

# PROBABILISTIC CHOICE IN RATS: THE EFFECTS OF DIFFERENTIAL LOSSES AND ALTERNATIVE OUTCOMES

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# Probabilistic Gains and Losses

- Probabilistic outcomes are partitioned as gains and losses relative to a *subjective reference point*
  - Gains: Outcomes  $>$  reference point
  - Losses: Outcomes  $<$  reference point
- In humans, the reference point may potentially reflect...
  - What an individual aspires or expects to have
    - Kahneman and Tversky (1979); Wang and Johnson (2012)
  - What an individual currently has
    - Kahneman and Tversky (1979)
  - What an individual minimally requires to have
    - Stephens and Krebs (1986); Wang and Johnson (2012)
  - Or, what an individual could have had for making a different choice
    - Boles and Messick (1995)
- Due primarily to the procedures in use, it has been difficult to determine what such a reference point may be in animals

# Identifying a Reference Point

- Choice between a certain smaller outcome and a larger uncertain outcome

Certain  
1 pellet,  $p = 1.00$

Uncertain  
4 pellets,  $p = .50$   
0 pellets,  $p = .50$

- General assumption: the 4-pellet outcome is a **gain**
  - Greater than the expected value of the uncertain choice (2)?
    - *What an individual expects or aspires to have*
  - Greater than the zero-pellet outcome (0)?
    - *What an individual currently has or minimally requires to have*
  - Greater than the certain smaller outcome (1)?
    - *What an individual could have had for making a different choice*

# Identifying a Reference Point

- Previous research (Marshall, 2013)
  - Manipulated uncertain food amounts in a probabilistic choice task
  - Measured win-stay / lose-shift behavior
    - More uncertain choices following gains than following losses
      - Evenden and Robbins (1984); Marshall and Kirkpatrick (2013); Stopper and Floresco (2011)
- Possible reference point: Expected value of the certain choice

# Goals of the Current Experiment

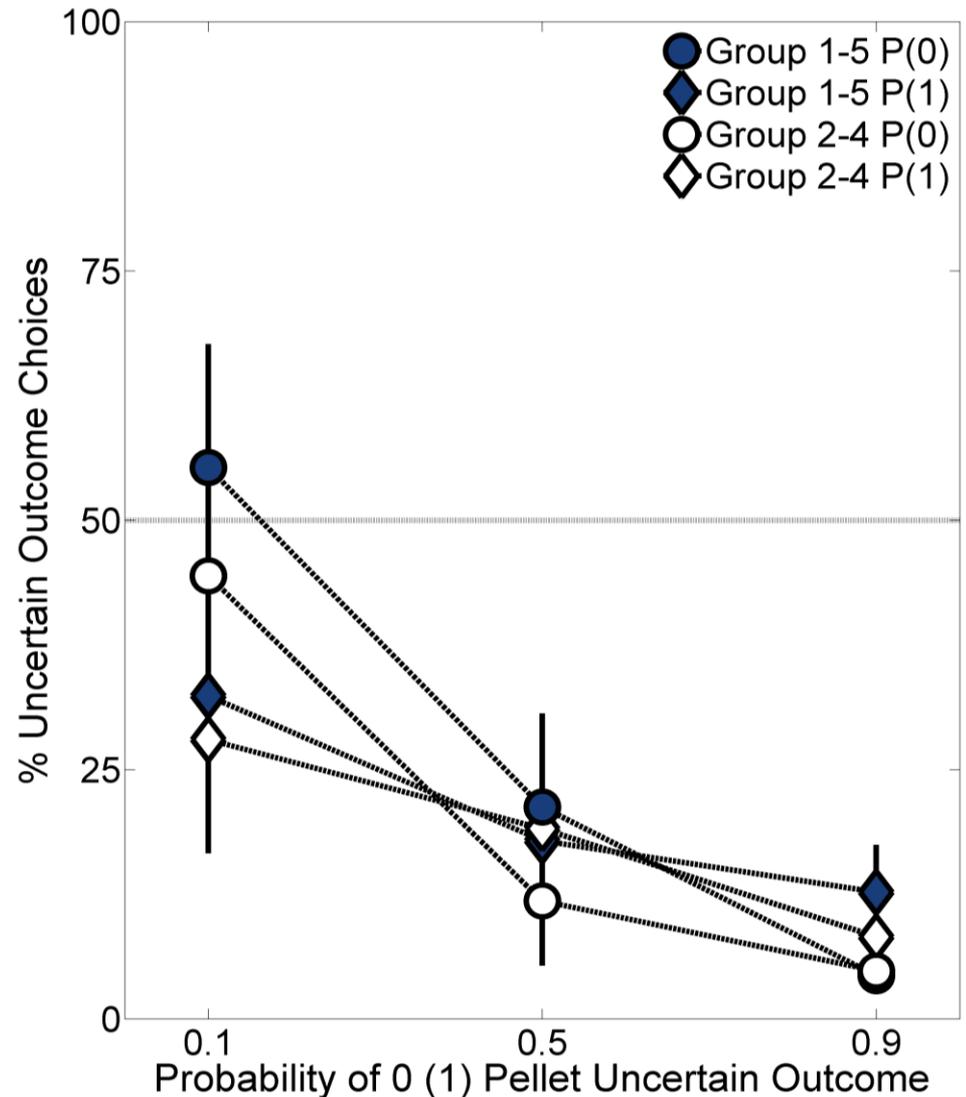
- (1) Determine if the expected value of the certain choice outcome or its individual outcome values comprise the reference point
  - Previous research in our laboratory has maintained the same parameters of the certain choice
- (2) Determine if the effects of the previous outcome will differ if the probability of a non-zero loss and the probability of a zero-magnitude loss is manipulated

