A Transdiagnostic Approach to Treating Self-Control Failure

Warren K. Bickel, Ph.D.
Addiction Recovery Research Center
Virginia Tech Carilion Research Institute
Virginia Tech
Goal

- Self-control failure, a dysregulation of a dual system, is a central component of addiction and related disorders.
- Predictions by this dual system can be tested:
  - Decreasing flexibility across disorder progression
  - The valuation of drug is inversely related to the length of the window for integrating reinforcements
- Explore a new approach to interventions (Narrative Theory and Methods)
- Explain it from my experience of coming to understand this new theory across my career.
The Question
Time Course of Positive and Negative Outcomes
Valuing the Future

Years

Controls

Heroin

00 01 02 04 05
Alcoholism
Cigarettes
Obesity
Risky Behavior
Table 1. Contributors to global mortality in 2000, categorized by fundamental cause.

<table>
<thead>
<tr>
<th>Fundamental cause</th>
<th>Primary shortfalls and drivers</th>
<th>Millions of years of life lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Childhood and maternal malnutrition</td>
<td>Poverty, technology, apathy</td>
<td>200</td>
</tr>
<tr>
<td>High blood pressure, cholesterol, overweight, low physical activity</td>
<td>Consumption, denial</td>
<td>150</td>
</tr>
<tr>
<td>Unsafe sex</td>
<td>Ignorance, denial</td>
<td>80</td>
</tr>
<tr>
<td>Tobacco</td>
<td>Denial</td>
<td>50</td>
</tr>
<tr>
<td>Unsafe water</td>
<td>Poverty, technology, apathy</td>
<td>50</td>
</tr>
<tr>
<td>War and revolution (20th-century average)</td>
<td>Violence</td>
<td>40</td>
</tr>
<tr>
<td>Indoor smoke from solid fuels</td>
<td>Poverty, technology</td>
<td>35</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Wasted potential, ignorance, denial</td>
<td>30</td>
</tr>
<tr>
<td>Urban air pollution</td>
<td>Consumption, technology</td>
<td>6</td>
</tr>
<tr>
<td>Global climate change</td>
<td>Consumption, technology, denial</td>
<td>5</td>
</tr>
</tbody>
</table>

Holdren, 2008, Science

310 or 52%!
Contemporary Status of the Analysis of Disease

Unique Etiology +

Extreme Specialization +

Reductionistic Approach +

Increased rates of publication

= Scientific Silos
A New Application of an Old Approach

“Thence is imposed the task of everywhere seeking out in the natural phenomena those elements that are the same, and that amid all multiplicity are ever present.”

-Ernst Mach (1893) Physicist and Philosopher of Science
The Study of Trans-Disease Processes (TDP)

• “the goal of the analysis of TDP... is to understand the processes that operate in more than one disease and use that information to inform, in principle, all the diseases in which it is evident.”

-Bickel & Mueller (2009)
Delay Discounting
(AKA temporal discounting, delay of gratification, inter-temporal choice, time preference, etc.)

• refers to the reduction in value of a reinforcer as a function of the delay to reinforcer delivery.

• Psychophysical Titration Procedure
  – Developed by Mazur (1987) with pigeons
  – Used by Rachlin, Raineri, and Cross (1991) with humans
### Adjusting Procedure with Hypothetical Money

<table>
<thead>
<tr>
<th>Immediate Adjusting</th>
<th>Delayed Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>$990</td>
<td>$1,000</td>
</tr>
<tr>
<td>$980</td>
<td>$1,000</td>
</tr>
</tbody>
</table>
Adjusting Procedure

Point of Subjective Equality

Delay
Hyperbolic Decay Model (Mazur, 1987)

\[ V = \frac{A}{1 + kD} \]

- \( V \) = Value of reinforcer
- \( A \) = Amount of reinforcer
- \( D \) = Delay of reinforcer
- \( k \) = Discounting rate
Excessive Discounting: A Trans-Disease Process

