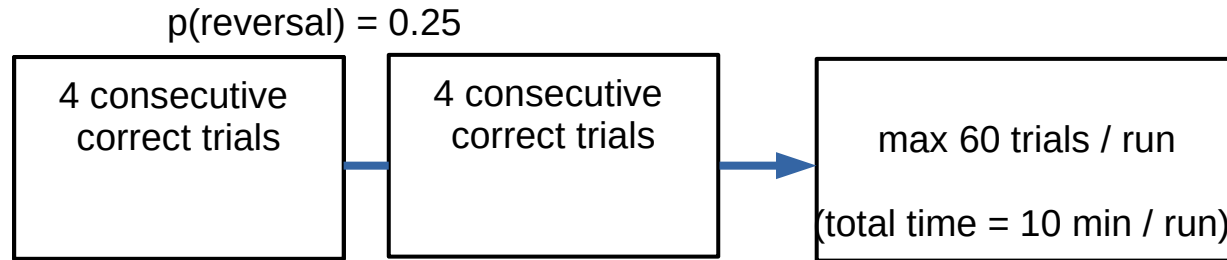
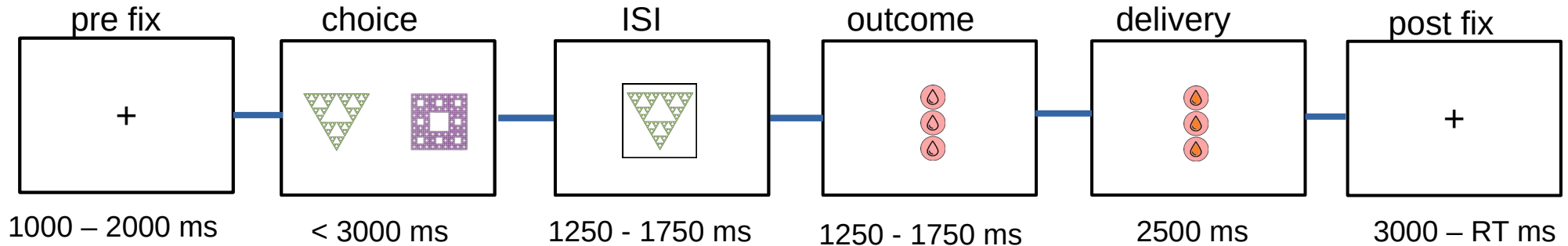


