

# Week 6 – First-level fMRI data analysis

L06-03. Overview of model building

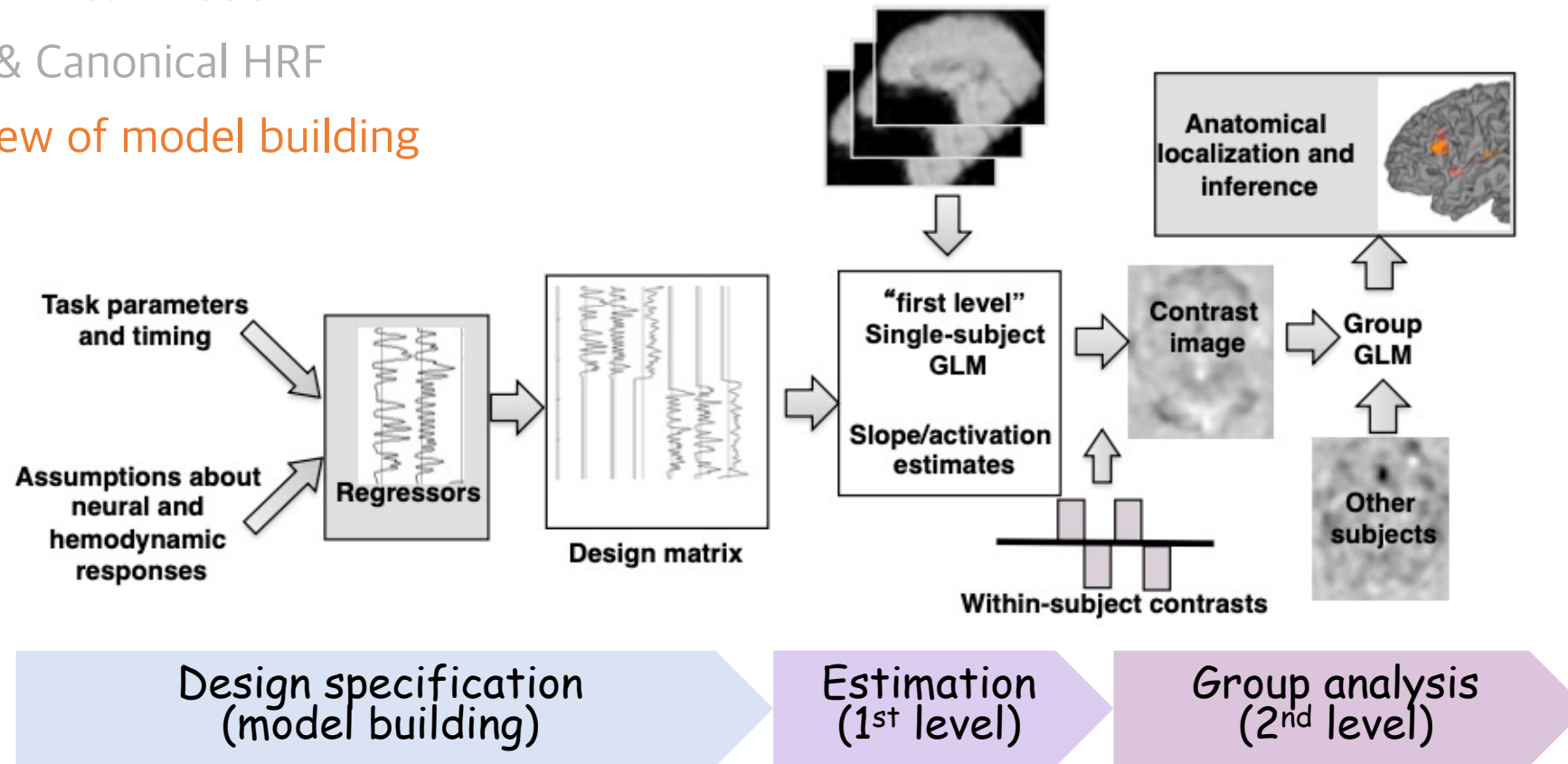
**Byeol, Hongji, and Jungwoo**

2 April 2021



### 3. Overview of model building

- General linear model
- BOLD & Canonical HRF
- Overview of model building

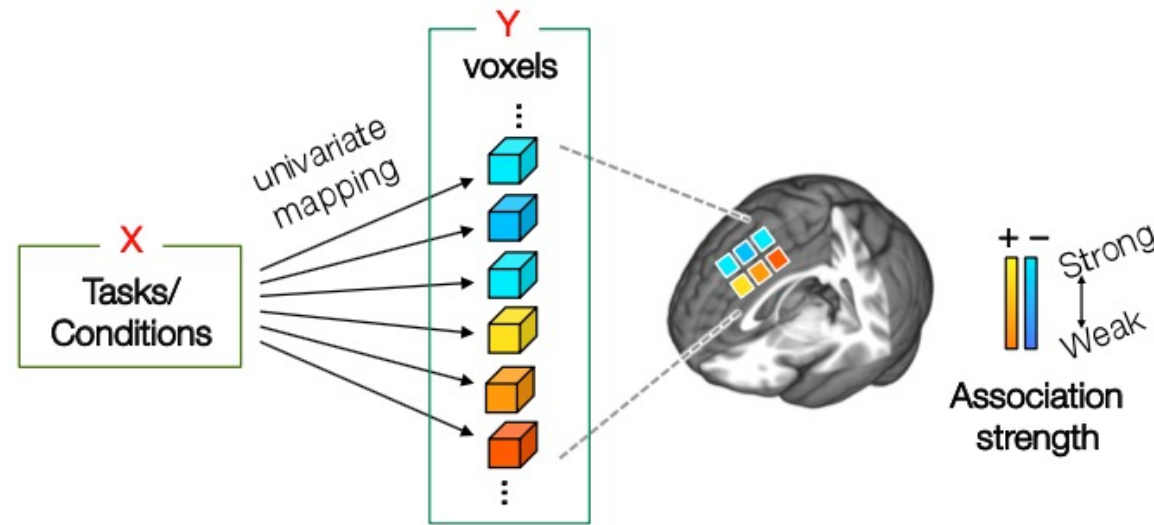


Contents credit: Tor Wager



