Delay discounting (intertemporal choice or impulsive choice) in mice and rats

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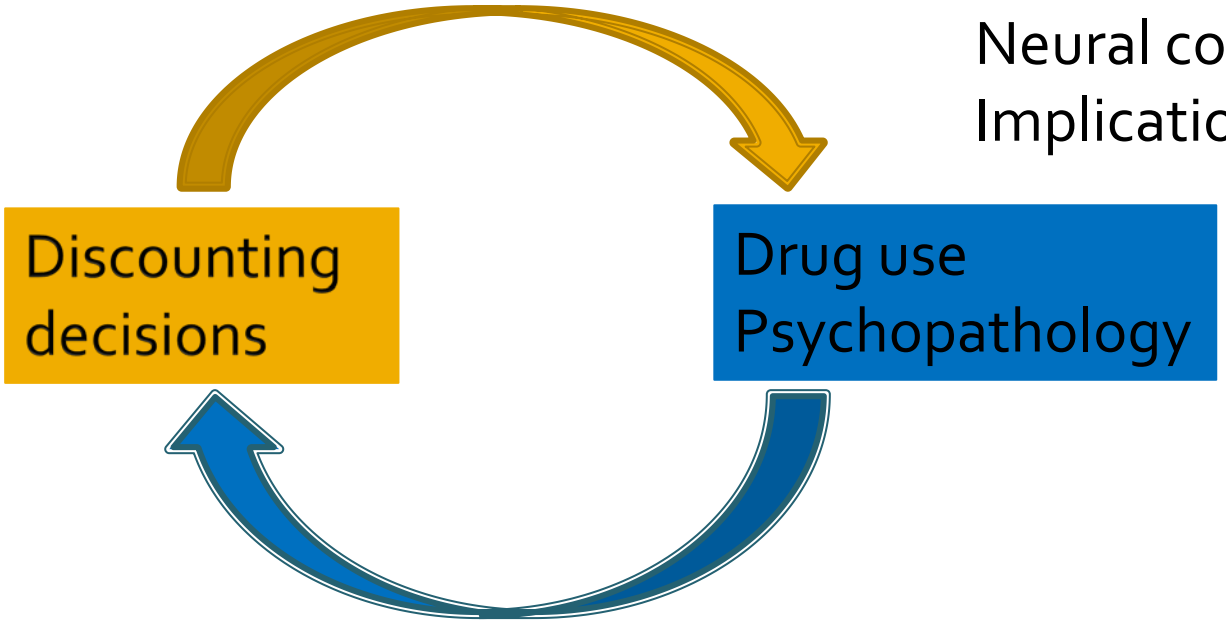
Why the need for an animal model?

- Beginning in the late 1990s, data indicated that individuals who are dependent or heavily use drug/alcohol discount <u>more</u> than individuals who do not, e.g., Yi et al 2011.