# Current Procedure

- 24 male experimentally-naïve Sprague Dawley rats
- Choice between a certain and an uncertain outcome
  - Certain outcome
    - Group 2-4: **2** or **4** pellets ( $\mu = 3$  pellets)
    - Group 1-5: **1** or **5** pellets ( $\mu = 3$  pellets)
  - Uncertain outcome: **0**, **1**, or **11** pellets
    - Zero- and non-zero loss (i.e.,  $<$  Certain outcome expected value)
- Probabilities of uncertain outcomes
  - Manipulated the probability of zero pellets across phases
    - $P(0) = .1, .5, .9$
  - Manipulated the probability of one pellet across phases
    - $P(1) = .1, .5, .9$

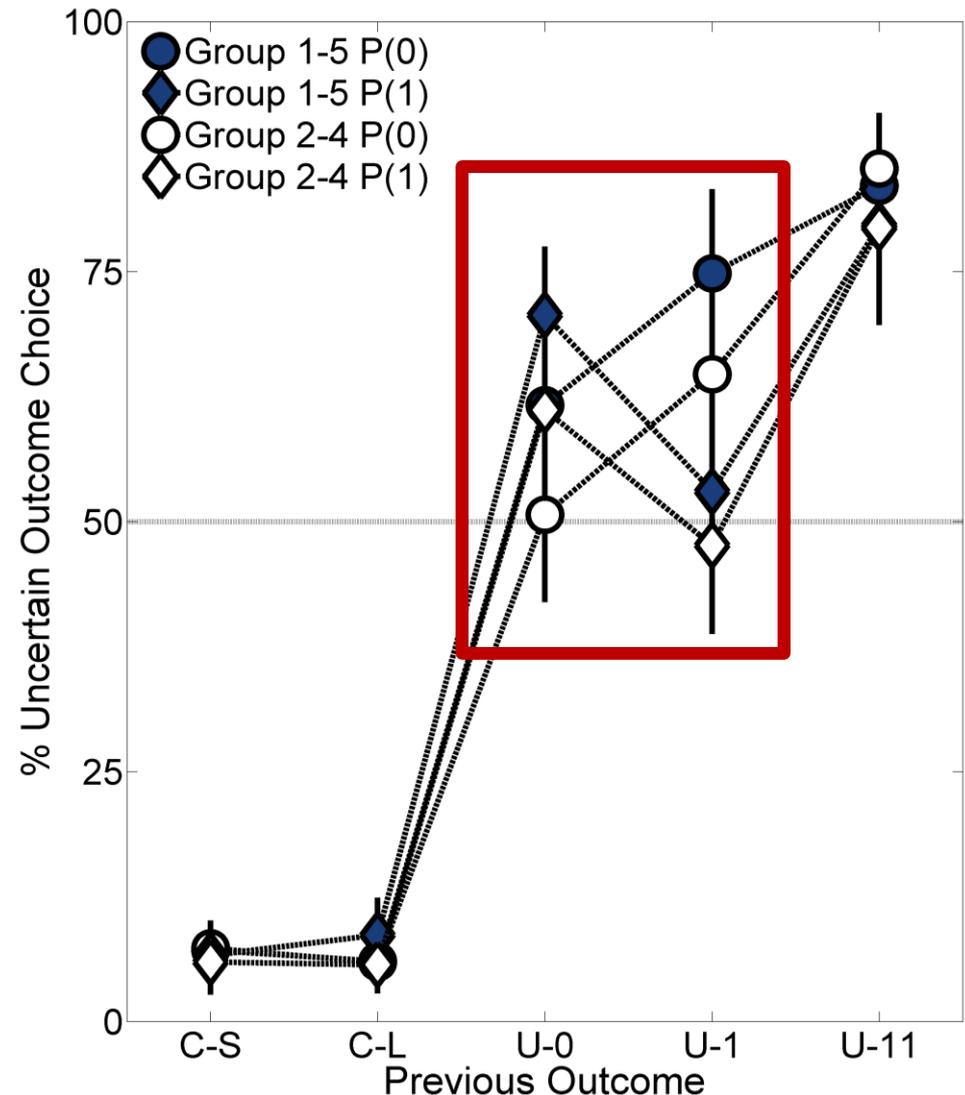
# Probability of the 11-Pellet Reward

- Decrease in % uncertain outcome choice with increases in  $P(0)$  and  $P(1)$
- Group 1-5  $\approx$  Group 2-4
  - Expected value of certain choice was more important than the individual values
- Steeper functions within  $P(0)$  manipulation
  - Differences in global behavior depending on if zero- or non-zero loss probability is manipulated