### 3. Model building - Mass Univariate Approach

- Typically analysis is performed by constructing a separate model for each voxel
  - Brain activity in one voxel is the outcome (Y)
  - Stimulus, task, and/or behavioral variables are the predictors (X)
  - ‘Mass univariate approach’: Assumes voxels are independent, each its own separate test



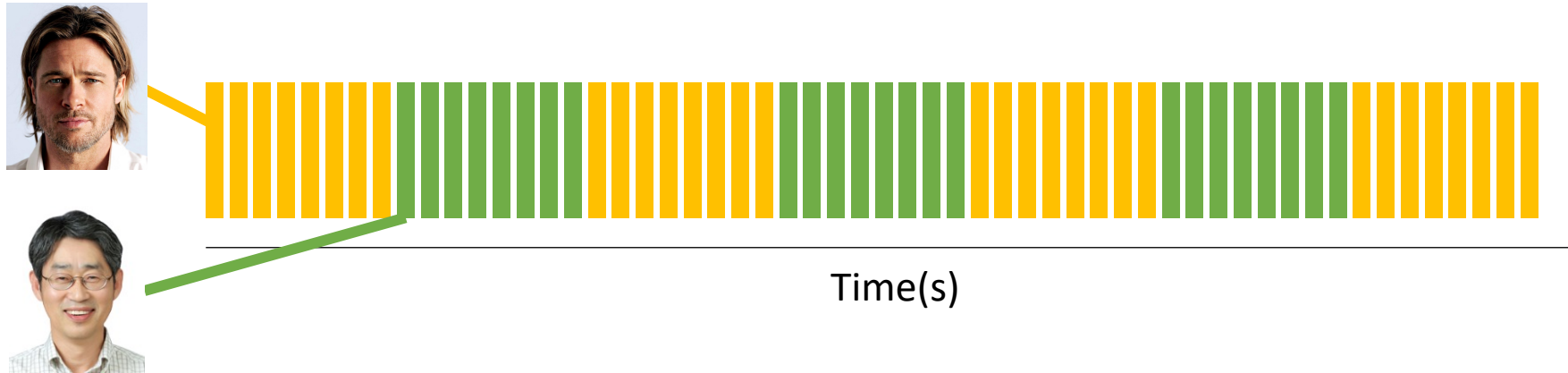
Woo & Wager 2015; Image credit: Wani Woo