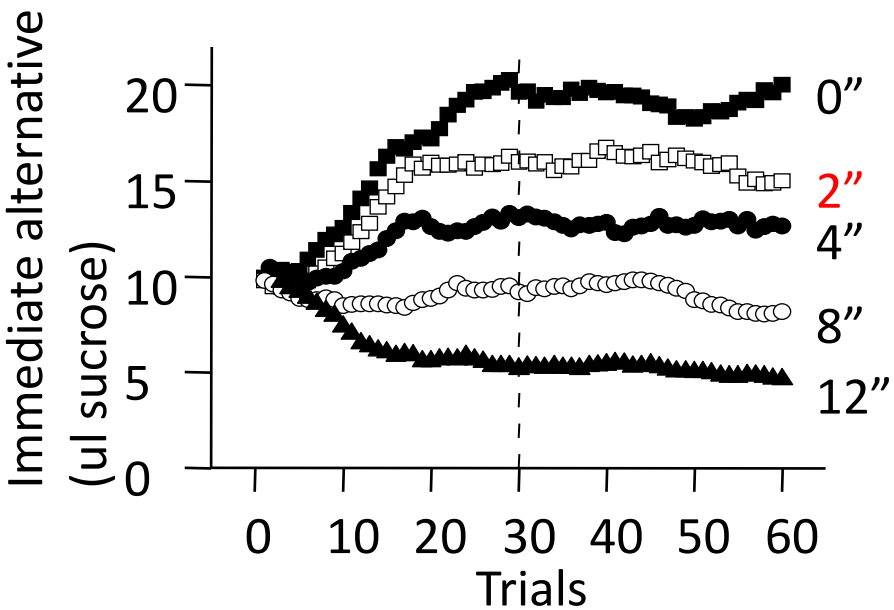
- But mechanisms are unclear…

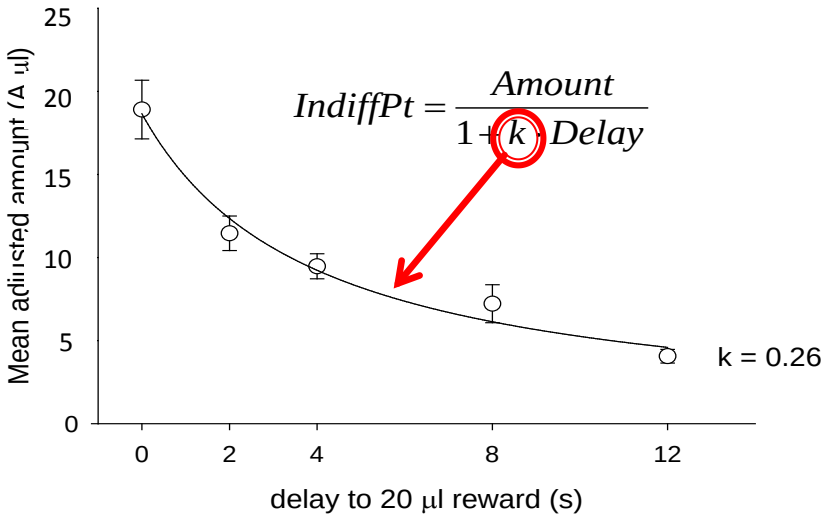
Genetic relationships
Neural correlates
Implications for treatment?



Description of our model: the adjusting amount procedure (based on Richards et al 1997)

Trial	Immediate amount (µl)	Delayed amount (µl)	Delay (s)	Choice
4	11	20	2	Immediate





Extensions/related models

- Other rodent models
  - Adjusting delay
  - T-maze
  - Within session
- Assessment of other economic parameters
  - Probability of reward
  - Response effort
  - Gains vs losses
- Extensions to other species
  - Pigeon
  - Nonhuman primate

Procedural commonalities between human and rodent models

- Choice task:
  - smaller sooner reward vs larger, later reward
  - assessment over a range of delays
- Main dependent variable:
  - preference index (indifference point, percent choice) at each delay
- Interpretation:
  - Heightened relative preference for smaller, sooner rewards indicates impulsivity/inability to delay gratification/aversion to delay

Convergent results - validity

- Mathematical function describing the effects of delay
- Commodity dependence of discounting rate
- Heritability of discounting rate
- Many similar neural regions implicated in discounting decisions

Procedural distinctions between human and rodent models

	Human Studies	Rodent Studies
Rewards	Commonly hypothetical	Experiential

Divergent results

- Environmental factors with different effects
  - reward amount
  - acute and chronic drug administration

Future directions, questions & recommendations

- Development of rodent methods that
  - do not use food restriction
  - can yield reliable data more rapidly
- Delineation of component processes and their contribution to discounting decisions in humans and animal models
- Assess the limits of task sensitivity
- Studies to assess convergence explicitly, esp. in the drug abuse arena,
  - e.g. does discounting predict extinction of drug taking in animal models as it appears to predict cessation in humans?