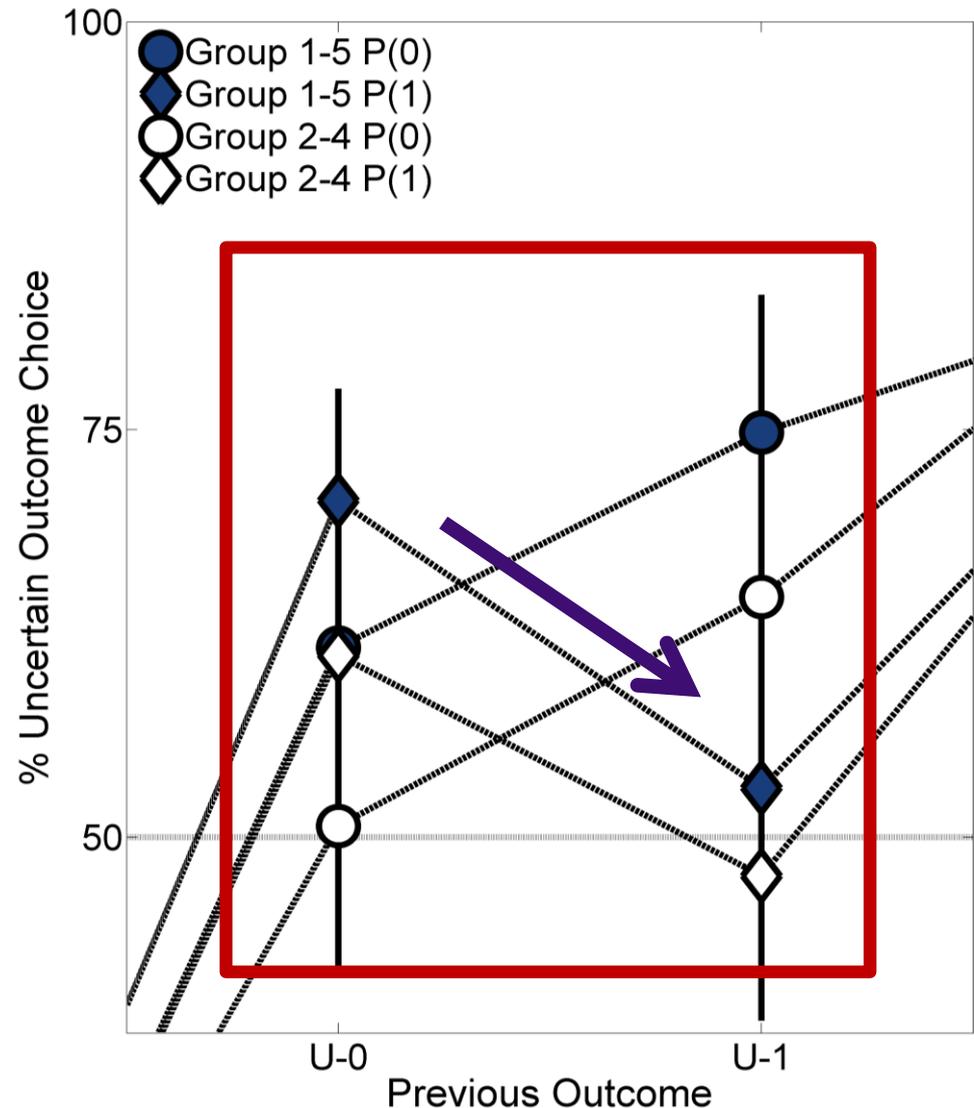
# Effect of the Previous Outcome

- More uncertain choices following U-11 outcome than U-1 and U-0 outcomes
  - Win-stay / lose-shift behavior
- Group 1-5  $\approx$  Group 2-4
  - Expected value exhibits a greater influence than individual values
- $P(0) \neq P(1)$ 
  - In P(1) manipulation, there were more uncertain choices following U-0 than following U-1 outcomes
  - 0 is less of a loss than 1?