Modelling beliefs in reversal learning

Task review



$$p(\text{win})_1 = 0.65$$

$$p(\text{win})_2 = 0.35$$

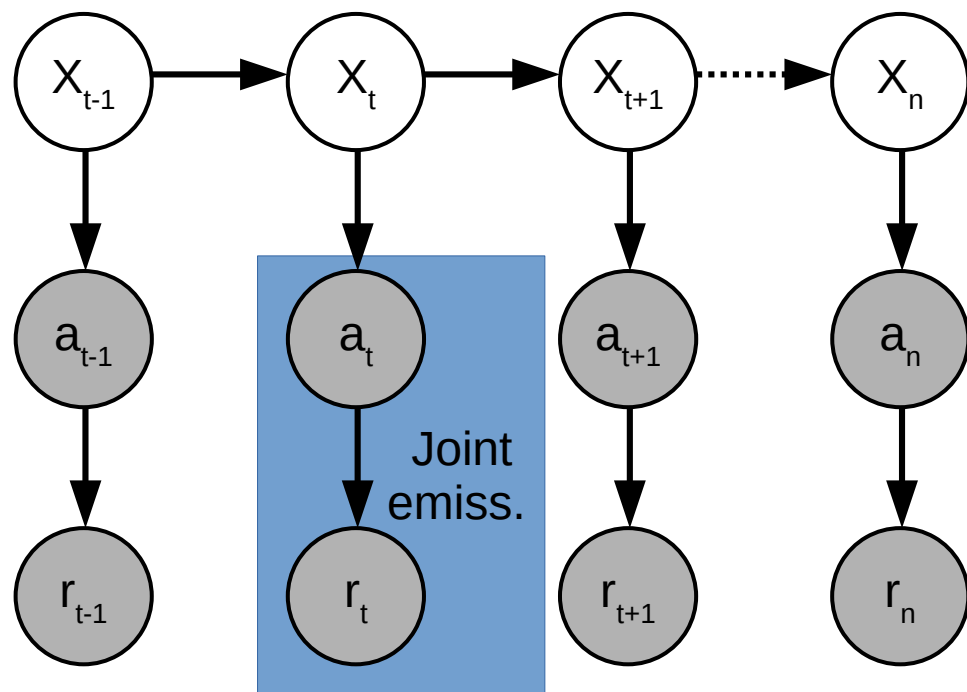
$$p(\text{win})_1 = 0.35$$

$$p(\text{win})_2 = 0.65$$

10min: Win magnitudes = Loss magnitudes = [\$0.25, \$0.50, \$0.75]

6-day: Win magnitudes = [\$0.10, \$0.20, \$0.30], Loss = 0

Joint Emission HMM



$$Q_t(\text{chosen}) = \sum_{x_t} \sum_{R_t} R \cdot p(r|a_t = \text{chosen}, x_t) p(a_t = \text{chosen}|x_t) p(x_{t-1})$$

$$Q_t(\text{unchosen}) = \sum_{x_t} \sum_{R_t} R \cdot p(r|a_t = \text{unchosen}, x_t) p(a_t = \text{unchosen}|x_t) p(x_{t-1})$$

$$EV_t = \sum_{a_t} Q_t(a_t)$$

$X = \{opt_0 \text{ high}, opt_1 \text{ high}\}$
 $R = \{0, 1\}$
 $A = \{opt_0 \text{ selected}, opt_1 \text{ selected}\}$

Vocab

$$p(x_t|x_{t-1}) = \begin{bmatrix} 1-\delta & \delta \\ \delta & 1-\delta \end{bmatrix}$$

Transition

$$p(r_t, a_t|x_t) = p(r_t|a_t, x_t) p(a_t|x_t)$$

Emission

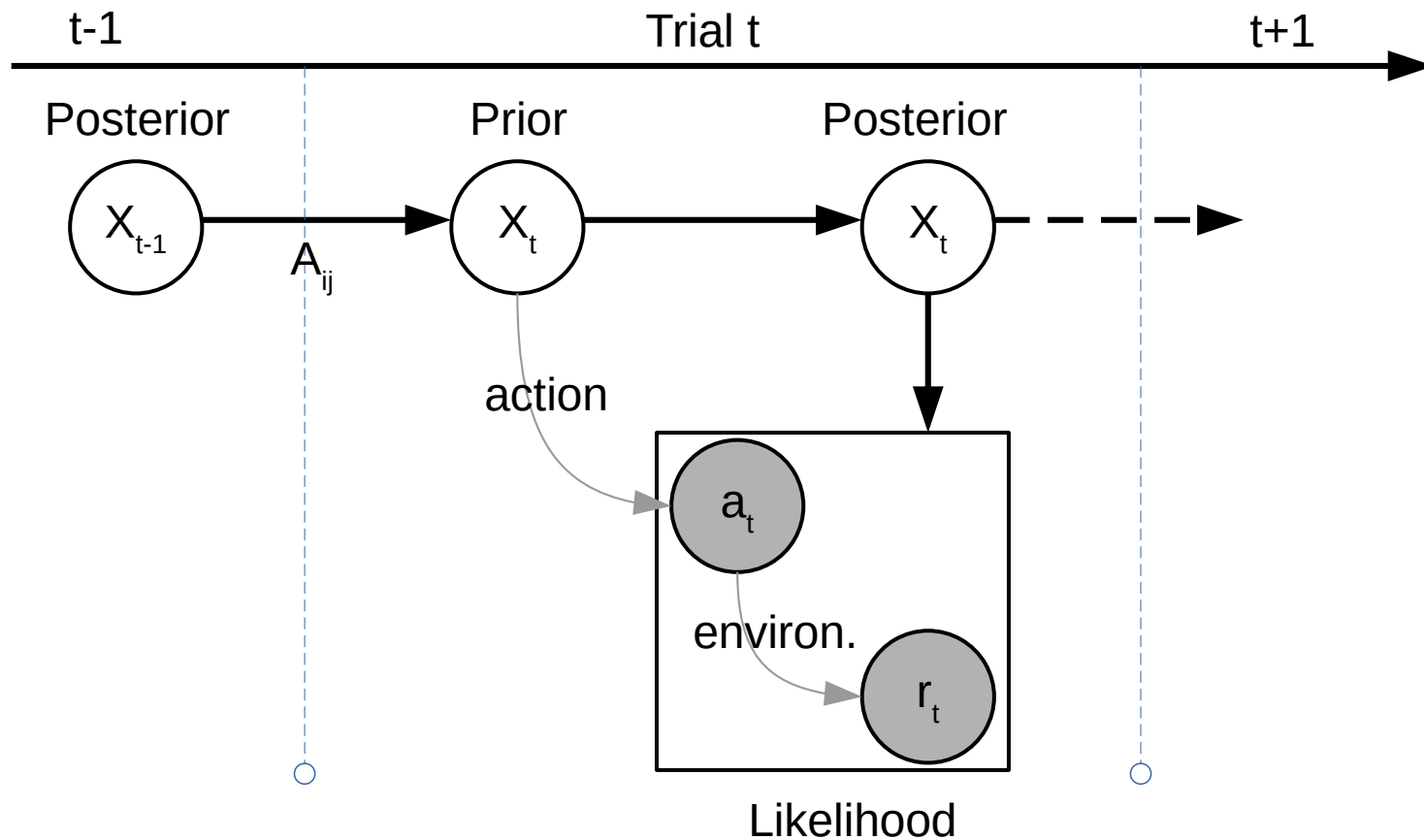
$$p(a_t|x_t) \propto \beta(p(x_t) - \alpha)$$

