Data Science in Context

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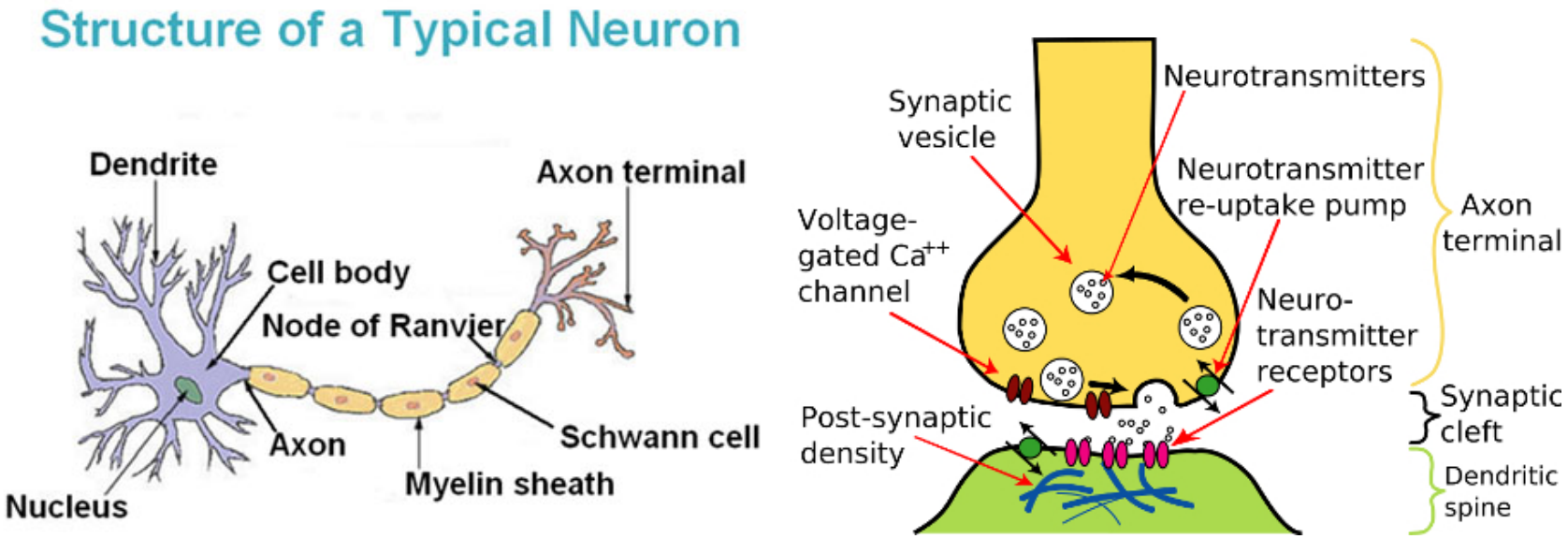
Dopamine kinetics



[1]: Typical neuron: Public Domain, https://commons.wikimedia.org/w/index.php?curid=254226

[2]: Vesicles: Creative Commons, https://commons.wikimedia.org/w/index.php?curid=4001388

Random Walk

- Release
- Diffusion
- Reuptake

D	E	I	J	K	L	AC	AD	AE	
	column number	4.00000000	5.00000000	6.00000000	7.00000000	24.00000000	25.00000000	26.00000000	27.
	distance from electrode in μm	44.00000000	42.00000000	40.00000000	38.00000000	4.00000000	2.00000000	0.00000000	2.
								electrode	
reiteration#	time in sec								
		2.75000000		2.75000000		0.00000000		0.00000000	
1	0.00741		2.75000000		2.75000000		0.00000000		0.
			2.72362816		2.72362816		0.00000000		0.
2	0.01481	2.72362816		2.72362816		0.67670040		0.00000000	
		2.69731262		2.69731262		0.66097474		0.00000000	
3	0.02222		2.69731262		2.69731262		0.33048737		0.
			2.67105412		2.67105412		0.32041287		0.
4	0.02963	2.57164092		2.67105412		0.81826671		0.32041287	
		2.54566713		2.64485339		0.80093553		0.32041287	
5	0.03704		2.59526026		2.64485339		0.56067420		0.
			2.56923135		2.61871120		0.54651725		0.
6	0.04444	2.41204369		2.59397127		0.91278114		0.54651725	
		2.38646380		2.56794534		0.89452755		0.54651725	
7	0.05185		2.47720457		2.58028682		0.72052240		0.
			2.45145919		2.55429277		0.70426738		0.
8	0.05926	2.26157949		2.50287598		0.98336628		0.70426738	
		2.23640880		2.47706721		0.96448831		0.70426738	
9	0.06667		2.35673800		2.50578447		0.83437785		0.
			2.33130396		2.47996859		0.81688180		0.
10	0.07407	2.12318713		2.40563627		1.03626755		0.81688180	
		2.09843026		2.38007301		1.01695345		0.81688180	
11	0.08148		2.23925164		2.42505287		0.91691763		0.

