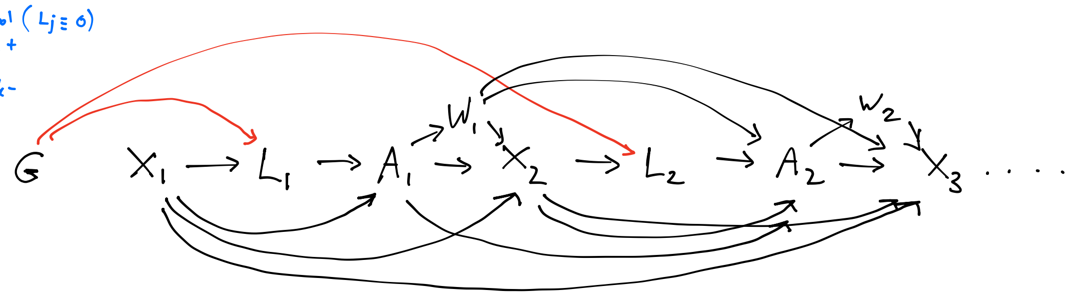
$G=0$: control ($L_j \equiv 0$)
$G=1$: lick +
$G=2$: lick -



$$H_j = (\bar{X}_j, \bar{A}_{j-1}, \bar{W}_j)$$

	static	dynamic
determin	$a=1$	$d(x)$
stochastic	$\text{bern}(\frac{1}{2})$	

$$d_j(H_j) = \mathbb{1}(G=1)\, X_j\, \text{Bern}(0.5) + \mathbb{1}(G=2)(1-X_j)\,\text{Bern}(1)$$

$$d_j^{(1)}(H_j) = X_j\,\text{Bern}(0.5), \quad \bar{d}_j^{(1)} \equiv (d_1^{(1)}, \dots, d_j^{(1)})$$

$$d_j^{(2)}(H_j) = (1-X_j)\,\text{Bern}(1), \quad \bar{d}_j^{(0)} \equiv \text{sim.}$$

$$\mathbb{E}(X_{j+1} \mid G=1) = \mathbb{E}(X_{j+1}(\bar{d}_j^{(1)}))$$

$$\mathbb{E}(X_{j+1} \mid G=2) = \mathbb{E}(X_{j+1}(\bar{d}_j^{(0)}))$$

more typical for opto

$$\mathbb{E}\left(X_{j+1}(\bar{\ell}_{j-1}, 1) - X_{j+1}(\bar{\ell}_{j-1}, 0)\right) = \alpha_1 + \alpha_2(\dots)$$

... in dopamine paper, may consider conditional effects given $\bar{X}_j$

$$\mathbb{E}(X_{j+1}(\bar{\ell}_j)) \overset{MSM}{=} \alpha_0 + \alpha_1\left(\sum_{s=1}^{j} \ell_s\right) + \alpha_2\left(\sum_{s=1}^{j} \ell_s\right)^2$$

0. estimand of interest
1. identification + estimation
2. modeling

$$\mathbb{E}(X_3(\ell_1, \ell_2) \mid X_1 = 1, X_2 = 1)$$

$$= \mathbb{E}(X_3(\ell_1, \ell_2) \mid X_1 = 1, X_2 = 1, G=1)$$

$$= \mathbb{E}\left(\mathbb{E}(X_3(\ell_1, \ell_2) \mid X_1 = 1, X_2 = 1, G=1, L_1) \mid X_1 = 1, X_2 = 1, G=1\right)$$

$$G \perp\!\!\!\perp X_3(\ell_1, \ell_2) \mid X_1, X_2$$

$$G \perp\!\!\!\perp X_2(\ell_1) \mid X_1$$

$$X_3(\ell_1, \ell_2) \perp\!\!\!\perp L_2 \mid X_1, X_2, G, L_1$$