$$p(r_t|a_t, x_t) = \begin{cases} \begin{bmatrix} 1-p_0 & p_1 \\ p_0 & 1-p_1 \end{bmatrix}, & \text{if } r_t = 0 \\ \begin{bmatrix} p_0 & 1-p_1 \\ 1-p_0 & p_1 \end{bmatrix}, & \text{if } r_t = 1 \end{cases}$$

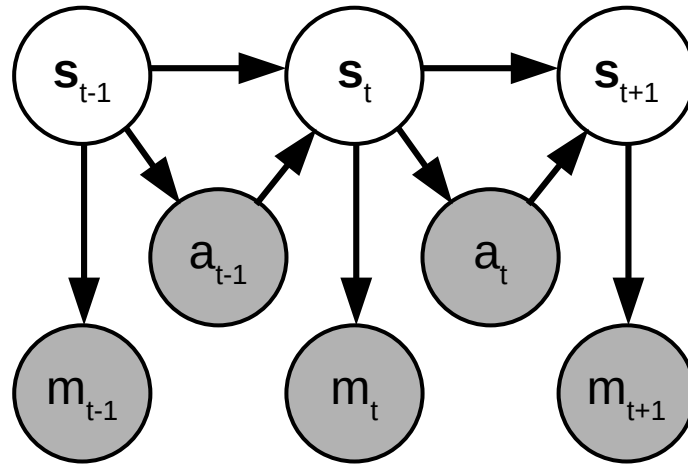
$$p(x_t = i) = \frac{p(r_t|a_t, x_t = i) p(a_t|x_t = i) \sum_{x_{t-1}} A_{ij} p(x_{t-1})}{\sum_{x_t} p(r_t|a_t, x_t) p(a_t|x_t) \sum_{x_{t-1}} A_{ij} p(x_{t-1})}$$

