Temptation Lecture 1

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Plan for this Part of Course

- Bounded Rationality (4 lectures)
- Reference dependence (3 lectures)
- Temptation and Self control (3 lectures)
- Neuroeconomics (2 lectures)

Tentative Plan For Temptation

- Introduction: Why is temptation important?
- Evidence for temptation
- Models of temptation and self control
- Optimal behavior under temptation
  - Commitment vs Fleximility
  - Optimal control of visceral urges
- Applications
  - Contract design (yes, again)
  - Taxation

Tentative Plan For Today

- Why is temptation important?
- Evidence for temptation
  - Preference for Commitment
  - Dynamic Inconsistency
- Models of temptation and self control
  - Gul and Pesendorfer [2001]
  - Q-hyperbolic discounting [Laibson 1997]
  - Fudenberg and Levine [2006]
- Other interesting factoids
  - Willpower depletion
  - Sophistication

Why is Temptation and Self Control Important

- Temptation problems *seem* to be ubiquitous
- They effect the poor disproportionately
- 'Self Control' seems to be important in later life outcomes
- Roll Powerpoint!

Spotting Temptation and Self Control

- These behaviors seemed to be linked to temptation and self control
- But how would we know?
- As social scientists, when do we want to say we observed someone 'giving in' to temptation?

By the Nature of the Chosen Object?

- i.e. we identify self control problems with activities certain activities
  - Smoking
  - Drug taking
  - Undersaving (relative to some normative level)
- Claim "There is no 'rational' reason to take drugs, so anyone who takes drugs must be in the grip of a self control problem"
- This goes against standard economic methodology
- Very proscriptive – maybe benefit of cigarette smoking is higher than long term costs for some people

By Comparing People's Stated Aims to their Actions?

- E.g., tell us that they want to quit smoking, but then carry on smoking
- Standard economic line: revealed preference
- If someone says they want to do a, but actually does b, we would generally consider this evidence that they prefer b over a
- Talk is cheap

By Observing Choices Over Time?

- For example:
  - People repeatedly quit smoking, then restart
  - People take drugs when they are younger but not when they are older
  - People smoke when drunk, but not when sober
- Hard to distinguish between temptation and changing tastes
- Maybe drinking and cigarette smoking are compliments?

Two Standard Ways

- Preference for Commitment
- Time inconsistentency

Preference for Commitment

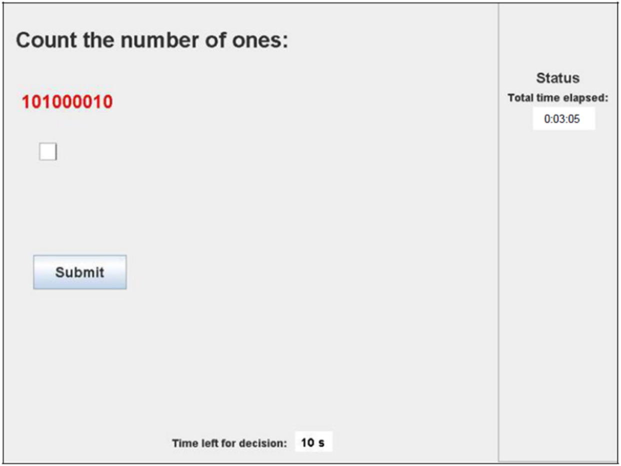
- Imagine we saw the following behaviors:
  - A gambler asks to be banned from a casino
  - A drinker asks to be given a drug that makes them violently ill if they drink
  - A diner pays to have a smaller portion of fries with their meal
- In other words, people choose at time t to reduce their choice set at time $t+1$
- One interpretation: worried about temptation at time $t+1$
  - Will either have to resist temptation
  - Or will give in and choose something they shouldn't

Preference for Commitment

- Is Temptation Only Explanation for Preference for Commitment?
- Would not be exhibited by
  - Was perfectly happy with the amount they drank
  - Had changing preferences over drinking, but were happy to make a game-time decision
- Stops talk being cheap
- However, there are other possibile reasons to limit choice
  - Regret [Sarver 2008]