• Addiction (alcohol, cigarettes, cocaine, methamphetamine, opioids, sedatives)*
• Problem Gambling
• Obesity
• Low vs High SES
• Risky Sexual and Injection Practices
• Outcomes in clinical trials of behavior change

• Health Behaviors (BP-checks, cholesterol testing, dental visits, eating breakfast, exercise, follow physician advice, flu shot, mammograms, pap smear, prostate exam, seat belt, or medically compliant)
• Debt
• At the other Extreme: Anorexia, OCD

* Not marijuana dependence
Excessive Discounting: A Candidate Behavioral Marker of Addiction

- Predicts who will later use substances
- Degree of discounting is proportional to drug use
- Can distinguish drug dependent from controls & or in recovery
- Is predictive of therapeutic success
- Can be changed therapeutically

* Bickel et al., 2014
Delay Discounting as a Multi-Component Process?

McClure et al., *Science*, 2004
Competing Neurobehavioral Decision Systems

**Impulsive System**
- Embodied: Limbic & Para Limbic brain regions
- Function: Biological Reinforcers,
- Characteristics in health: Regulatory balance
- Characteristics in disease: Hyperactive

**Executive System**
- Embodied: Prefrontal Cortex
- Function: Valuation of future, Planning, Remembering
- Characteristics in health: Regulatory balance
- Characteristics in disease: Hypoactive

Bickel et al., 2007
Addiction-Related Loss of Value of Normally Rewarding Events

• Reduced happiness, interest, and pleasure in response to normally-rewarding events

• Associated with an enhanced valuation of drug reinforcement.

• Perhaps, addiction-related loss of normal reward and enhanced valuation of drug are inversely related

• This constitutes the behavioral economic concept of Reinforcer Pathology

Reinforcement Pathology

- Reinforcers are integrated over a temporal window.
- If the temporal window of integration decreases, then the valuation of brief intense reinforcers should increase, while the valuation of low intensity temporally extended reinforcers should decrease.
Reinforcer Pathology?

Temporal Window of Reinforcement Integration

$S^{R+}$
Reinforcer Pathology

Temporal Window of Reinforcement Integration

Reinforcement Value

$S^R+$
Reinforcer Pathology

Temporal Window of Reinforcement Integration

Reinforcement Value
Reinforcer Pathology

Temporal Window of Reinforcement Integration

$S_{R^+}$

Reinforcement Value
Reinforcer Pathology

Temporal Window of Reinforcement Integration

$S^R+$

Reinforcement Value
Testing Reinforcement Pathology

• If a shorter temporal window increases the value of drug reinforcement and decreases the valuation of “normally-rewarding events,” then, perhaps, increasing the temporal window, even if only momentarily, should decrease drug reinforcement.
Toward Narrative Theory

- Humans are social organisms
- The social brain hypothesis suggests group size and sociality are major evolutionary determinant in the PFC size and executive function (Dunbar & Schultz, 2007).
Toward Narrative Theory

• Human can have more friends and acquaintances via the use of language

• 65% of human conversations are about “gossip” (Dunbar, 2004).

• We use distinct story-like structures to talk with each other (Marr, 2004)

• Humans see narratives when none exist:
  – Heider & Simmel (1944)
  – Gazzagna (2005)
Toward Narrative Theory
Heider & Simmel (1944)

• 34 undergraduates were shown a brief film
• Two triangles and a circle moved across the screen and a rectangle remained stationary
• Asked what they saw
• 33 created a narrative such as the circle was “nervous” and escaping from the rectangle
• 1 said he saw geometric shapes
Split Brain Studies
(Gazzaniga, 2005)
Toward Narrative Theory

• Examine the effects of narrative and narrative structure on the salience, valuation, and preference for immediate and delayed options.
Framework for Narrative Methods

- Components
  - Who generates the narrative? Self or Others
  - Who is it about? Self or Others
  - Temporal Perspective? Now or Later
  - Valance? Positive or Negative
  - Human Biases? Incorporated or Not
Now

Later

By self, for self  By others, for self  By others, for others

Pos.  Neg.
Episodic Future Thinking

Now

Later

By self, for self

By others, for self

By others, for others

Pos.

