Dissociating the Roles of Delay and Probability Discounting in Gambling Behavior

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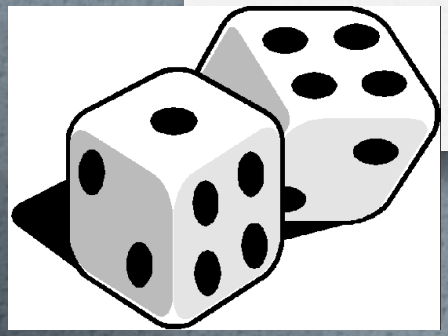


Now or Later?

- How would you like a gift?

- **<u>Now</u>** vs. **<u>1 week</u>**
- Rewards now are worth more than later
  - Delayed rewards are ***<u>discounted</u>***

Delay Discounting

Now

Later

- Outcomes in future are <u>devalued</u> – 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

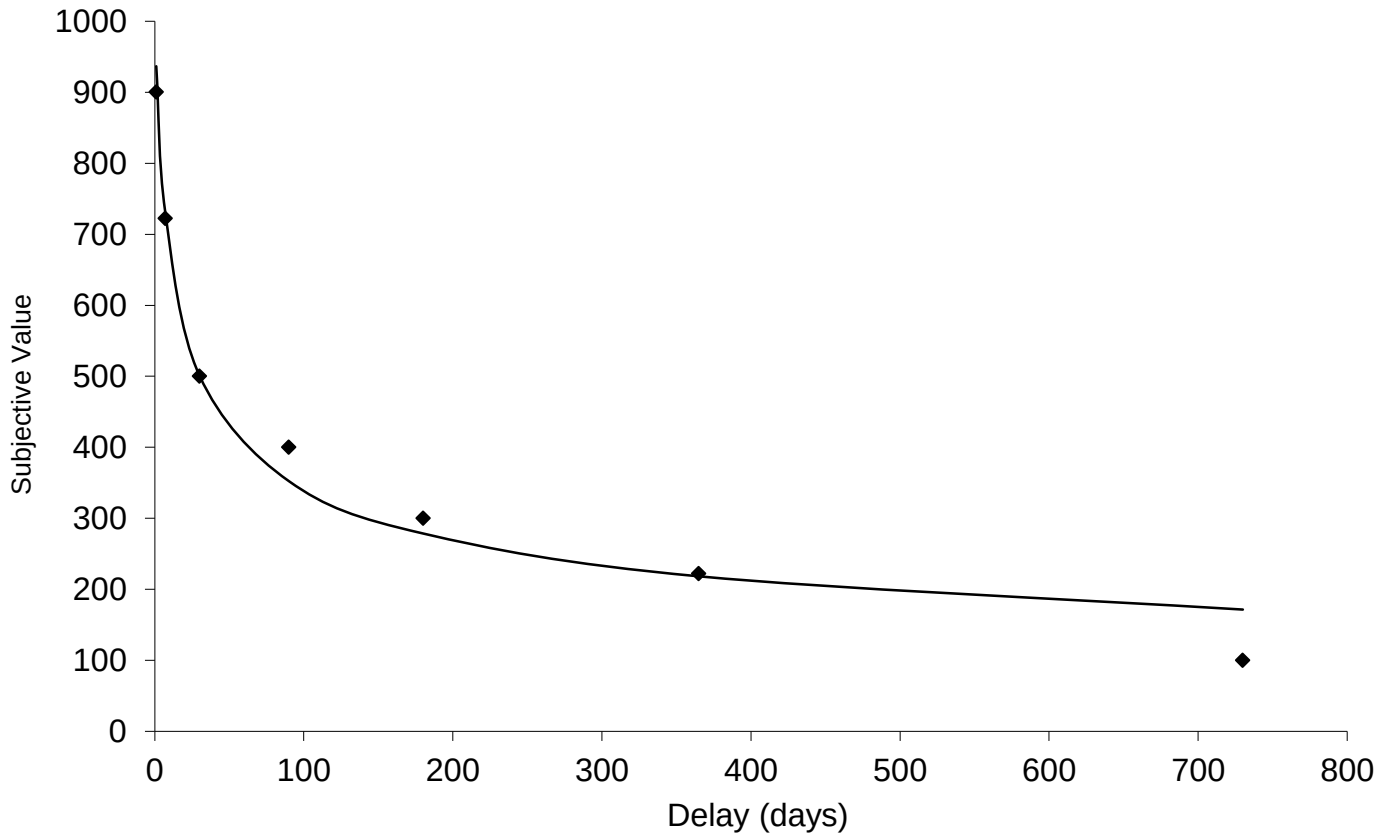
Delay Discounting Paradigm

- Decisions between <u>smaller, immediate</u> vs. <u>larger, delayed</u> 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