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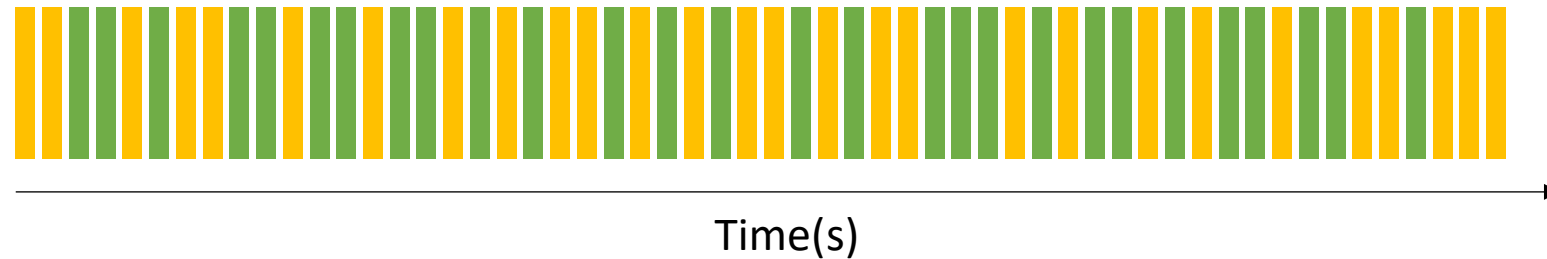


### 3. Model building - Experimental design

- Block design: Similar events are grouped or stimulation is sustained



- Event-related design: Brief events of different types are intermixed



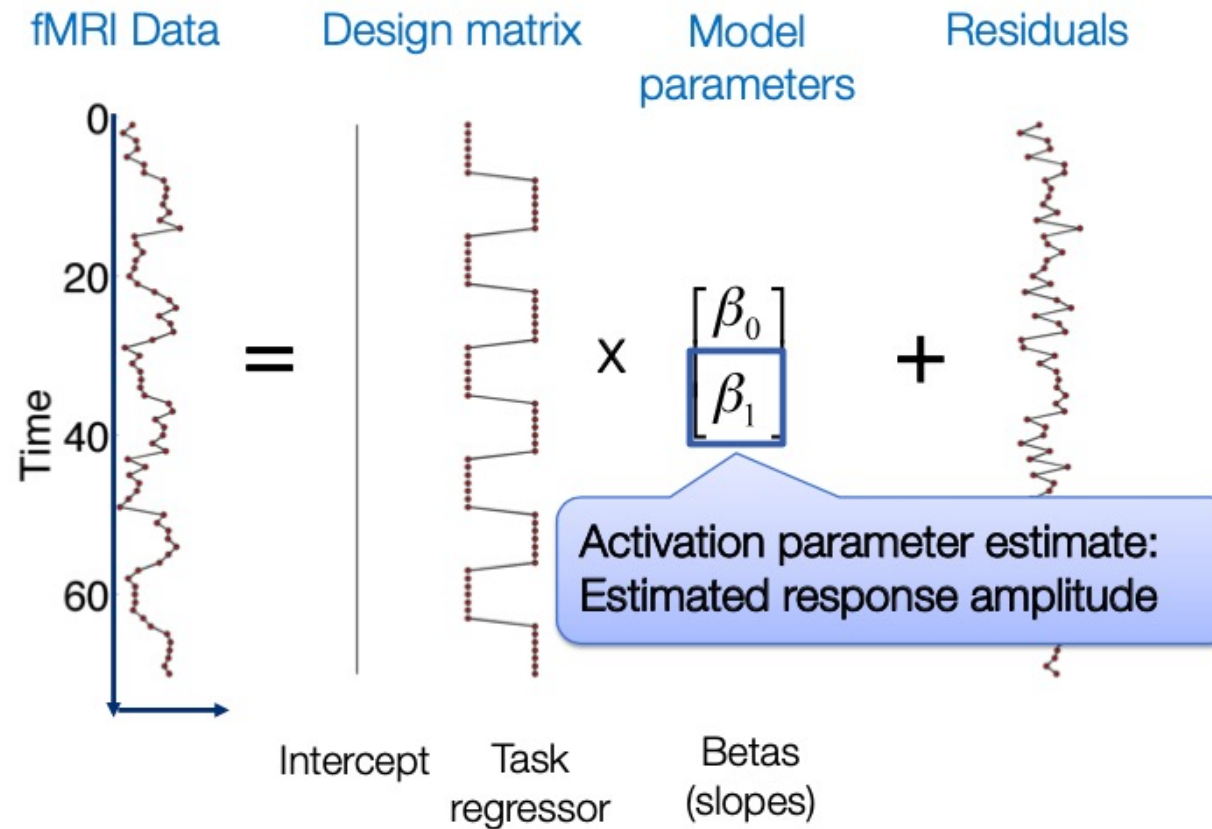
### 3. Model building - A basic design matrix

