Dissociating the Roles of Delay and Probability Discounting in Gambling Behavior

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Now or Later?

- How would you like a gift?

- Now vs. 1 week
  - Rewards now are worth more than later
    - Delayed rewards are discounted
Delay Discounting

$100

Now

$50

Later

- Outcomes in future are devalued - make current options more attractive
- Tendency varies across individuals
What’s your preference?

Which option do you prefer?:
(a) $995 now; (b) $1000 in 1 year
(a) $900 now; (b) $1000 in 1 year
(a) $800 now; (b) $1000 in 1 year
(a) $700 now; (b) $1000 in 1 year
(a) $600 now; (b) $1000 in 1 year
(a) $500 now; (b) $1000 in 1 year
(a) $400 now; (b) $1000 in 1 year
(a) $300 now; (b) $1000 in 1 year
(a) $200 now; (b) $1000 in 1 year
(a) $100 now; (b) $1000 in 1 year
(a) $50 now; (b) $1000 in 1 year
Delay Discounting Paradigm

- Decisions between smaller, immediate vs. larger, delayed rewards across several delays

- Switch point = Subjective value of delayed reward
  - E.g., How much $1000 in one year is worth to you right now
  - Smaller subjective values indicate greater degree of discounting
Individual subjective values for multiple delays can be plotted and fit a curve to the function:

$$v_d = \frac{V}{1 + kD}$$

Note: $k =$ rate of discounting
Area Under Discounting Curve

- AUC calculated from actual data points rather than curve fit to data (theoretically-neutral) (Myerson, Green, & Warusawitharana, 2001)

- Greater degree (rates) of discounting = lower subjective values (i.e., smaller AUC = steeper discounting) – 0 → 1.0
Steep rate of discounting

\[ k = 0.013; \text{AUC} = 0.27 \]

\[ k = 0.0007; \text{AUC} = 0.89 \]
Delayed Gratification
Delay Discounting & Gambling

- PGs discount delayed rewards more steeply than controls
  - Dixon et al. (2003)
  - MacKillop et al. (2006)
  - Petry (2001)
  - Petry & Casarella (1999)
Delay Discounting & Gambling

- Problem gamblers prefer smaller, immediate rewards over larger, delayed rewards
- Why?
  - PGs discount long-term benefits of abstaining from gambling
  - Highlights gambling's function as a way to satisfy immediate needs
Callan, Shead, & Olson, 2011

- $N = 59$ students/staff at UWO (regular gamblers)
- Delay discounting paradigm
  - $1000 @ 7$ delays (1, 7, 30, 90, 180, 365, 730 days)
- Choice of $1-$5 cash / $1-$5 worth of instant win scratch tickets
  - 47% purchased at least one ticket ($M = 1.32$ tickets, $SD = 1.85$)
## Results

<table>
<thead>
<tr>
<th>Measures</th>
<th>1.</th>
<th>2.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AUC</td>
<td>--</td>
<td>-.50**</td>
</tr>
<tr>
<td>2. Tickets</td>
<td>-.50**</td>
<td>--</td>
</tr>
</tbody>
</table>
Evidence that steeper delay discounting predicts increased gambling in immediate context

Link btw desire for instant rewards & gambling
What about Probability Discounting?

- Similar to delay discounting but with uncertain (probabilistic) rewards
- We discount value of probabilistic rewards according to comparable mathematical function:
  \[ v_d = \frac{V}{1 + h\Theta} \]

  -Notes: \( h \) = rate of probability discounting
    \( \Theta \) = odds against receiving reward
What’s your preference?

Which option do you prefer?:
(a) $995 for sure; (b) 25% chance of $1000
(a) $900 for sure; (b) 25% chance of $1000
(a) $800 for sure; (b) 25% chance of $1000
(a) $700 for sure; (b) 25% chance of $1000
(a) $600 for sure; (b) 25% chance of $1000
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(a) $200 for sure; (b) 25% chance of $1000
(a) $100 for sure; (b) 25% chance of $1000
(a) $50 for sure; (b) 25% chance of $1000
Individual subjective values for multiple odds against can be plotted and fit a curve to the function:

\[ v_d = \frac{V}{1 + h\Theta} \]

- Note: \( \Theta = \text{odds against} = \frac{(1-p)}{p} \)

![Probability Discounting of Rewards](image-url)
Summary of Gambling-Related Probability Discounting Research