Update

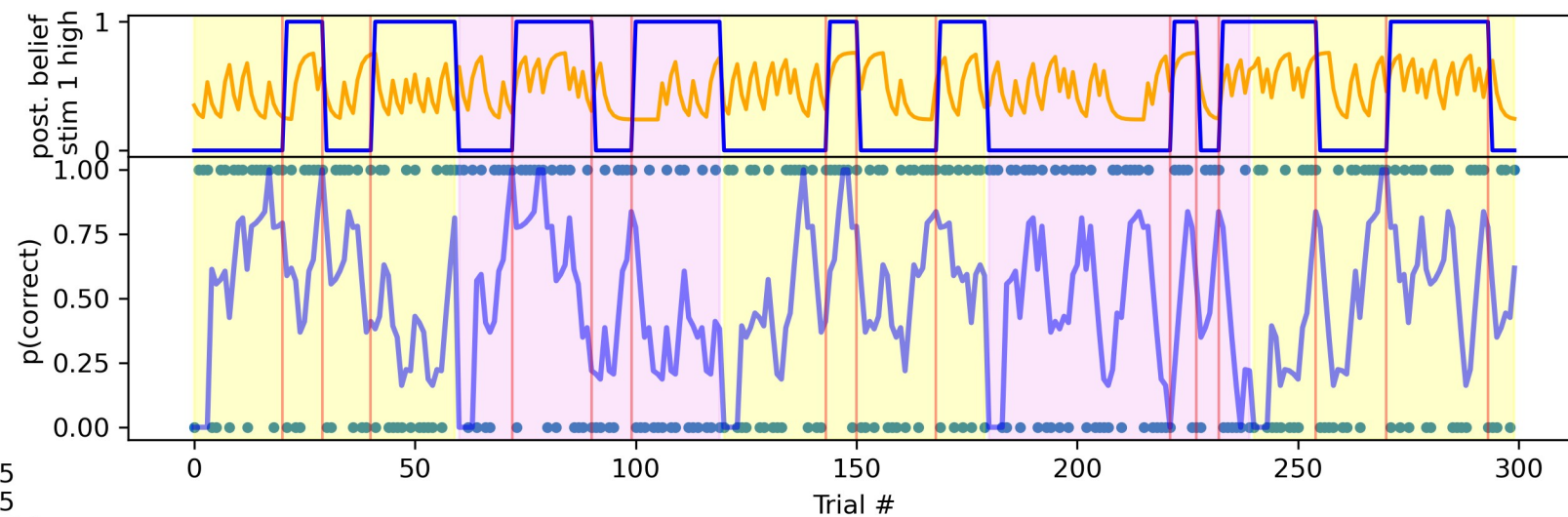
Joint Emission HMM



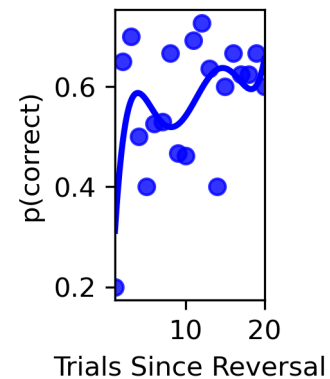
Vs POMDP graphical model



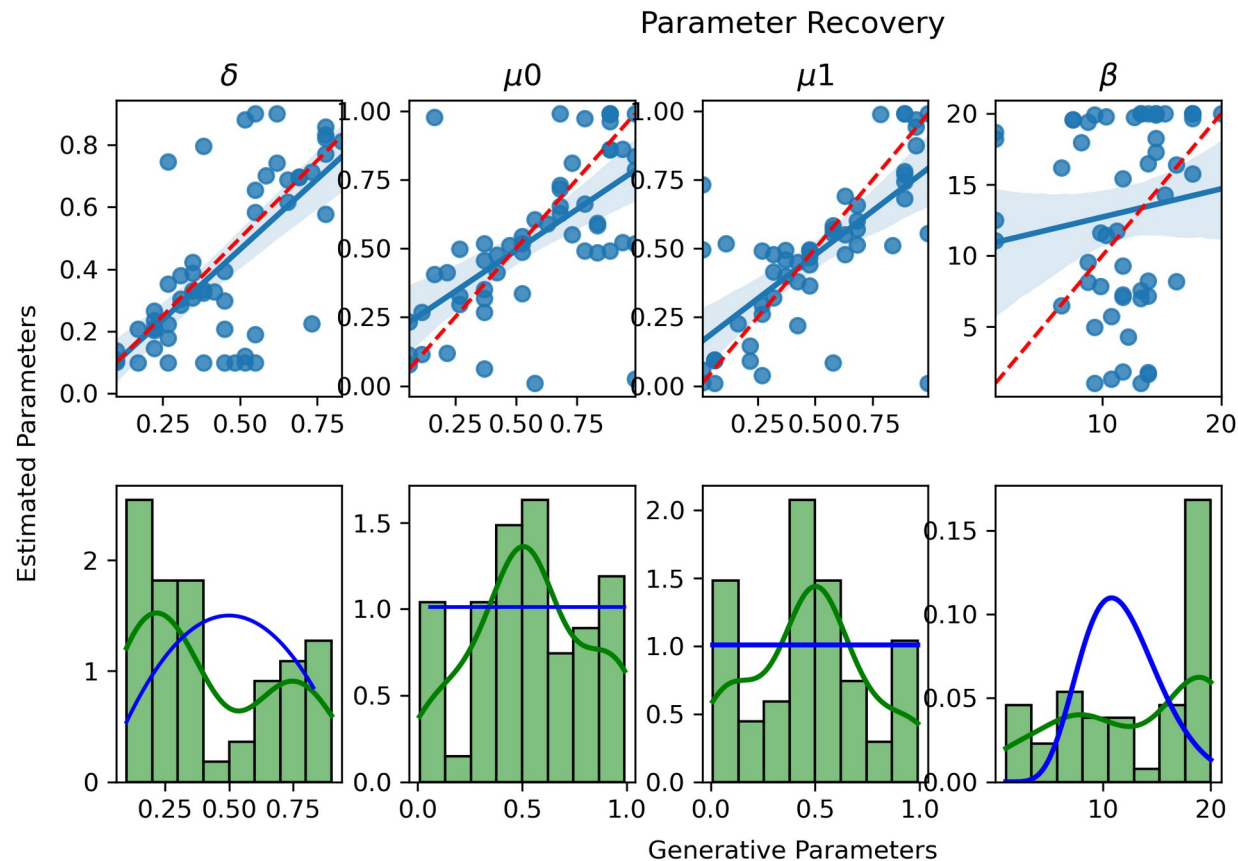
Joint HMM simulation