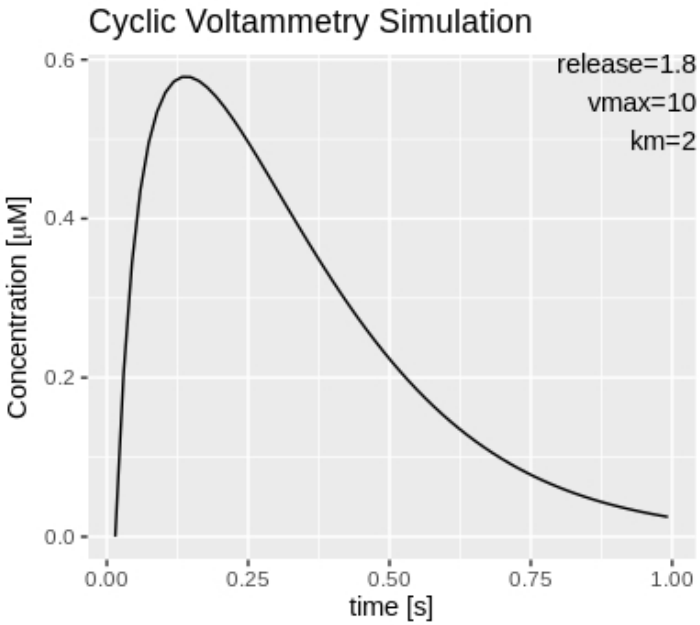
Michaelis-Menten Equation

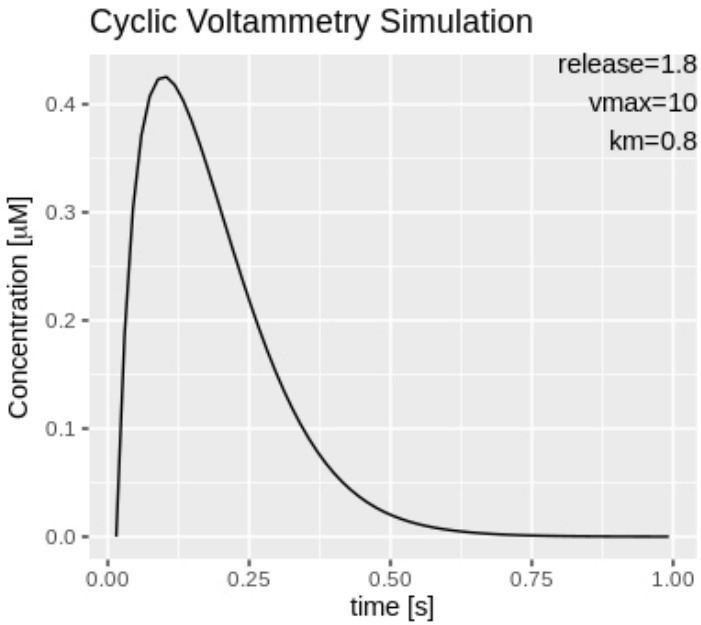
- Reuptake

$$Vo = \frac{V_{max}[S]}{Km + [S]}$$

V0 = Initial velocity (moles/times)
[S] = substrate concentration (molar)
V_{max}= maximum velocity
K_m = substrate concentration at half V_{max}

