Group 6: Project 1

1) According to Kacelnik (see Daw & Touretzky, 2000, for a summary), animals assign subjective value to an option according to its reward rate (average reward):

$$V = R/(ITI + D)$$

where R is the reward magnitude, ITI is the intertrial interval, and D is the post-choice delay until reward delivery. This is equivalent to a form of hyperbolic discounting, in contrast with exponential discounting:

$$V = \gamma^D R$$

where γ is a discount factor. Implement these two models and compare their indifference curves for two options with different reward magnitudes and delays (as in Figure 1 in Daw & Touretzky, 2000). How do these indifference curves change as a function of the various parameters (R, ITI, γ)?

2) Niv et al. (2007) have argued that average reward is encoded by tonic dopamine levels. Simulate the effects of amphetamine administration by increasing the average reward term: $R' = R + C$, where C is the additive effect of amphetamine. How does this manipulation affect temporal discounting? How does it relate to empirical studies (e.g., Cardinal et al., 2000)?

3) Note that in order to account for Mazur's data, Daw & Touretzky had to assume that animals underestimate the intertrial interval. Discuss this assumption in light of the experiments reported by Blanchard et al. (2013). What might cause animals to underestimate the intertrial interval?

References:

Blanchard, T.C., Pearson, J.M., & Hayden, B.Y. (2013). Postreward delays and systematic biases in measures of animal temporal discounting. *Proceedings of the National Academy of Sciences, 110,* 15491–15496.

Cardinal, R. N., Robbins, T. W., & Everitt, B. J. (2000). The effects of d-amphetamine, chlordiazepoxide, alpha-flupenthixol and behavioural manipulations on choice of signalled and unsignalled delayed reinforcement in rats. *Psychopharmacology, 152*, 362–375.

Daw, N. D., & Touretzky, D. S. (2000). Behavioral considerations suggest an average reward TD model of the dopamine system. *Neurocomputing, 32-33*, 679–684.

Niv, Y., Daw, N.D., Joel, D., & Dayan, P (2007). Tonic dopamine: opportunity costs and the control of response vigor. *Psychopharmacology, 191*, 507–520.