Lab Evidence for Preference For Commitment

- Hauser et al. [2010]
- Basic Setup: Counting task

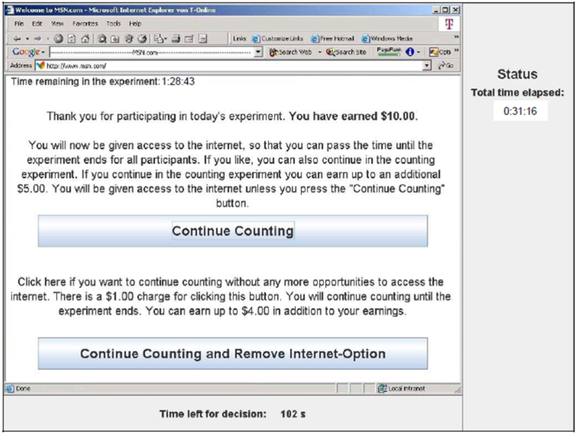


Lab Evidence for Preference For Commitment

- Counting task appeared every 1, 2 or 3 minutes
- Experiment lasts 2 hrs
- Subjects earn $15 if they get at least 70% of all counting tasks correct
- (This is a really unpleasant task)

Lab Evidence for Preference For Commitment

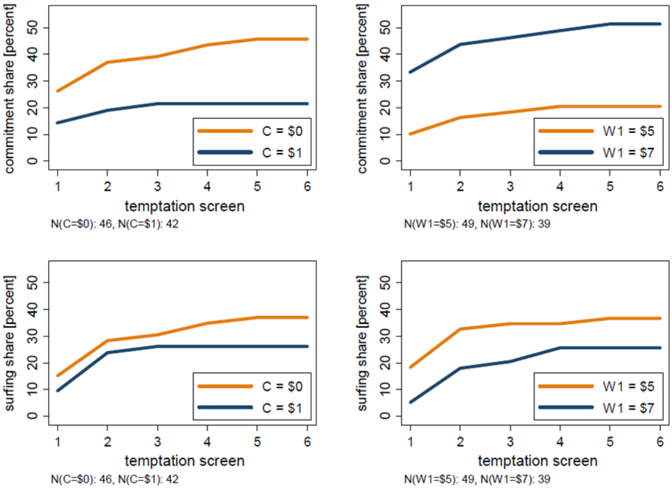
- Every so often, (and to their surprise) subjects would face a temptation screen:



Lab Evidence for Preference For Commitment

Phase	Duration	Number of counting tasks	Number of temptation screens	Commitment cost [in $]	Final payoff if surfing [in $]	Additional payoff for counting to end of experiment [in $]
0	30 min	15	0			
1	45 min	12	6	C	P_1	$W_1 = 15 - P_1$
2	45 min	12	6	C	P_2	$W_2 = 15 - P_2$

Lab Evidence for Preference For Commitment



Field Evidence for Commitment Devices: Ashrad el at [2006]

- SEED fund accounts: Offered as well as normal accounts
  - No benefit other than commitment
- Client either sets a date or an amount that they want to save (202 of 842 took it up)
- Cannot withdraw until that goal is met
- Two types of goal
  - Amount (142)
  - Date (60)
- Two types of additional commitment
  - Locked box (costs a small fee) which is then taken to the bank (167)
  - Automatic transfers (2)

Field Evidence for Commitment Devices: Ashrad el at [2006]

- There are commercially available commitment devices
  - SMarT
  - Stikk
  - Beeminder
- But surprisingly few
- Also hard to get temptation in the Lab
- Puzzle: If temptation is so ubiquitous, why are there so few commitment devices

Two Standard Ways

- Preference for Commitment
- Time inconsistentency

Time Inconsistency

- Imagine you are asked to make a choice for today
  1. Salad or burger for lunch
  2. 10 minute massage today or 11 minute massage tomorrow
  3. End class early today and move extra time to next week
- And a choice for next Thursday
  1. Salad or burger for lunch
  2. 10 minute massage Thursday or 11 minute massage friday
  3. End class early on Thursday and move extra time to a week later
- Choice {burger,salad} or {10,11} is a 'preference reversal'
- Evidence that you are tempted by the burger, but would 'prefer' to choose the salad

Time Inconsistency

- This is not consistent with standard intertemporal choice theory
- Preferences are *Stationary* and *Separable*
  - Implies exponential discounting
- Is it evidence for temptation?
- Not necessarily - could be changing tastes

- But in many cases choices varied *consistently*
- Thirsty subjects
  - Juice now (60%) or twice amount in 5 minutes (40%)
  - Juice in 20 minutes (30%) or twice amount in 25 minutes (70%)
- Hard to explain with changing tastes
- Could potentially be explained by probability weighting
  - Halevy [2008]

Is Time Consistency Related to Preference for Commitment?