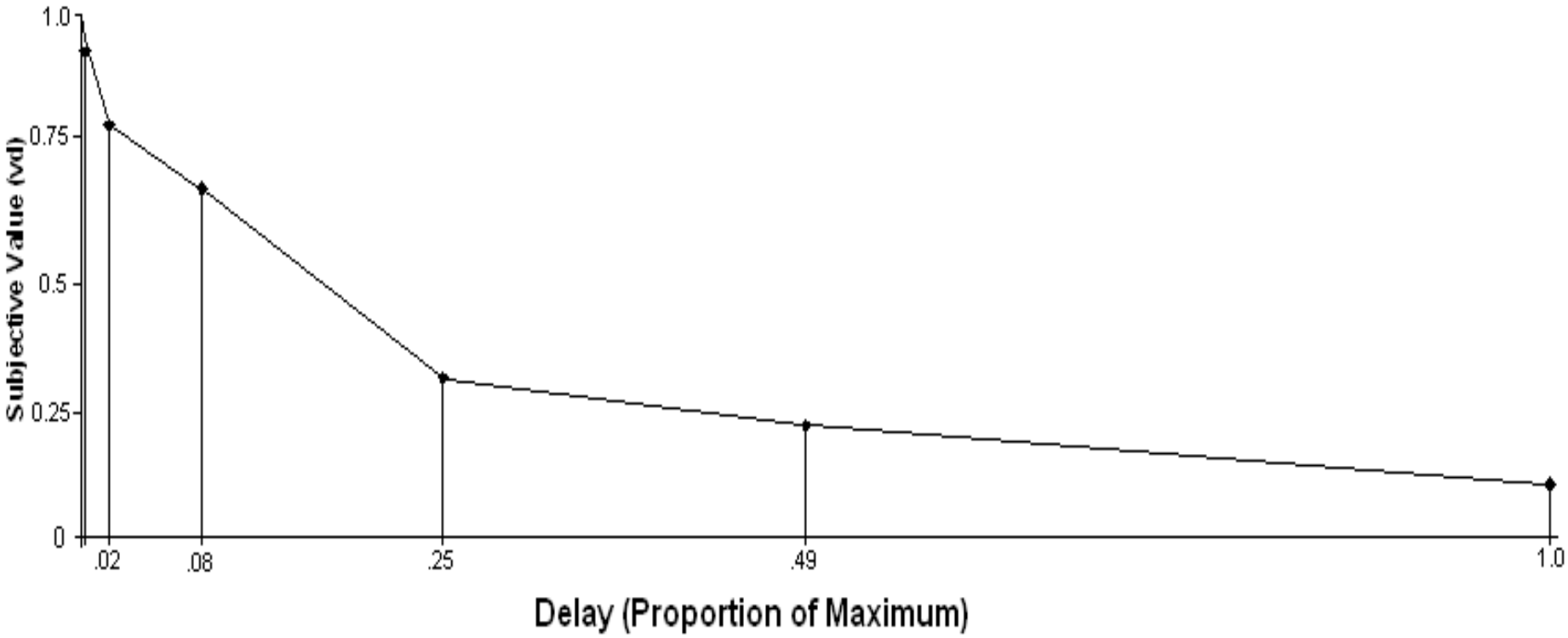
- Individual subjective values for multiple delays can be plotted and fit a curve to the function:

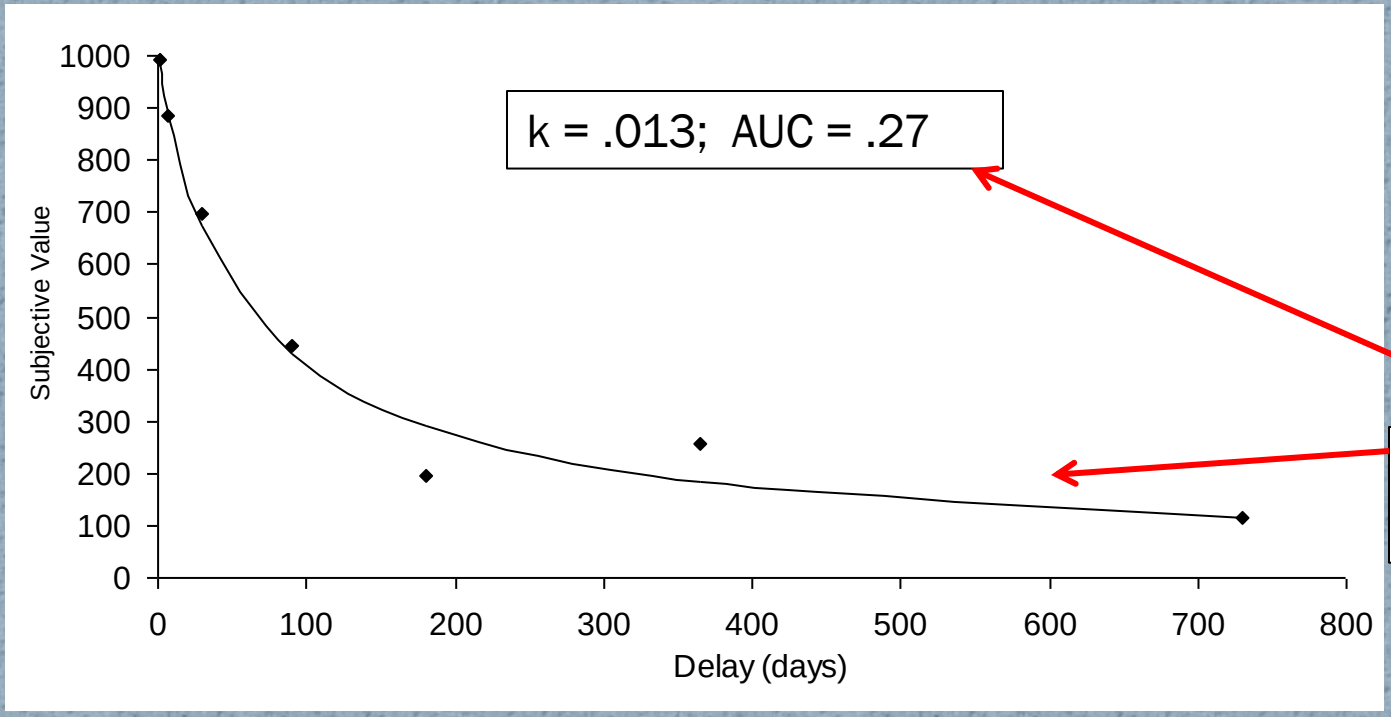
$v_d = V/(1 + kD)$ Note: k = rate of discounting



