Intertemporal Choices and Delay (Future) Discount

Making a choice between immediate reward and delayed (future) reward

Overview: Factors that Influence Intertemporal Choices

Reinforcement Schedules
Matching Law
Diminishing Marginal Returns
Future discount functions
SS vs. LL Rewards
Goal and MR Settings and SQ Trajectory
Life-history Variables
Relational Variables
Physiological Variables

Learning and Training

Two reward dimensions:
Amount and Time (delay)

Four reinforcement schedules:

Fixed interval	Fixed ratio
Variable interval	Variable ratio

Matching Law

$$\frac{\text{Option A}}{\text{Option B}} = \frac{\text{Prob. A}}{\text{Prob. B}} = \frac{1/\text{Delay A}}{1/\text{Delay B}}$$

What looks irrational for an individual, however, can be optimal for a group.
Probability matching allows the most efficient use of resources by multiple individuals.

Marginal Utility (MT) & Total Utility (TU)

Principle of diminishing marginal utility: As more units of a good are consumed, additional units will provide less additional satisfaction than previous units.

Delay (Future) Discount Functions

Organisms ‘discount the future’ when they value imminent goods over future goods.

What is present value of a future payment?

Exponential discounting function:

$$\text{Value} = \frac{\text{Value at no delay}}{(1 - \text{Discount rate})^{\text{Deley}}}$$

Behavioral economics:

We generally prefer smaller, sooner payoffs to larger, later payoffs when the smaller payoffs would be imminent;

When same payoffs are distant in time, we tend to prefer the larger, even though the time lag would be the same

Hyperbolic discounting function:

$$\text{Value} = \frac{\text{Value at no delay}}{[\text{Constant} + \text{Impatience factor} \times \text{delay}]}$$

Why is it so difficult to generate concern for events that are seen as belonging to the future even though their consequences may be dire?

While banks use a linear discount rate, there is strong evidence that human beings use a more complex function that comes from different parts of our brain. The more primitive parts (the brain stem and limbic system) are concerned with immediate survival and emotional responses. They are much less capable of long-term evaluation, but provoke the strongest reactions to pleasure or fear. The neocortex, on the other hand, is our thinking brain. It analyzes, predicts and plans for the future, but has more limited access to our emotional triggers.

Future discount and value function

Losses are typically discounted less than gains (dynamic inconsistency).

Discount ratio effect and intertemporal choice

Saving $5 /$10 vs. $5/$100

Ratio effects are reduced in an intertemporal saving context.

Discounting rates are greater for smaller rewards than larger rewards.

Goal setting and intertemporal choice

People prefer improving to declining sequence of rewards of the same overall value.

People require more compensation to delay delivery of a reward than they are willing to speed up delivery of that reward by the same amount of time.

SS (Smaller & Sooner) vs. LL (Larger & Later) Payoffs

Intertemporal choices involve a tradeoff between the amount and the delay of rewards.

People often discount future rewards, particularly when they are young, male, under stress, additive to drugs, prompted for immediate gains, and low in energy budget and blood sugar levels.

In making intertemporal decisions between SS and LL rewards, the process of approaching a goal (G) can be viewed as a process of status quo (SQ) **improvement** whereas the process of falling towards a minimum requirement (MR) can be seen as a process of SQ **deterioration**.

Goal, MR Settings & SQ Trajectory

For an upward expected SQ over time, SS should be preferred to LL (SS > LL) if SS can reach a goal earlier. SS (or any choice) should be preferred whenever it will be sufficient for reaching the goal state. The upper middle arrow is LL in respect to the upper left arrow but SS in respect to the upper right, yet in either case it should be preferred because it moves the person past the goal. Essentially, the crucial determinant is not maximizing value but minimizing the goal discrepancy as quickly as possible. Outcomes that fall both below or both above a reference point (a goal or a minimum requirement) are expected to be similar in their psychological values whereas outcomes that are located on different sides of a reference point are expected to be significantly different in psychological values.

For a downward expected SQ over time, LL options should be preferred to the SS alternatives (LL > SS) provided that the delay will not allow the person to fall or remain below the MR. However SS options should be preferred when they can keep the SQ above the MR or bring the SQ above the MR sooner than LL alternatives. In the case illustrated in the low part of the figure, the medium gain would be superior to the largest gain (SS > LL) since survival cannot be delayed. A starved man needs any food that can feed him instead of a delayed larger supply. As the SQ approaches the MR in time, the temporal difference is vital but the amount difference is functionally null.

Life-History Variables

Sex Differences in Life-History Variables

	Men	**Women**
Lifespan		
Reproductive Span		
Reproductive Variance		
Future Discount		

Diminishing Marginal Return		
Financial Goals		

A Hypothetical Framework of Personal Temporal Values at Risk

	Diminishing Marginal Return	Future Discount
Leaders		
Politicians/Bureaucrats		
Gamblers		
Professors/Teachers		
Youth		
Elders		
Men		
Women		

Life Expectancy and Risk Taking

Organisms "discount the future' when they value imminent goods over future goods.

The variance in life expectancy was found to be highly correlated with homicide rates (Daly & Wilson, 1997).

Psychologists, economists, and criminologists have found that people who are more risk taking (young adults, poor people, and criminal offenders) all tend to discount strongly the future.

Who will discount a future reward more, men or women?

In a study conducted in Russia, a significant negative correlation between the proneness to risk-taking and life-expectancy was obtained among men only.

$r = -.322$, $p > .01$

Relational Variables

Hamilton's rule: **C < rB**

An investment should be made if the cost to the investor (C) is less than the benefit to the receiver (B) discounted by r.

Rate-of-Return and **Net Present Value** (NPV) **Rule**:

$NPV = C_0 + C_1 / (1 + r)$

$\mathbf{C_0}$ = the investment at present which is usually a negative number, $\mathbf{C_1}$ =the expected return at a future time, and r = the rate of discount.

Revised NPV Rule:

NPVr = $[C_0 / (1 + r1)] + C_1 / (1 + r2)$

r1 = relational index
r2 =the rate of future discount

Physiological Variables

Physiology of Foraging: Fluctuating Blood Glucose Levels Affect Future (Delay) Discounting (Wang & Dvorak, 2009)

Daily changes in energy consumption and expenditure, as indicated by blood glucose levels, may also provide a dynamic weighting scale for evaluating immediate versus future returns.

- When body energy budget is positive or increasing, organisms should be, on average, more future oriented.
- When body energy budget is negative or decreasing, organisms should value present resources more than future resources to avoid survival threatening consequences.

Time Perspectives

Time Paradox 1 - Time is one of the most powerful influences on our thoughts, feelings, and actions, yet we are usually totally unaware of the affect of time in our lives.

Time Paradox 2 - Each specific attitude toward time—or time perspective—is associated with numerous benefits, yet in excess each is associated with even greater costs.

Time Paradox 3 - Individual attitudes toward time are learned through personal experience, yet collectively attitudes toward time influence national destinies.

Past, Present, and Future Orientations

Past Negative
Present Hedonistic
Future
Past Positive
Present Fatalistic

http://fora.tv/2008/11/12/Philip_Zimbardo_The_Time_Paradox

The Marshmallow Study

The ability to delay gratification at age four is twice as good as a predictor of later SAT scores as IQ. Poor impulse control is also a better predictor of juvenile delinquency than IQ.