- Block design: one predictor (regressor) of interest (e.g., Task - Control, Famous vs. Non-famous)

Observed data Outcome data

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} = \begin{bmatrix} 1 & X_{11} & \dots & X_{1p} \\ 1 & X_{21} & \dots & X_{2p} \\ \vdots & \vdots & & \vdots \\ 1 & X_{n1} & \dots & X_{np} \end{bmatrix} \times \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_p \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_n \end{bmatrix}$$

Design matrix Model parameters Residuals

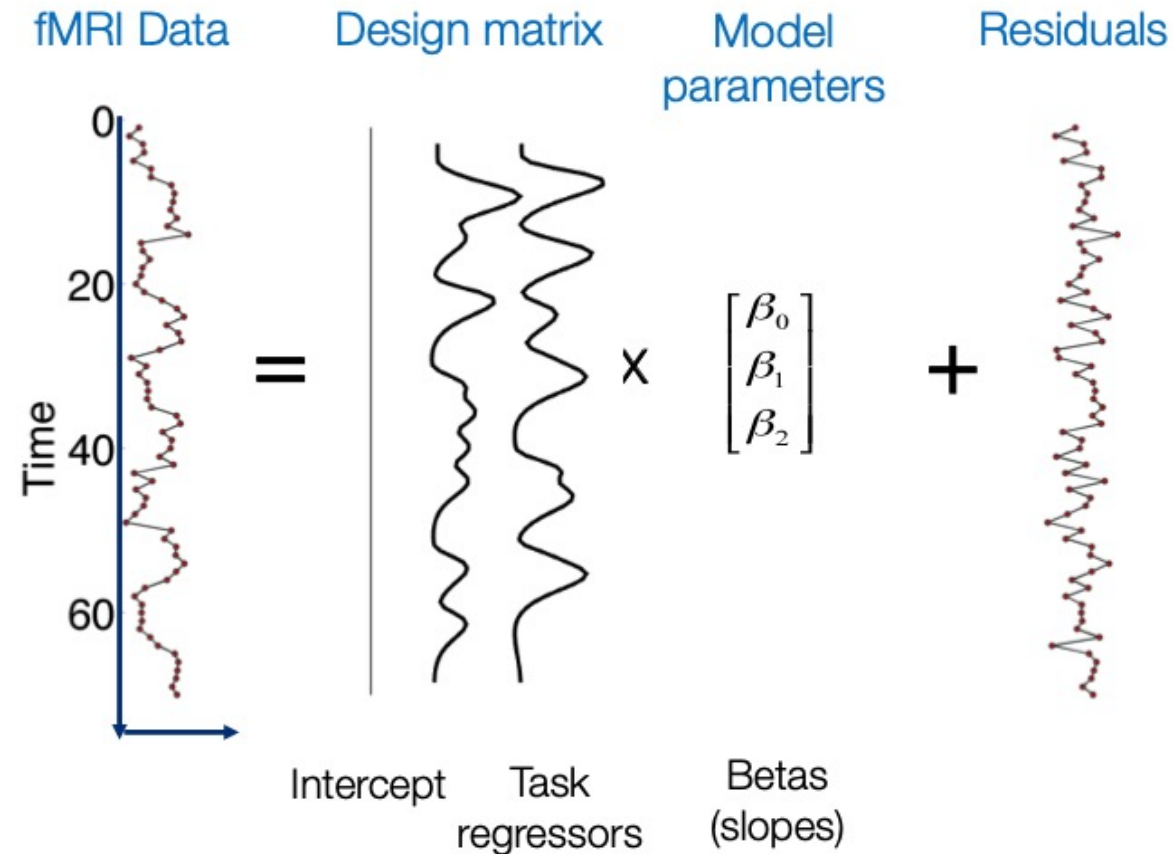


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### 3. Model building - A basic design matrix