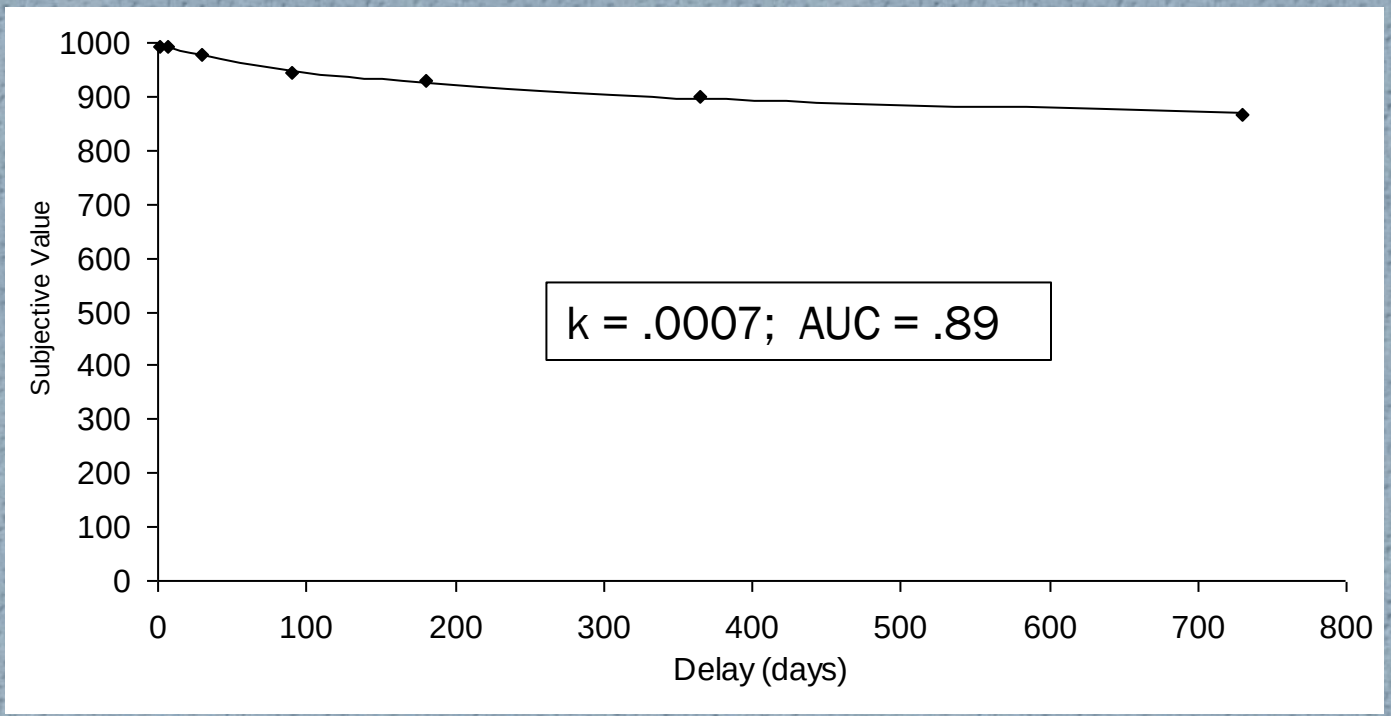
Area Under Discounting Curve

- 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





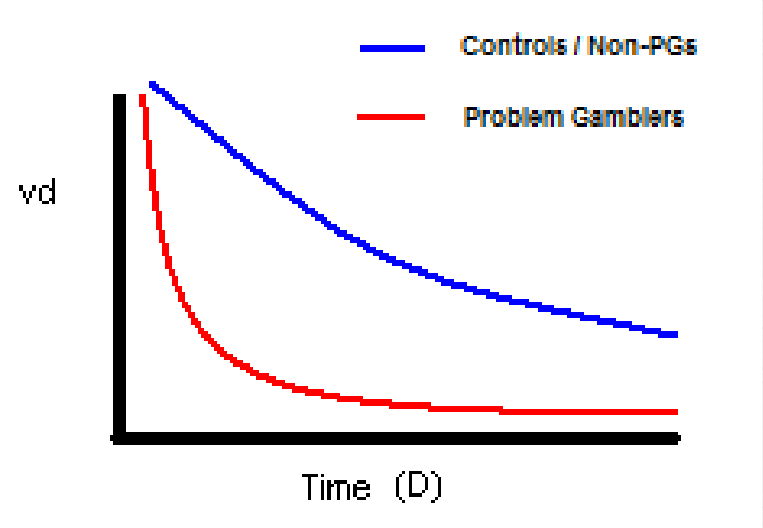
Steeper rate of discounting



Delayed Gratification

Delay Discounting & Gambling

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



Delay Discounting & Gambling

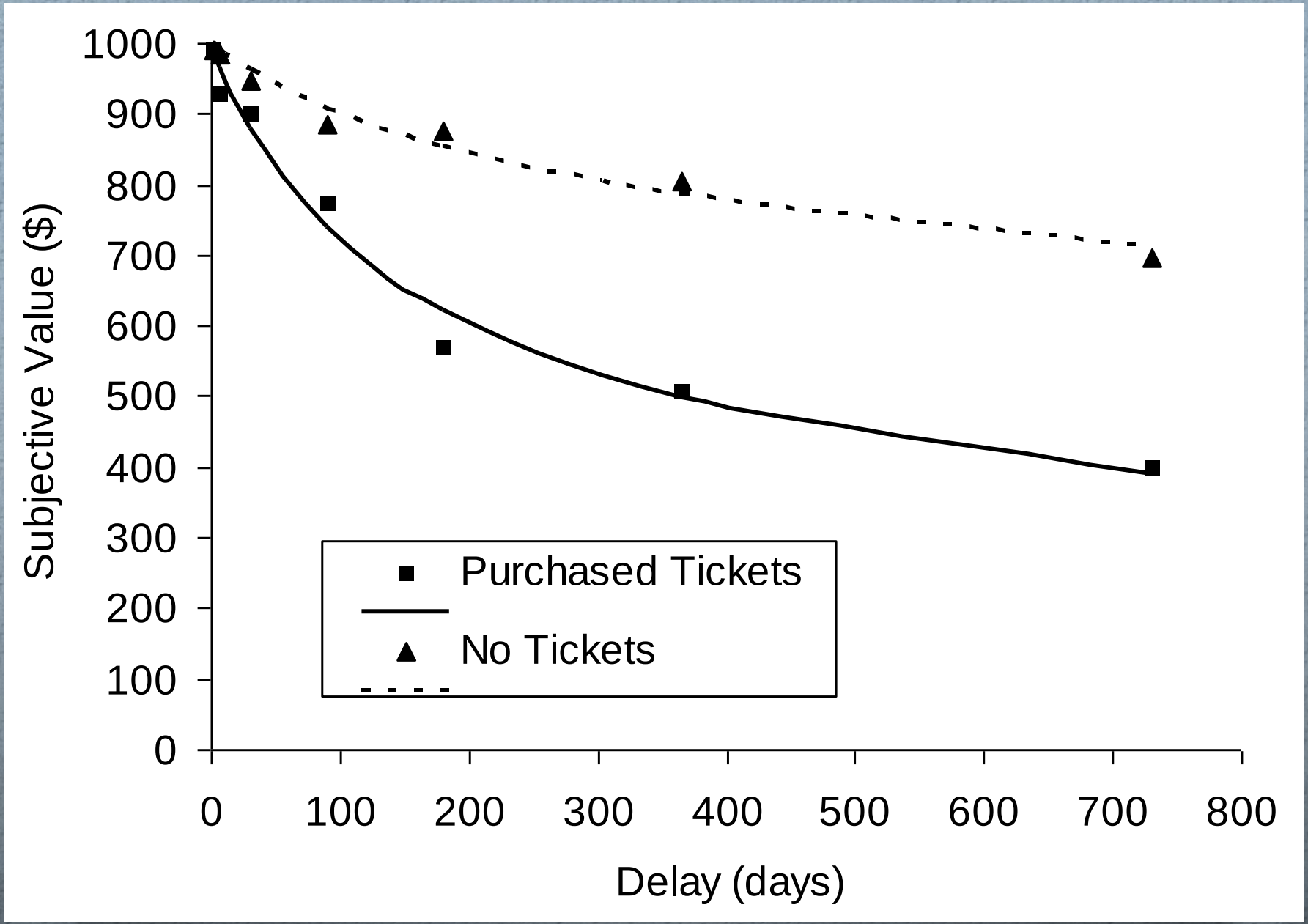
- Problem gamblers prefer smaller, immediate rewards over larger, delayed rewards
- Why?
  - PGs discount long-term benefits of abstaining from gambling
- Highlights gambling's function as a way to satisfy **immediate needs**

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

Measures	1.	2.
1. AUC	--	
2. Tickets	-.50**	--


1000
900
800
700
600
500
400
300
200
100
0
Subjective Value ($)
0
100
200
300
400
500
600
700
800
Delay (days)
Purchased Tickets
No Tickets

Callan, Shead, & Olson, 2011

- Evidence that steeper delay discounting predicts increased gambling in <u>immediate context</u>
  - 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:

