A rat model of impulsive choice behavior: Reward-related correlates of performance.

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Impulsive choice

High levels of impulsive choice:

ADHD  (e.g., Barkley et al., 2001; Kuntsi et al., 2001; Solonto et al., 2001)

Gambling  (e.g., Dixon et al., 2003; 2006)

Substance abuse  (e.g., Kirby & Petry, 2004; Madden et al 1997; Mitchell, 1999; Vichinich & Simpson, 1998)

Relapse in smoking cessation treatment programs  (Krishnan-Sarin et al, 2007; Yoon et al, 2007)
What do we mean by impulsive choice?

EASY DECISION: SMALL (S) OR LARGE (L)

One cookie or two?
What do we mean by impulsive choice?

EASY DECISION: SOONER (S) OR LATER (L)

In 10 minutes or in 30 minutes?
What do we mean by impulsive choice?

DIFFICULT DECISION:
SMALLER SOONER (SS) OR LARGER LATER (LL)

One cookie in 10 minutes or two cookies in 30 minutes?
What do we mean by impulsive choice?

DIFFICULT DECISION: SS or LL?

One cookie in 10 minutes or two cookies in 30 minutes?

The impulsive choice would be to take the one cookie SS option. Why would people lose self-control?
What are momentary and molar maximizing?

WHAT GETS ME MORE COOKIE PER MINUTE DELAY?:

One cookie in 10 minutes or two cookies in 30 minutes?
What are momentary and molar maximizing?

WHAT GETS ME MORE COOKIE PER MINUTE DELAY?:

One cookie in 10 minutes or two cookies in 30 minutes?

I can wait three times the delay for twice the amount of cookie.
What are momentary and molar maximizing?

I’LL TAKE ONE COOKIE IN 10 MINUTES PLEASE

I’m living for the moment. I’m momentary maximizing.
What are momentary and molar maximising?

WHEN CAN I CHOOSE AGAIN?
What are momentary and molar maximizing?

I HAVE TO WAIT TWO HOURS?

10 MIN 120 MINUTES CHOICE

30 MIN 120 MINUTES CHOICE
What are momentary and molar maximizing?

I’LL WAIT 30 MINS FOR TWO COOKIES

LL option

I’m looking at the bigger picture. I’m molar maximizing.
Individual differences in choice

Here be rats..... Gaaargh hh
Individual differences in choice

A rat version of the cookie dilemma:

**SS 10s 1 PELLET**  **LL 30s 2 PELLET**
Individual differences in choice

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SS 10s 1 PELLET    LL 30s 2 PELLET
Individual differences in choice

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A rat version of the cookie dilemma:

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Inter-trial interval (ITI) 120 s until next choice
Individual differences in choice

SS 10s - 1 PELLET      LL 30s - 2 PELLET

PERCENTAGE LL CHOICE
Moderating choice behavior

Why?
The ability to moderate choice behavior depending on outcome is important:

Underlying factors may be a cause of disorders, e.g.:  
- Insensitivity to outcome delay
- Insensitivity to outcome amount
- Current motivational state
Moderating choice behavior

Manipulating the SS delay:

**SS 1 PELLET**  **LL 30s 2 PELLET**

5 s, 15 s or 30 s (over session blocks)

30 s
Moderating choice behavior

Manipulating the SS delay

**SS 1 PELLET**
**LL 30s 2 PELLET**

Increasing SS delay increases molar maximizing
Moderating choice behavior

Manipulating the LL amount:

**SS 10s 1 PELLET**  **LL 30s**

10 s

30 s

1 pellet, 2 pellet or 3 pellet (over session blocks)
Moderating choice behavior

Manipulating the LL amount:

SS 10s 1 PELLET
LL 30s

Increasing LL amount increases molar maximizing

PERCENTAGE LL CHOICE

LL 1 PELLET  LL 2 PELLET  LL 3 PELLET

LL AMOUNT

MEQ
Moderating choice behavior

Manipulating current motivational state:

SS 10s 1 PELLET   LL 30s 2 PELLET
Moderating choice behavior

Manipulating current motivational state:

SS 10s 1 PELLET
LL 30s 2 PELLET

Pre-feeding increases momentary maximizing
Predicting choice behavior

Correlating performance on other behavioral tasks with choice behavior.

Why?
Predicting choice behavior

Correlating performance on other behavioral tasks with choice behavior.

Why?

If performance on simple tasks can predict choice behavior they can be used in screening
Predicting choice behavior

Correlating performance on other behavioral tasks with choice behavior.

Why?

If performance on simple tasks can predict choice behavior they can be used in screening.

If performance on other tasks is related to choice behavior the tasks may share underlying factors useful in intervention.
Predicting choice behavior

Outcome efficiency: differential reinforcement of low rates (DRL)

DRL 10s and DRL 30s (separate sessions and levers)
Predicting choice behavior

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DRL 10s and DRL 30s (separate sessions and levers)
Predicting choice behavior

Outcome efficiency: DRL 10s
Predicting choice behavior

Outcome efficiency: Correlation with choice

Outcome efficiency on DRL 10s predicts molar maximizing
Predicting choice behavior

Incentive motivation to work for increasing reward: Progressive ratio (PR)

PR3 1 pellet compared to PR3 4 pellet
Predicting choice behavior

Incentive motivation to work for increasing reward: PR

PR3 1 pellet compared to PR3 4 pellet
Predicting choice behavior

Incentive motivation to work for increasing reward: PR

PR3 1 pellet compared to PR3 4 pellet
Predicting choice behavior

Incentive motivation to work for increasing reward: PR

![Graph showing mean breakpoint for 1 pellet vs. 4 pellets. The graph indicates a higher mean breakpoint for 4 pellets compared to 1 pellet.](image)
Predicting choice behavior

Incentive motivation to work for increasing reward: Correlation with choice

Greater increase of work rate for larger outcomes predicts molar maximizing
Applications of a rat model

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Develop behavioral screening and interventions based on work with rats.
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Manipulate choices and produce biases that are found in human disorders.
Investigate factors underlying choice behavior.
Explore other behaviors that may be influencing choice.
Develop behavioral screening and interventions based on work with rats.
Explore neurobiological areas that are currently unavailable in human research.
Thanks go to:

Behavioral testing:
  Aaron Smith
  The rats

Members of the KK behavioral neuroscience lab
Mellissa Williamson, 35, a Bullitt Avenue resident, worries about the effect on her unborn child from the sound of jackhammers.