- Event-related design: two predictors (e.g., Famous and Non-famous)

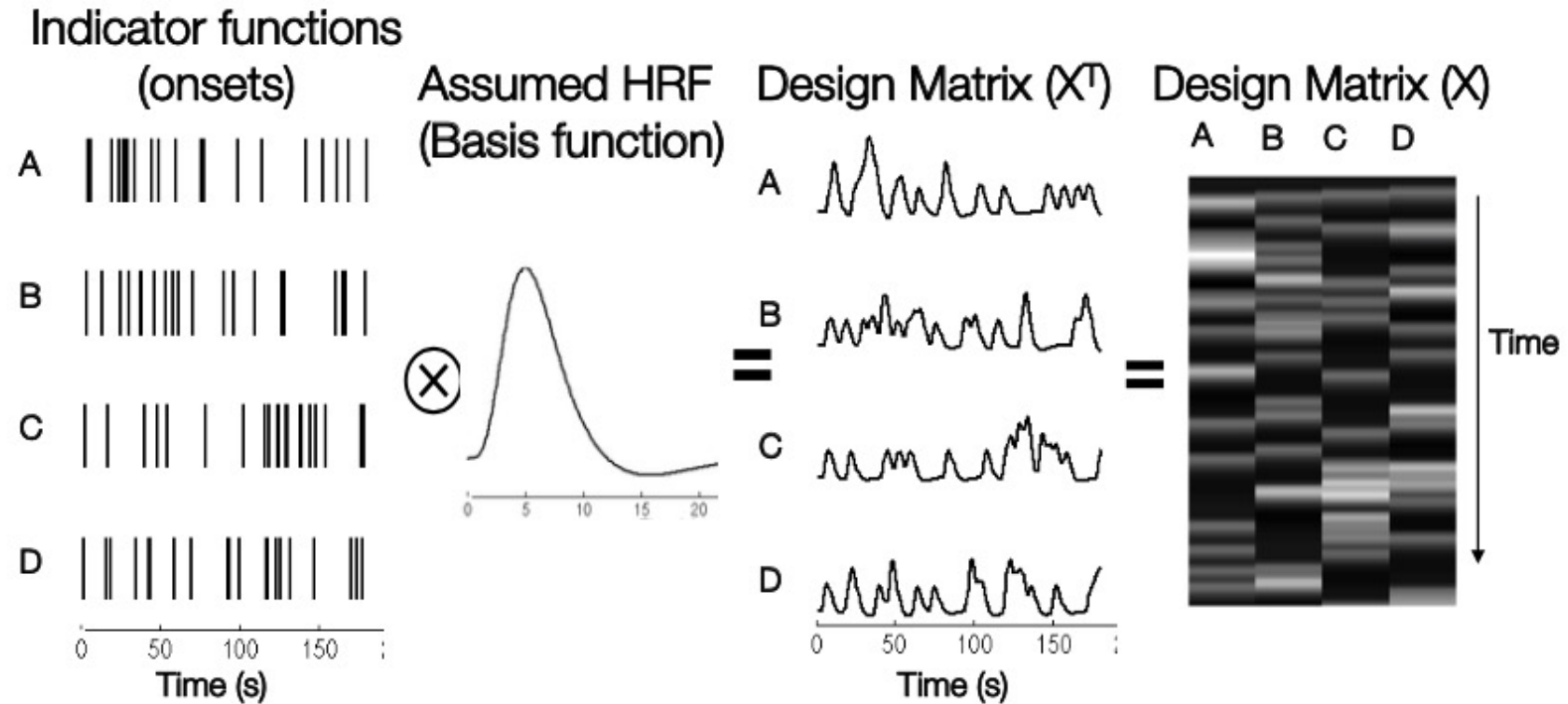


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### 3. Model building - with multiple predictors