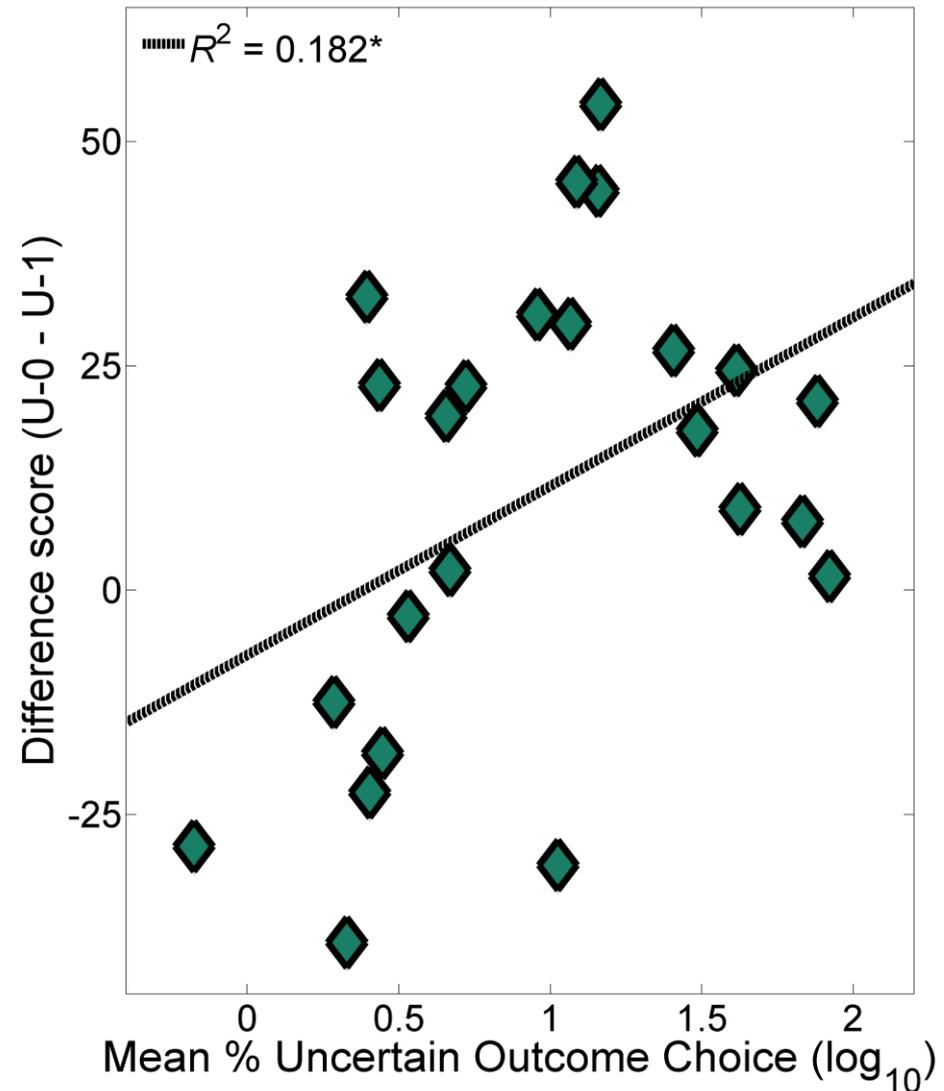
# Effect of the Previous Outcome

- Investigated whether the reduction in post U-1 behavior vs. post U-0 behavior was related to the propensity to make risky choices
- Are rats that are more likely to gamble following U-0 than following U-1 more susceptible to “gambling” despite experienced losses?



# Effect of the Previous Outcome

- More risky choices → greater reduction in uncertain choice behavior following U-1 outcomes
- The probabilistic presentation of *non-zero losses* may be more effective than that of reward omission to reduce problematic gambling behavior



# Factors of Probabilistic Choice Behavior

- *(1) Determine if the expected value of the certain choice outcome or its individual outcome values comprise the reference point*
  - The expected value of the certain choice is a more likely candidate for a subjective reference point than the corresponding individual reward outcomes
- *(2) Determine if the effects of the previous outcome will differ if the probability of a non-zero loss and the probability of a zero-magnitude loss is manipulated*
  - Differences in behavior at the molar and molecular level
  - Differential sensitivity to differential losses

# Theoretical Perspectives

- Reference points for probabilistic gains and losses
  - What an individual aspires or expects to have
  - What an individual currently has
  - What an individual minimally requires to have
  - Or, what an individual could have had for making a different choice



- Scratch tickets
  - If you win \$8 off a \$10 scratch ticket, the first thing that likely comes to mind may be...
    - “Shoot! I could have kept my \$10!”
  - Rather than...
    - “Yay! I won \$8, which is much less than the jackpot...”



# Theoretical Perspectives

- If we are to understand the effects of previous and prospective **gains** and **losses**, we should be aware of the reference point that distinguishes outcomes as such
- Conclusion
  - (1) Computations of subjective valuation may be more complex than initially envisioned
  - (2) Gains or losses may be regarded as such relative to alternative outcomes in the environment
  - (3) The presentation of non-zero losses may be an effective neurocognitive intervention to reduce problematic risky decision making behaviors, and to identify those individuals susceptible to such behaviors

# Thank you!

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**The  
Reward,  
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