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 exchangle sequences $\{(x_i^j, y_i^j)_{i=1}^{n_j} \mid j = 1, 2 \dots N_P\}$ of MEP size y_i^j recorded at stimulus intensity x_i^j from j^{th} participant, for a total of N_P participants.

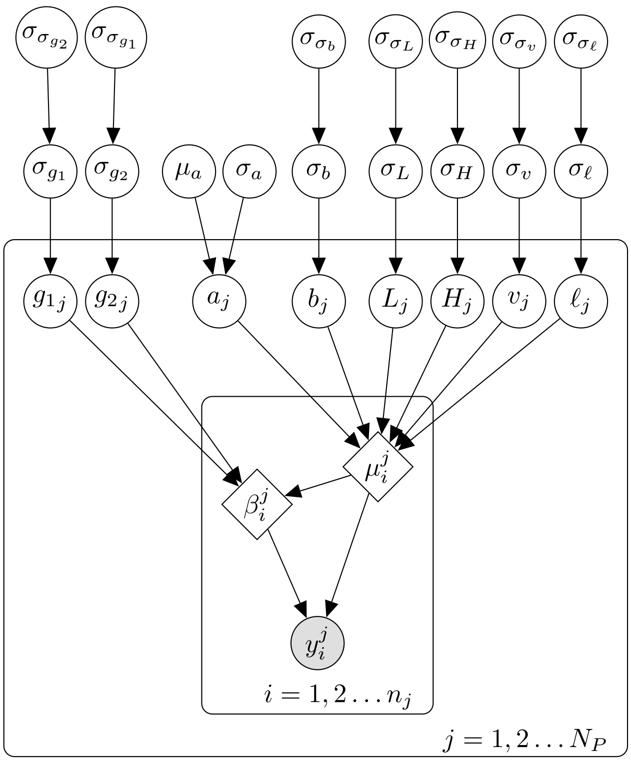
The first stage of hierarchy is the *participant-level* and specifies parametric model $P(y_i^j \mid x_i^j, \theta_j)$ for each of the N_P sequences and models the MEP size y_i^j as a function of stimulus intensity x_i^j and participant specific parameters θ_j. In the second stage, $\theta_1, \theta_2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

$$y_i^j \mid x_i^j, \theta_j, \gamma \sim P(y_i^j \mid x_i^j, \theta_j, \gamma) \tag{4.3.1}$$

$$\theta_j \mid \gamma \sim P(\theta_j \mid \gamma) \tag{4.3.2}$$

$$\gamma \sim P(\gamma) \tag{4.3.3}$$

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



$$y_i^j \mid x_i^j, \Omega_0^j \sim \mathcal{G}\left(\mu_i^j \cdot \beta_i^j, \beta_i^j\right)$$

$$\mu_i^j = \mathbb{E}\left(y_i^j \mid x_i^j, \Omega_0^j\right) = \mathcal{F}\left(x_i^j \mid \Omega_0^j\right)$$

$$\beta_i^j = g_{1_j} + \frac{\mu_i^j}{g_{2_j}}$$

$$a_j \sim \mathcal{TN}\left(\mu_a, \sigma_a\right) \quad \theta \sim \mathcal{HN}\left(\sigma_\theta\right) \ \forall \theta \in \Omega_1$$

$$\theta \sim \mathcal{HN}\left(\sigma_\theta\right) \ \forall \theta \in \Omega_2$$

$$\mu_a \sim \mathcal{TN}\left(50, 20\right) \quad \sigma_a \sim \mathcal{HN}\left(30\right)$$

$$\sigma_{\sigma_L} \sim \mathcal{HN}\left(.05\right) \quad \sigma_\theta \sim \mathcal{HN}\left(5\right) \ \forall \theta \in \Omega_2 \setminus \{b\}$$

$$\Omega_1 = \{b, v, L, \ell, H\} \quad \Omega_2 = \{\sigma_b, \sigma_v, \sigma_L, \sigma_\ell, \sigma_H\}$$

There are few key details here. Firstly, in (3.2.2), we model the expected observed MEP size as a rectified-logistic function of stimulation intensity. Secondly, the nuisance parameter of the Gamma distribution is a linear combination of this expected value, which allows for capturing how the spread changes with respect to MEP size. This results in narrower credible intervals for the threshold estimates.