- Single subject, single voxel



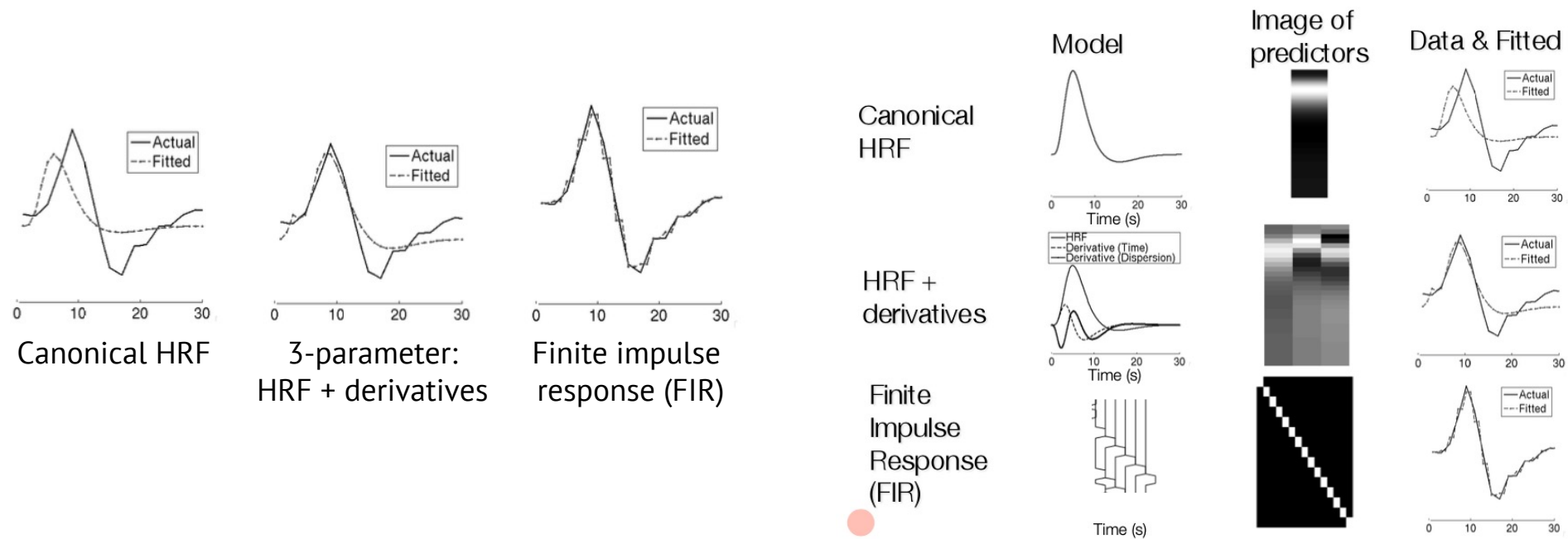
- SPM and general model  
This is how we make the single-trial model

Contents credit: Tor Wager



### 3. Model building - Temporal Basis Functions

- Often a fixed canonical HRF is used to model the response to neuronal activity
- To allow for different types of HRFs in different brain regions, use **temporal basis functions**. (>> following videos)