Neg.
Episodic Future Thinking (EFT)

- Participants simulate future positive events as they make decisions about small immediate rewards versus larger delayed reward.
- EFT decreases discounting and entails enhanced coupling of brain regions (Hippocampus, Amygdala) not usually associated with discounting (Peters & Buchel, 2010).
- Epstein has extended EFT to the obese in a series of studies (2013).
Episodic Future Thinking

• A positive story generated by subjects about their future:
  – decreased discounting (greater valuation of future)
  – decreased measures of demand in both cigarette smokers and alcohol dependent individuals
  – decreased the amount smoking

• Consistent with the conception of reinforcer pathology and supports the notion that window of integration interacts with reinforcer value
Now

Abundance

Later

Scarcity

By others, for others

By self, for self

By others, for self

By others, for others
Scarcity and Abundance

- The psychological consequences of scarce resources endemic in poverty are of growing scientific and societal importance.
- Discounting is greater among those with low incomes (Lawrence, 1991).
- Abrupt point loss is associated with greater discounting in undergraduates (Haushofer et al., 2013).
- Our goal is to extend this work to scarcity and abundance narratives and examine its effects on gains & losses occurring in the future & past.
Bickel, Yi, Kowal & Gatchalian, 2008
Scarcity and Abundance

• A scarcity narrative generated by the experimenter about the participants’ current financial status increased the rate delay discounting for gains and losses in the future and the past

• An abundance story had minimal effects.

• Explicit zero generally decreased the rate of discounting regardless of scenario
By others, for others
By self, for self
By others, for self
By others, for others

Now
Later
Regret
Regret Expression and Social Learning

- We often learn from conspecifics (Gilman, Curran, Calderon, Stoeckel, & Eden, 2014)
- Regret avoidance is a human bias (Zeelenberg, 1999) and anticipation of regret leads to greater forethought regarding decisions (Janis & Mann, 1977)
- Bring together to determine if these narratives change sexual discounting (e.g., Johnson & Bruner, 2012)
Negative Outcomes With and Without the Expression of Regret

• Negative outcome with regret narrative generated by the experimenter about a putative friend who expressed regret delayed gratification for the most attractive and least STI partners

• A negative outcome narrative delayed sexual gratification with the least attractive partner

• These effects were selective and did not affect monetary discounting
Episodic Future Thinking

Now

Later

Abundance

By self, for self

Scarcity

By others, for self

Regret

By others, for others

Pos.

Neg.
Future Directions for Narrative Theory

- Fill other cells of the matrix
- Interaction with Nootropic medications
- Quantify the information in the narratives
  - Shannon’s theory of information?
Conclusions

• Delay discounting can be changed via narratives.
• Those changes appear to also impact valuation of drug reinforcers (reinforcer pathology).
• The longevity of the effects of these narratives are unknown and important to study.
• The studies presented here manipulated these narratives across 4 dimensions and may contribute an approach to interventions and develop narrative theory.
• This approach may also permit a means to empirically test prevention and therapeutic messages.
The most amazing thing for me is that every single person who sees a movie, not necessarily one of my movies, brings a whole set of unique experiences. Now, through careful manipulation and good storytelling, you can get everybody to clap at the same time, to hopefully laugh at the same time, and to be afraid at the same time.

-Steven Spielberg
Thanks

**Addiction Recovery Research Center**
- Kirstin Gatchalian
- Chris Frank, Ph.D.
- Mikhail Koffarnus, Ph.D.
- Amanda Quisenberry, Ph.D.
- Sarah Snider, Ph.D.
- Jeff Stein
- Laura Hartz
- Brian Brown
- Alex Bianco
- Corey Judd
- Patsy Marshall
- Lara Moody
- Elan Perry
- Mariah Schroen
- Nicole Seymour
- David Patterson

**Supported by:**
- NIDA,
- NIAAA,
- NCI,
- VTCRI