- A natural question: Do those who exhibit time inconsistency demand commitment?
- Evidence is not great (Caseri 2009)
  - Subjects asked to choose between \$100 in t days and \$110 in t+2 days
  - Preference reversal occurs if subjects switch from the former to the latter as t increases
  - 62% of subjects show preference reversal
  - Subjects who exhibited preference reversals offered the chance to commit
  - Either commit to later option now, or choose again in 2 days time
  - 65% of subjects would pay to commit if it were free
  - 17% would pay \$2 for commitment
- Also evidence from Ashraf et al. that time inconsistency related to commitment

Preference Over Menus

- In order to discuss preference for commitment we need to be able to discuss preferences over menus
- Let X be a set of alternatives and $\mathcal{X}$ be non empty subsets of X
- Let $\succeq$ be a preference relation on $\mathcal{X}$
    - Interpretation: preference over menus from which you will later get to choose
- Let $\trianglerighteq$ be a preference relation on X
    - Interpretation: preferences when asked to choose from a menu

- The Standard Model of Preference over Menus

$$U(A) = \max_{x \in A} u(x)$$

- Key behavioral implications
  - Sophistication

$$X \succ X \cup \{p\} \Rightarrow p \rhd x \ \forall \ x \in X$$

  - 'Independence of Irrelevant Alternatives'

$$X \succeq Y \Rightarrow X \cup Y \sim X$$

- Larger choice sets always weakly preferred

The Gul Pesendorfer Model

- Preference over menus given by

$$U(A) = \max_{x \in A} [u(x) + v(x)] - \max_{y \in A} v(y)$$

- u : 'long run' utility
  - Choice over singleton choice sets
- v : 'temptation' utility
  - Can lead to preference for smaller choice sets
- Interpretation: :
  - Choose x to maximize $u(x) + v(x)$
  - Suffer temptation cost $v(y) - v(x)$

- Consider x, y, such that

$$\begin{aligned} u(x) &> u(y) \\ u(y)+v(y) &> u(x)+v(x) \end{aligned}$$

- Then

$$\begin{aligned} U(\{x\}) &= u(x) \\ U(\{x,y\}) &= u(y)+v(y)-v(y)=u(y) \\ U(\{y\}\} &= u(y) \end{aligned}$$

- Interpretation: give in to temptation and choose y
- 'Weak set betweenness'

$$\{x\} \succ \{x,y\} \sim \{y\}$$

Why Preference for Smaller Choice Sets?

Avoid 'Willpower Costs'

- Consider x, y, such that

$$\begin{aligned} u(x) &> u(y) \\ v(y) &> v(x) \\ u(x)+v(x) &> u(y)+v(y) \end{aligned}$$

- Then

$$\begin{aligned} U(\{x\}) &= u(x) \\ U(\{x,y\}) &= u(x)+v(x)-v(y) \\ U(\{y\}\} &= u(y) \end{aligned}$$

- Interpretation: fight temptation, but this is costly
- 'Strict set betweenness'

$$\{x\} \succ \{x,y\} \succ \{y\}$$

Axiomatic Characterization of GP Model

- Set Betweenness: for any A, B

$$A \succeq A \cup B \succeq B$$

- Independence: for any A, B , C

$$\begin{array}{rcl} A & \succeq & B \\ \rho A + (1-\rho) C & \succeq & \rho B + (1-\rho) C \end{array}$$

- Sophisitication

- We say that a decision maker exhibits self control at C if there exists A, B such that $A \cup B = C$ and

$$\{A\} \succ \{C\} \succ \{B\}$$

- implies that

$$\arg\max_{x \in A} u(x) + v(x) \neq \arg\max_{y \in A} v(y)$$

  most tempting option not chosen
- Note that there is no 'willpower' distinct from long run and temptation preferences.