- Theoretically linked to gambling
- Existing research
  - Shead et al. (2008) – no assoc btw. prob. discounting & PGSI scores
  - Holt et al. (2003) – gamblers lower h vs. non-gamblers
  - Madden et al. (2009) – PGs lower h vs. controls
Current Research Program

Purpose: Clarify how tendencies towards each type of discounting relate to gambling behavior

- How does discounting (including other types) relate to actual gambling behavior?
- Can discounting be manipulated reliably?
- Can changes to discounting impact gambling initiation and decisions?
Shead & Talisman (2013): Methods

- 51 university students with “gambling experience”
- Questionnaires: demographics, GAQ, PGSI
- 2 discounting tasks: 1) delay, 2) probability
- 1 of 2 gambling tasks - opportunity to gamble with $5
  - 1) Instant win scratch tickets ($n = 26$)
  - 2) Roulette game ($n = 25$)
Shead & Talisman (2013)
## Sample Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender - Female</strong></td>
<td>71%</td>
<td></td>
<td></td>
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<tr>
<td><strong>PGSI Category</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Non-problem (0)</td>
<td>41.2%</td>
<td></td>
<td></td>
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<tr>
<td>Low-risk gambler (1-2)</td>
<td>51.0%</td>
<td></td>
<td></td>
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<tr>
<td>Moderate risk gambler (3-7)</td>
<td>7.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem gambler (8+)</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>22.2</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td><strong>Gambling Activity (Past month)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gambling Frequency</td>
<td>7.4</td>
<td>14.1</td>
<td></td>
</tr>
<tr>
<td>Time Spent Gambling (hours)</td>
<td>4.6</td>
<td>8.9</td>
<td></td>
</tr>
<tr>
<td>Money gambled</td>
<td>$51.40</td>
<td>$82.80</td>
<td></td>
</tr>
<tr>
<td>$ spent out of $5 on tickets/roulette in session</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Scratch tickets</td>
<td>$2.96</td>
<td>$1.91</td>
<td></td>
</tr>
<tr>
<td>Roulette</td>
<td>$3.52</td>
<td>$1.81</td>
<td></td>
</tr>
<tr>
<td>Combined</td>
<td>$3.24</td>
<td>$1.86</td>
<td></td>
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</tbody>
</table>
Results

- Degree of **delay discounting** related to self-reported recent gambling activity but **not** to gambling in session
- ↑ delay discounting associated with more **time** spent gambling in past month
- \( r = .28, p = .04 \)
Results

- In contrast, degree of **probability discounting** was not related to self-reported gambling but was related to gambling within session*

  - *Only for purchase of scratch tickets

  - ↓ rates of probability discounting associated with purchase of more instant win scratch tickets in session

  - \[ r = -.43, p = .03 \]
Results

- High proportion of Ps who either bought $5 or $1
  - No one bought 0 tickets
  - 11 bought 1 ticket
  - 2 bought 2 tickets
  - 1 bought 3 tickets
  - 1 bought 4 tickets
  - 11 bought 5 tickets

- Low purchasers: $M_{AUC} = 0.07$
- High purchasers: $M_{AUC} = 0.12$

\[t(23) = 2.55, \ p = 0.018, \ d = 1.01\]
Comparison of Probability Discounting Curves between Low ($1/$2) & High ($4/$5) Scratch Ticket Buyers

- Low Scratch Ticket Purchase ($1/$2)
- High Scratch Ticket Purchase $4/$5
Discussion

- Rates of probability and delay discounting related to different indicators of gambling
- Reflect *unique processes* involved in different aspects of gambling behavior
  - Delay discounting may relate to general tendency towards involvement in gambling (i.e., time spent)
  - Probability discounting may relate to decisions to gamble in immediate context
- Moderated by type of gambling activity
Next Studies

- Explore strategies to change discounting rates (esp. probability discounting)
  - Impact on gambling in immediate context vs. prospective gambling
- Clinical vs. non-clinical samples
- Findings will help identify potential clinical applications
Thank you for your attention!

- Additional thanks to:
  - Mitch Callan, University of Essex
  - Ontario Problem Gambling Research Centre
  - Mount Saint Vincent University
  - Grant Hatcher

- For a copy of this presentation & references email: Will.Shead@msvu.ca
References

References

- Petry, N. M. (2012). Discounting of probabilistic rewards is associated with gambling abstinence in treatment-seeking pathological gamblers. *Journal of Abnormal Psychology, 121*(1), 151-159.