$$v_d = V/(1 + h\Theta)$$

-Notes: h = rate of probability discounting

Θ = 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
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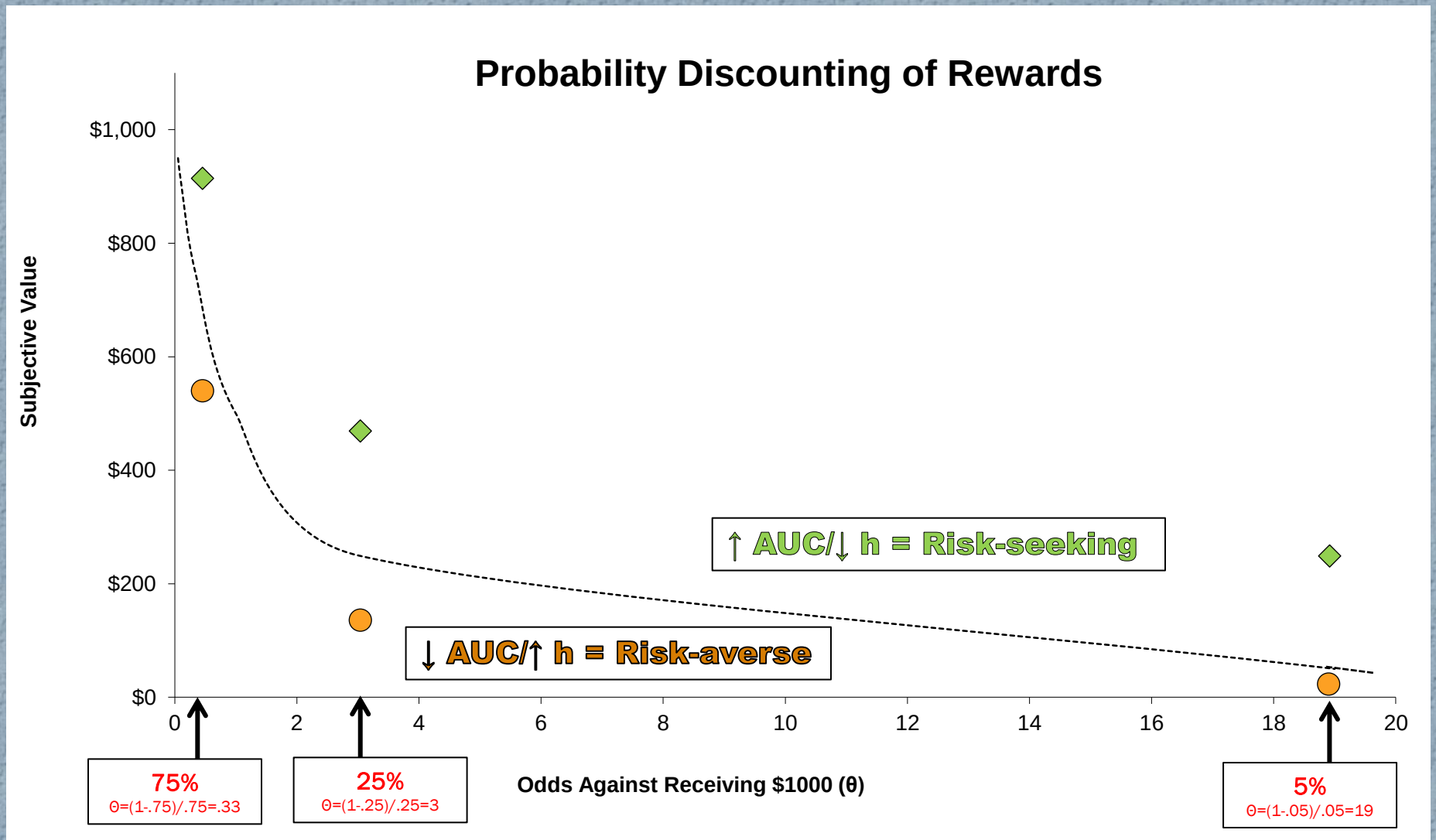
  (a) $200 for sure; (b) 25% chance of $1000
  (a) $100 for sure; (b) 25% chance of $1000
  (a) $50 for sure; (b) 25% chance of $1000

- Individual subjective values for multiple odds against can be plotted and fit a curve to the function:

$$v_d = V/(1 + h\Theta)$$ -Note: Θ = odds against = (1-p)/p



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

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

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
    - $r = -.43$, $p = .03$

