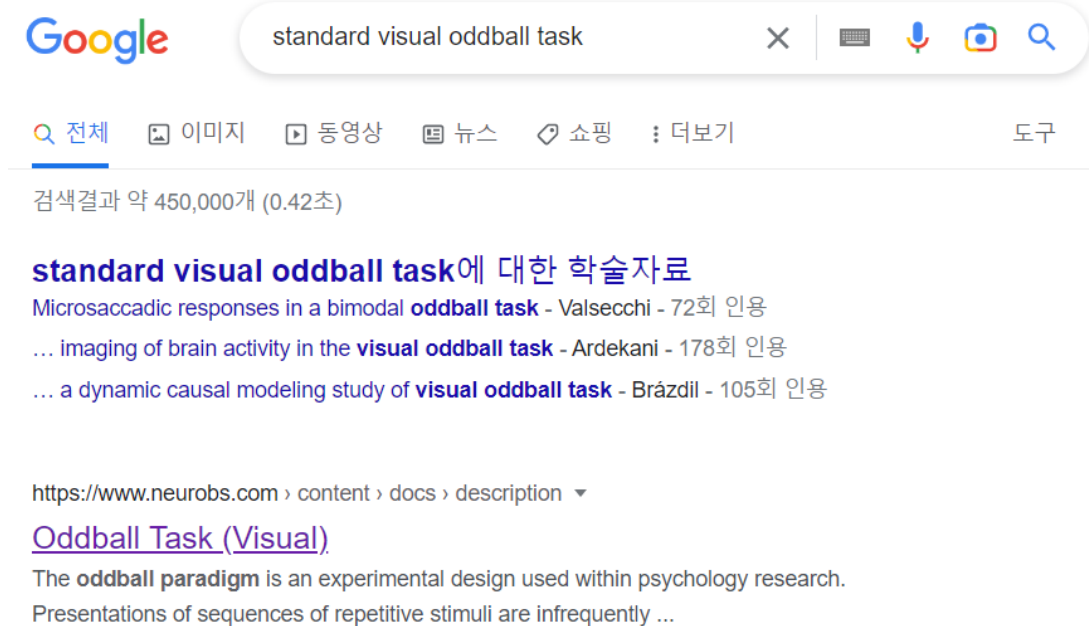
O : 215번 (Correct 215 Incorrect 0)  
X : 32번 (Correct 25 Incorrect 7)

# ERP components in Visual Oddball Task



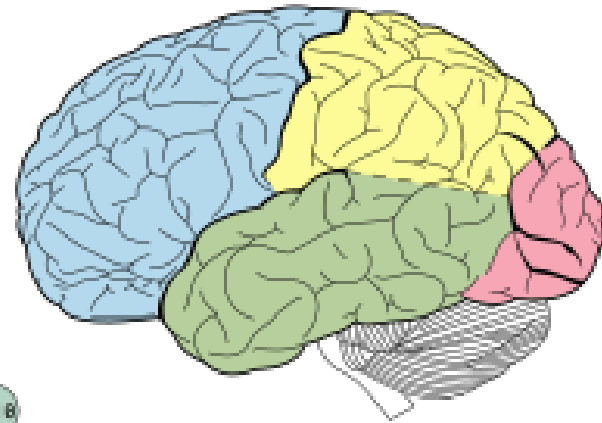
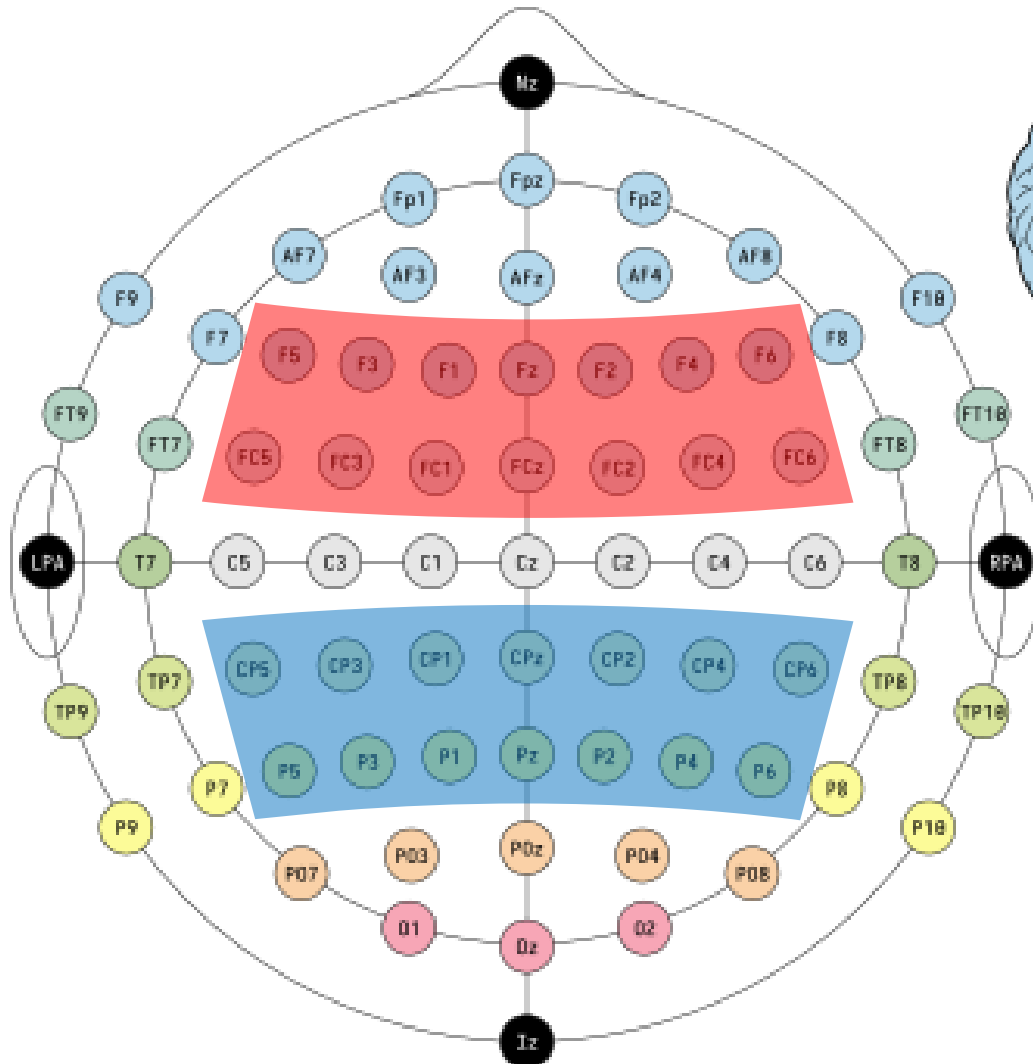
A fronto-central N2 component of ERP is primarily affected by perceptual novelty, whereas only the centro-parietal P3 component is modulated by both stimulus significance and novelty.