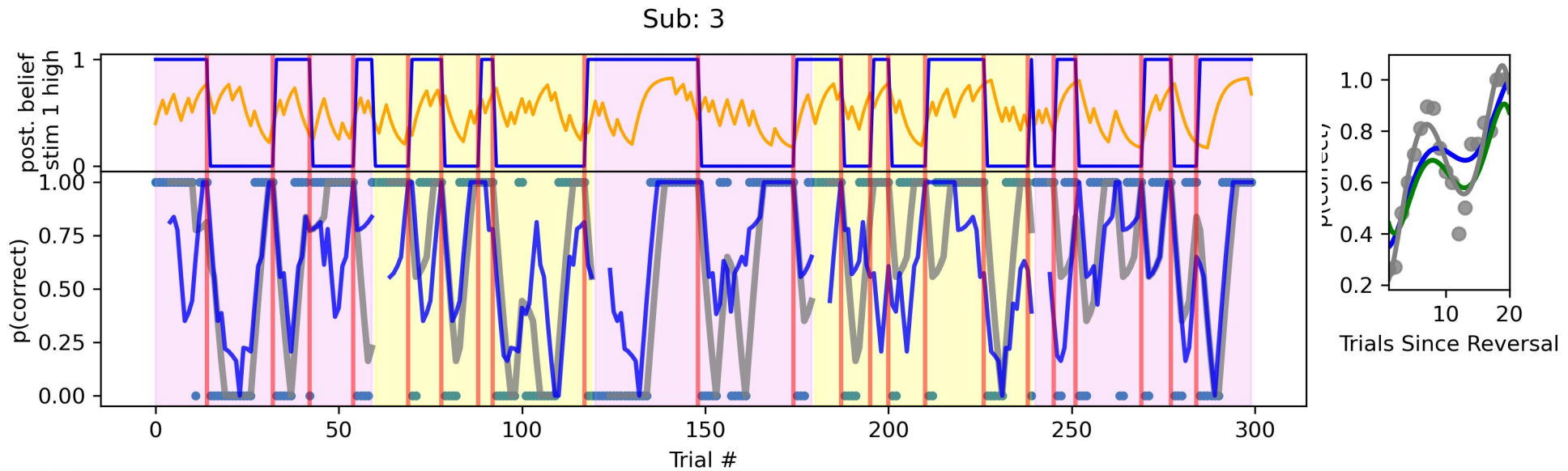
p_1: 0.65
p_0: 0.65
smBeta: 10
delta: 0.25



Parameter Recovery (MLE)



Fit to subject



fit_smBeta: 20.0
fit_p_1: 0.6
fit_p_0: 0.61
fit_delta: 0.1