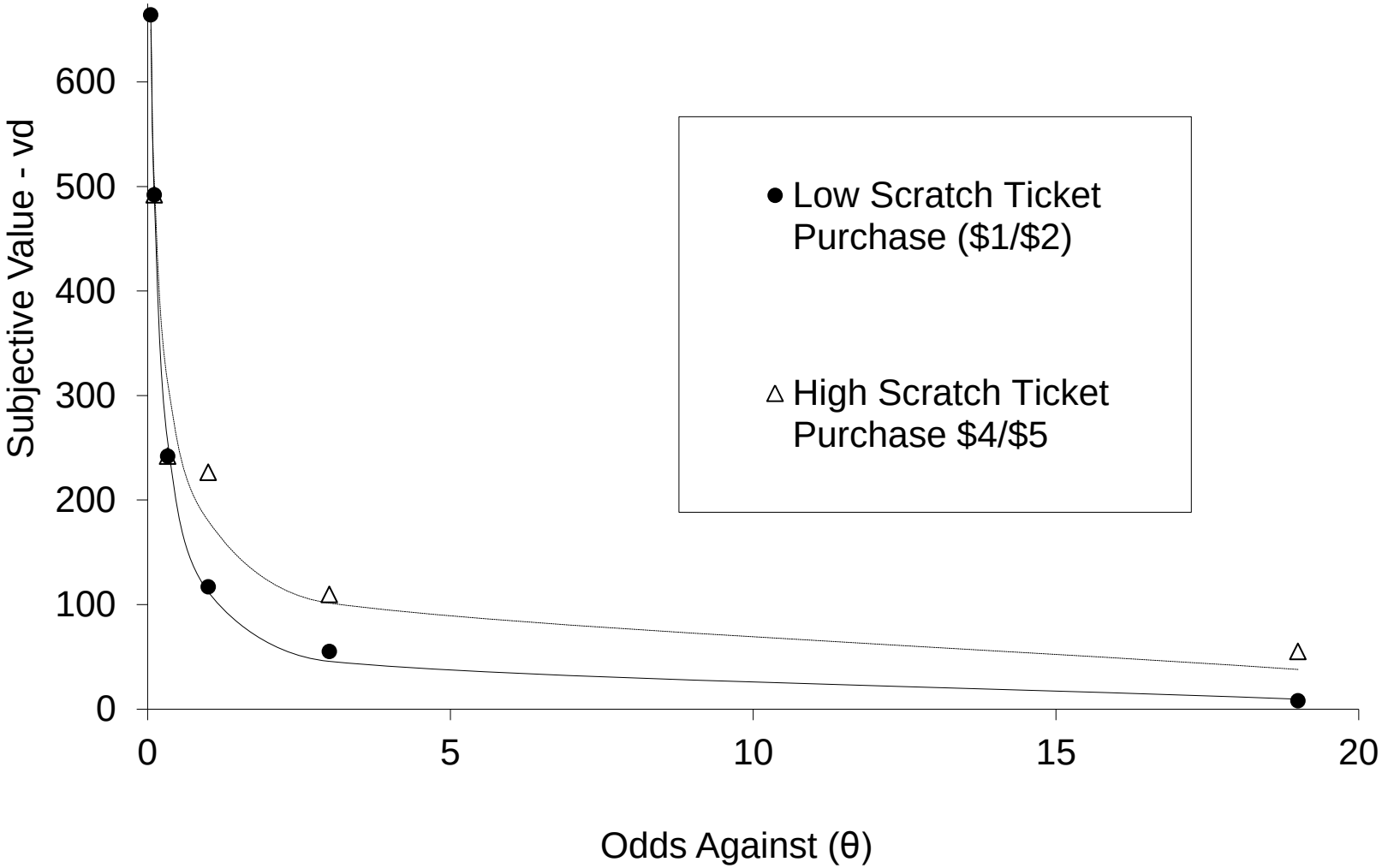
Results

- 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} = .07
- High purchasers: M_{AUC} = .12
  - $t(23) = 2.55$, $p = .018$, $d = 1.01$

Low Purchasers

High Purchasers

Comparison of Probability Discounting Curves between Low ($1/$2) & High ($4/$5) Scratch Ticket Buyers



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!