# ERP components in Visual Oddball Task



A **fronto-central N2 component of ERP** is primarily affected by perceptual novelty, whereas only the **centro-parietal P3 component** is modulated by both stimulus significance and novelty.

# EEG channel (electrode)



**Fronto-Central ??**

**Centro-Parietal ??**

F : Frontal 정면 (전두엽)

C : Central 중앙

P : Parietal 두정 (두정엽)

O : Occipital 후면 (후두엽)

T : Temporal 측면 (측두엽)

Z : Midline 중앙선

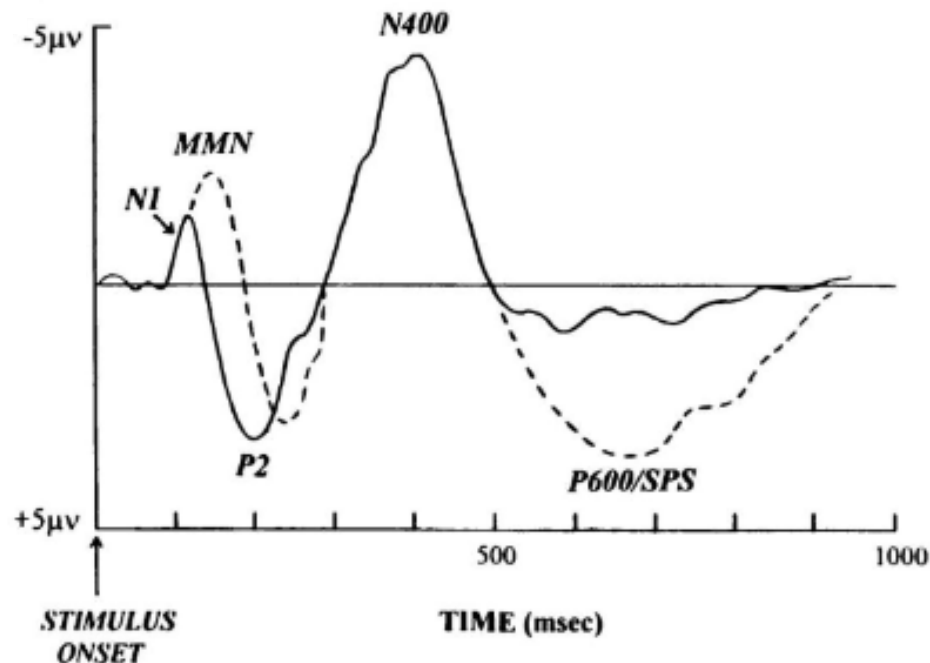


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: 실험자가 피험자에게 가한 Event(자극)에 대해서 발생한 뇌파(EEG)

*EVENT-RELATED POTENTIAL*



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## Waveform

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time interval between two components

③ Event code (=Trigger code)

# MATLAB 실습