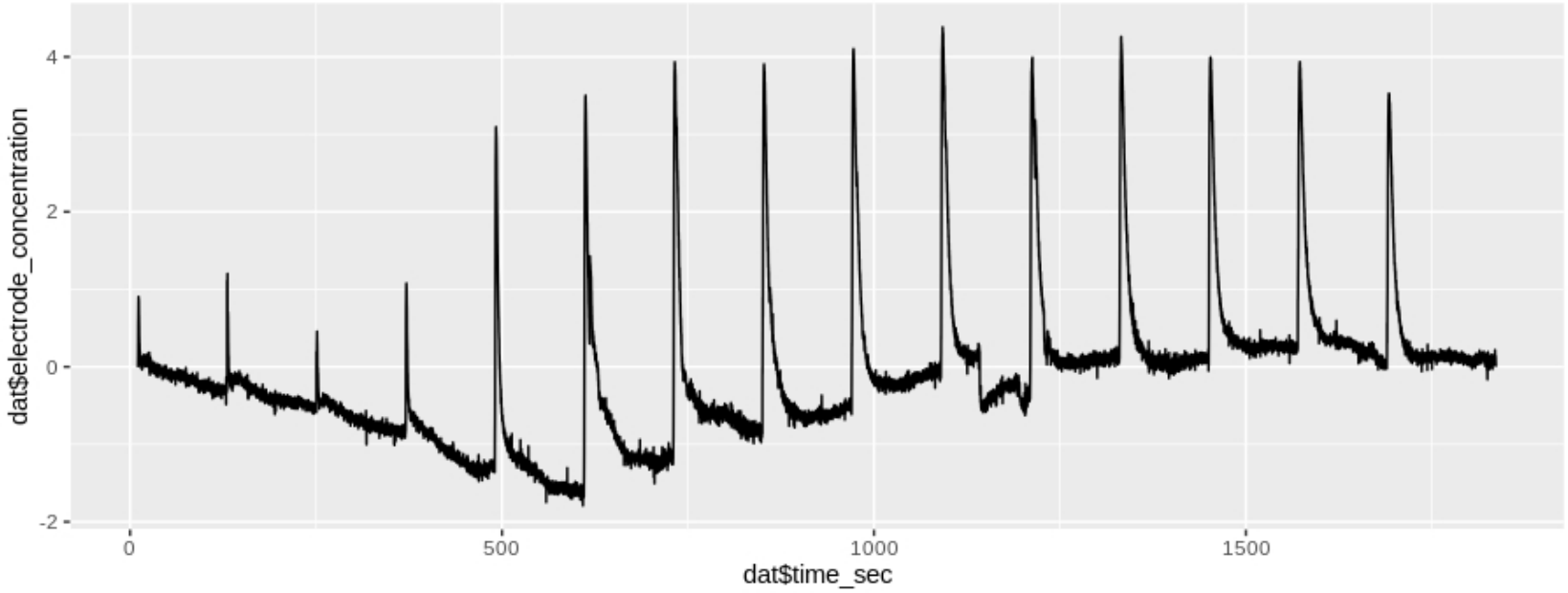
Simulation of DA concentration





Experimental data

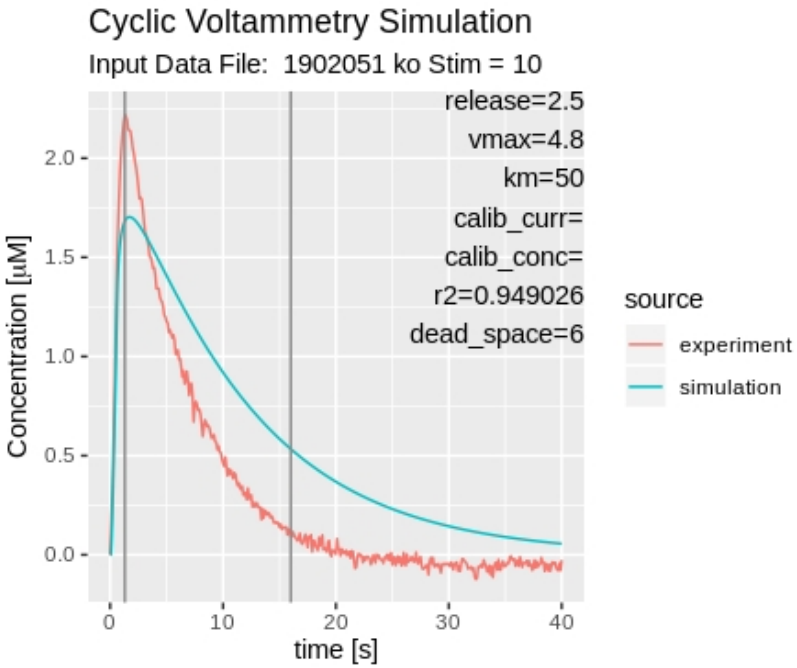
- Stimulate each two minutes.
- Amphetamine begins in fourth stimulus.
- Biological variability.
- DA concentration is net of release and reuptake.

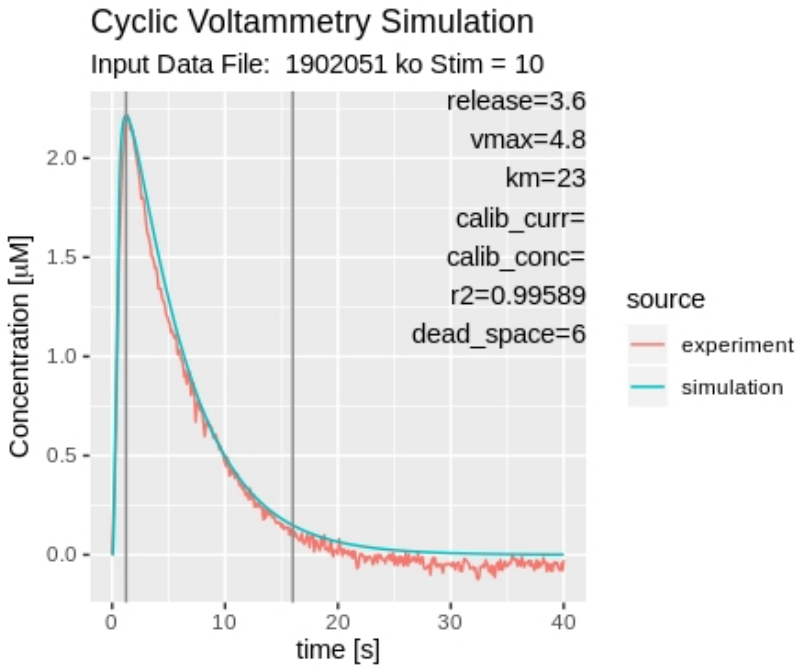


Fitting the model

Infer kinetics of DA

- Release
- km (reuptake)
- R-squared





Wrap up

- Mechanism of AMPH-evoked DA release.
- Controlled experiment using genotypes.
- Publication.
- Rwalk package on GitHub: https://github.com/pnojai/rwalk