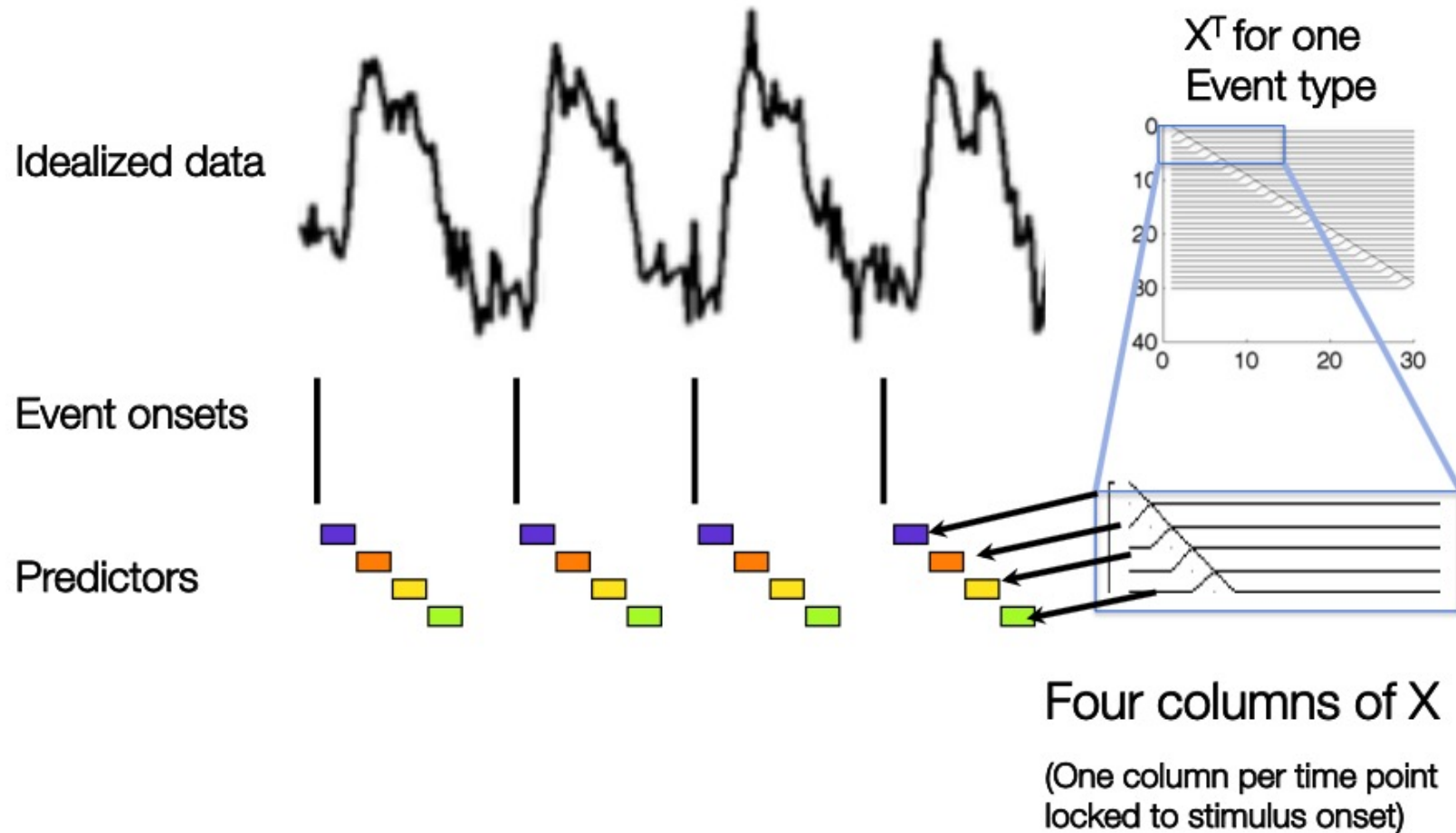


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### 3. Model building - Finite impulse response model

