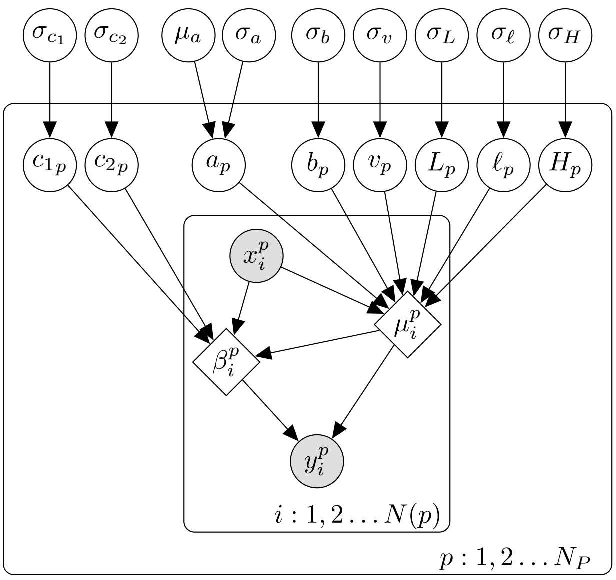
The simplest form of the standard 3−stage hierarchical model in the context of MEP size modeling can be described as follows. Let there be N_P exchangeable sequences $\{(x_i^p, y_i^p)_{i=1}^{n(p)} \mid j = 1, 2 \ldots N_P\}$ of MEP size $y_i^p \in \mathbb{R}^+$ recorded at stimulation intensity $x_i^p \in \mathbb{R}_0^+$ from p^{th} participant, for a total of N_P participants.

The first stage of hierarchy is the *participant-level* and specifies parametric model $P(y_i^p \mid x_i^p, \theta_p)$ for each of the N_P sequences and models the MEP size y_i^p as a function of stimulus intensity x_i^p and participant-specific parameters θ_p. In the second stage, $\theta_1, \theta_2 \ldots \theta_P$ are assumed to be exchangeable and generated from a common distribution $\mathrm{P}(\theta_p \mid \gamma)$ with hyper-parameters γ. In the third stage, the hyper-parameters γ are assumed to be unknown and are assigned a non-informative prior, also called hyperprior, density $P(\gamma)$.

$$y_i^p \mid x_i^p, \theta_p, \gamma \sim P(y_i^p \mid x_i^p, \theta_p, \gamma) \tag{4.3.1}$$
$$\theta_p \mid \gamma \sim P(\theta_p \mid \gamma) \tag{4.3.2}$$
$$\gamma \sim P(\gamma) \tag{4.3.3}$$

Figure 4.3.1 shows the graphical representation of the basic hierarchical model implemented by hbmep (Section 5.1) for recruitment-curve fitting



$$y_i^p \mid x_i^p, \Omega_1^p \sim \mathcal{G}\left(\mu_i^p \cdot \beta_i^p, \beta_i^p\right)$$
$$\mu_i^p = \mathcal{F}\left(x_i^p \mid \Omega_1^p\right) \quad \beta_i^p = c_{1p} + \frac{\mu_i^p}{c_{2p}}$$

$$a_p \sim \mathcal{TN}\left(\mu_a, \sigma_a\right)$$
$$\theta_p \sim \mathcal{HN}\left(\sigma_{\theta_p}\right) \ \forall \theta_p \in \Omega_1^p \setminus \{a_p\}$$

$$\mu_a \sim \mathcal{TN}\left(50, 20\right) \quad \sigma_a \sim \mathcal{HN}\left(30\right)$$
$$\sigma_{\sigma_L} \sim \mathcal{HN}\left(.05\right) \quad \sigma_\theta \sim \mathcal{HN}\left(5\right) \ \forall \theta \in \Omega_2$$

$$\Omega_1^p = \{a_p, b_p, v_p, L_p, \ell_p, H_p, c_{1p}, c_{2p}\}$$
$$\Omega_2 = \{\sigma_L, \sigma_H, \sigma_v, \sigma_\ell, \sigma_{c_1}, \sigma_{c_2}\}$$