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  - Ontario Problem Gambling Research Centre
  - Mount Saint Vincent University
  - Grant Hatcher

- For a copy of this presentation & references email:

  Will.Shead@msvu.ca

References

- Ainslie, G. (1975). Specious reward: A behavioral theory of impulsiveness and impulse control. *Psychological Bulletin, 82*, 463-496.
- Alessi, S. M., & Petry, N. M (2003). Pathological gambling severity is associated with impulsivity in a delay discounting procedure. *Behavioural Processes, 64*, 345-354.
- Callan, M. J., Shead, N. W., & Olson, J. M. (2011). Personal relative deprivation, delay discounting, and gambling. *Journal of Personality and Social Psychology, 101*(5), 955-973. doi: 10.1037/a0024778
- Crean, J. P., de Wit, H., & Richards, J. B. (2000). Reward discounting as a measure of impulsive behavior in a psychiatric outpatient population. *Experimental and Clinical Psychopharmacology, 8*, 155-162.
- de Wit, H., Flory, J. D., Acheson, A., McCloskey, M., & Manuck, S. B. (2007) IQ and nonplanning impulsivity are independently associated with delay discounting in middle-aged adults. *Personality and Individual Differences, 42*, 111-121. doi: 10.1016/j.paid.2006.06.026
- Dixon, M. R., Marley, J., & Jacobs, E. A. (2003). Delay discounting by pathological gamblers. *Journal of Applied Behavior Analysis, 36*, 449-458. doi: 10.1901/jaba.2003.36-449.
- Doiron, J.P., & Nicki, R.M. (2007). Prevention of pathological gambling: A randomized controlled trial. *Cognitive Behaviour Therapy, 36*, 74-84.
- Ferris, J. & Wynne, H. (2001). *The Canadian Problem Gambling Index: User Manual*. Report to the Canadian Inter-Provincial Task Force on Problem Gambling.
- Green, L., & Myerson, J. (1993). Alternative frameworks for the analysis of self control. *Behavior and Philosophy, 2*, 37-47.
- Holt, D. D., Green, L., & Myerson, J. (2003). Is discounting impulsive? Evidence from temporal and probability discounting in gambling and non-gambling college students. *Behavioural Processes, 64*, 355-367. doi: 10.1016/S0376-6357(03)00141-4
- Kirby, K. N., Petry, N. M., & Bickel, W. K. (1999). Heroin addicts have higher discount rates for delayed rewards than non-drug-using controls. *Journal of Experimental Psychology: General, 128*, 78-87.
- MacKillop, J., Anderson, E. J., Castelda, B. A., Mattson, R. E., & Donovick, P. J. (2006). Divergent validity of measures of cognitive distortions, impulsivity, and time perspective in pathological gambling. *Journal of Gambling Studies, 22*, 339-354. doi: 10.1107/s10899-006-9021-9.

References

- Madden, G. J., Petry, N. M., & Johnson, P. S. (2009). Pathological gamblers discount probabilistics rewards less steeply than matched controls. *Experimental and Clinical Psychopharmacology, 17*, 283-290. doi: 10.1037/a0016806
- Mischel, W., Ebbesen, E. B., Raskoff Zeiss, A. (1972). Cognitive and attentional mechanisms in delay of gratification. *Journal of Personality & Social Psychology, 21*(2), 204-218. doi: 10.1037/h0032198.
- Myerson, J., Green, L., & Warusawitharana, M. (2001). Area under the curve as a measure of discounting. *Journal of the Experimental Analysis of Behavior, 76*, 235-243.
- 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.
- Petry, N. M. (2001). Pathological gamblers, with and without substance use disorders, discount delayed rewards at high rates. *Journal of Abnormal Psychology, 110*, 482-487.
- Petry, N. M., & Casarella, T. (1999). Excessive discounting of delayed rewards in substance abusers with gambling problems. *Drug and Alcohol Dependence, 56*, 25-32. doi: 10.1016/S0376-8716(99)00010-1
- Reynolds, B., Karraker, K., Horn, K., & Richards, J. B. (2003). Delay and probability discounting as related to different stages of adolescent smoking and non-smoking. *Behavioural Processes, 64*, 333-344.
- Reynolds, B., Richards, J. B., Horn, K., & Karraker, K. (2004). Delay discounting and probability discounting as related to cigarette smoking status in adults. *Behavioural Processes, 65*, 35-42.
- Richards, J. B., Zhang, L., Mitchell, S. H., & de Wit, H. (1999). Delay or probability discounting in a model of impulsive behavior: Effect of alcohol. *Journal of the Experimental Analysis of Behavior, 71*, 121-143.
- Shead, N. W., Brine, S., Gaudet, J., Haggett, M., Rudolph, E., Talisman, E. (2012, June). *The impact of gambling and exposure to scientific communication on discounting of delayed gains.* Poster session presented at the 2012 Annual Convention of the Canadian Psychological Association, Halifax, NS.