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

<table>
<thead>
<tr>
<th>Certain</th>
<th>Uncertain</th>
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<tbody>
<tr>
<td>1 pellet, p = 1.00</td>
<td>4 pellets, p = .50</td>
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<tr>
<td>0 pellets, p = .50</td>
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• 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 (μ = 3 pellets)
    - Group 1-5: 1 or 5 pellets (μ = 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 ≈ 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 ≈ Group 2-4
  - Expected value exhibits a greater influence than individual values

- P(0) ≠ 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 $\rightarrow$ 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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