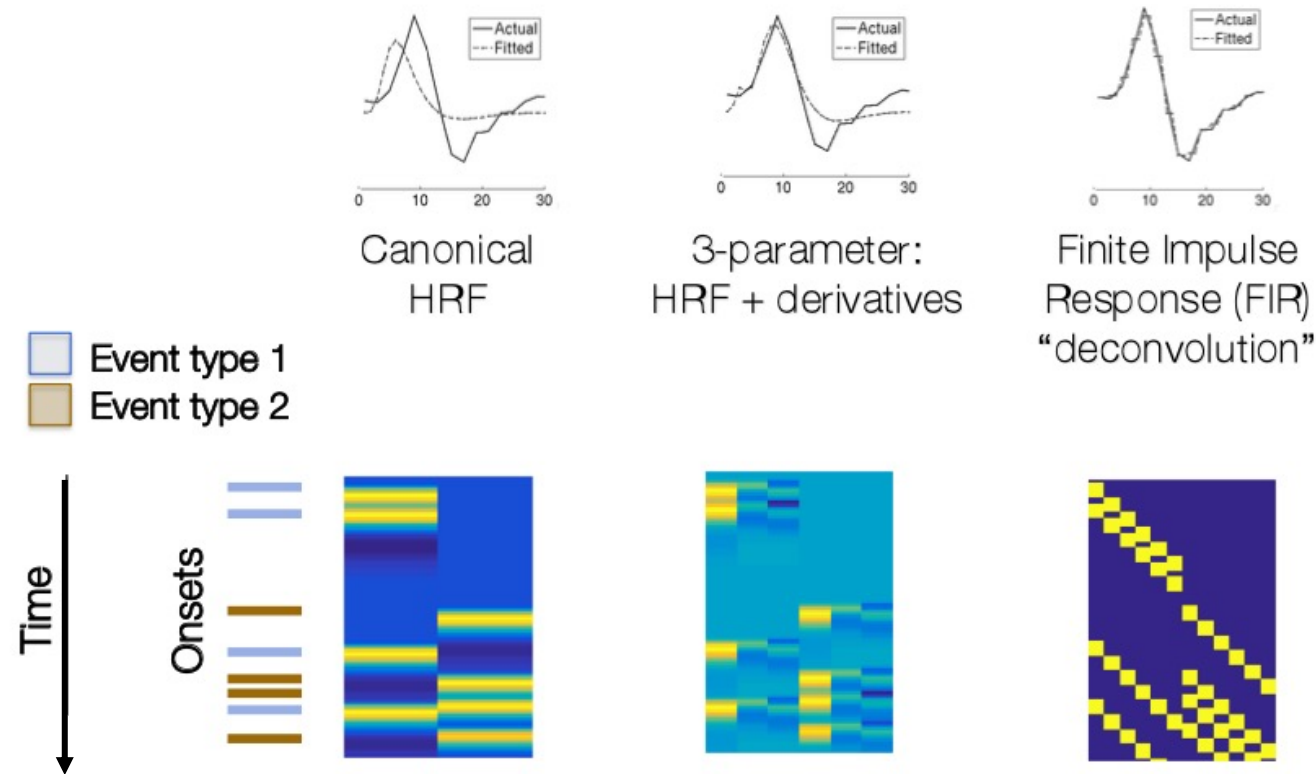


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### 3. Model building - Basis sets

- Design matrix has one predictor per event type (condition) per basis function

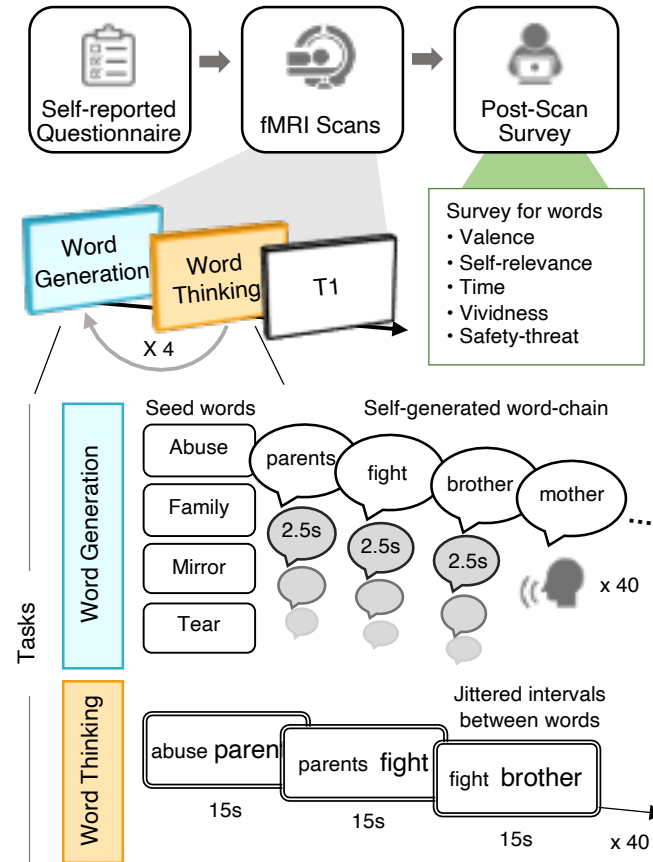


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### 3. Model building - FAST projects

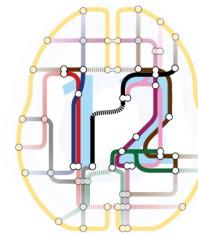
- Free Association Semantic Task (FAST)



- Single subject has 40 trials (15 secs) X 4 runs
- Three types of events during word thinking
    - View, emotion selection, concentration

With SPM

- Single-trial model (Canonical HRF)
- FIR model



### 3. Model building - FAST projects

See the COCOAN101 notion page for the next videos that are single-trial model and FIR model.

## Week 6

First-level fMRI data analysis

- First-level analysis (GLM),  
Single-trial model,  
FIR model - 별
- custom regressor - 홍지
- HRF modeling (derivative, etc.) - 정우



# Cocoan 101

<https://cocoanlab.github.io>