Implications of Linearity

- Imagine

$$\{x\} \succ \{x, y\} \succ \{y\} \succ \{y, z\} \succ \{z\}$$

- Implies

$$\begin{aligned} u(x) &> u(y) > u(z) \\ v(z) &> v(y) > v(x) \\ u(x) + v(x) &> u(y) + v(y) > u(z) + v(z) \end{aligned}$$

- Which in turn implies

$$\{x\} \succ \{x, z\} \succ \{z\}$$

- 'Self Control is Linear'

Limiting Case: No Willpower

- Imagine that differences in v are large relative to differences in u
- In the limit, model reduces to

$$U(A) = \max_{x \in A} u(x) \text{ s.t. } v(x) \geq v(y) \; \forall \; y \in A$$

- This is the 'Strolz' model
- Implies not strict set betweenness

Preference Over Consumption Streams

- Object of choice are now consumption streams:

$$C = \{c_1, c_2, ...\}$$

- c_i is consumption at date i
- Standard model

$$U(C) = \sum_{i=1}^{\infty} \delta^i u(c_i)$$

- Exponential Discounting

- Characterized by two conditions
- Separability

$$\begin{array}{ccc} \{c_1, .., c_{n-1}, x, c_{n+1}, ...\} & \succ & \{c_1, .., c_{n-1}, y, c_{n+1}, ...\} \\ & \Rightarrow & \\ \{d_1, .., d_{n-1}, x, d_{n+1}, ...\} & \succ & \{d_1, .., d_{n-1}, y, d_{n+1}, ...\} \end{array}$$

- Stationarity

$$\begin{array}{ccc} \{c_1, c_2, ...\} & \succ & \{d_1, d_2, ...\} \\ & \Rightarrow & \\ \{e, c_1, c_2, ...\} & \succ & \{e, d_1, d_2, ..\} \end{array}$$

- Violates Stationarity

$$
\begin{aligned}
\{10, 0, 0, \ldots\} &\succ \{0, 11, 0, \ldots\} \\
&\text{but} \\
\{0, 10, 0, 0, \ldots\} &\prec \{0, 0, 11, 0, \ldots\}
\end{aligned}
$$

- In general this is dealt with by replacing exponential discounting with some other form
  - Hyperbolic

$$U(C) = \sum_{i=1}^{\infty} \frac{1}{1+ki} u(c_i)$$

  - quasi hyperbolic

$$U(C) = u(c_1) + \sum_{i=2}^{\infty} \beta\delta^i u(c_i)$$

Quasi Hyperbolic Discounting

- Hyperbolic discounting is a pain to use, so people generally work with quasi hyperbolic discounting [Laibson 1997]
- Weaken stationarity to quasistationarity [Olea and Stralecki 2012]

$$\begin{array}{ccc} \{f, c_1, c_2, ...\} & \succ & \{f, d_1, d_2, ...\} \\ & \Rightarrow & \\ \{f, e, c_1, c_2, ...\} & \succ & \{f, e, d_1, d_2, ..\} \end{array}$$

- Stationarity holds after first period
- Note that agent is only 'special' in the first period

Consumtion and Savings

- In general, we do not observe choice over consumption streams
- Instead, observe choices over consumption levels *today*, which determine savings levels tomorrow
- Three period cake eating problem, with initial endowment y
- Formulate two versions of the problem
  - a single agent chooses c_0, c_1 and c_2 in order to maximize

$$U(C) = \sum_{i=0}^{2} \delta^i u(c_i) \text{ st } \sum_{i=0}^{2} c_i \leq 3y$$

  - a game between 3 agents $k = 0, 1, 2$ where agent k chooses c_k to max

$$U(C) = \sum_{i=k}^{2} \delta^i u(c_i) \text{ st } c_k \leq s_{k-1}$$

  - where s_{k-1} is remaining cake, and taking other agents strategies as given

Consumption and Savings with Exponential Discounting

- Under exponential discounting, these two approaches give same outcome
- Assuming CRRA utility

$$
\begin{aligned}
c_1 &= \frac{3y}{1+(\delta)^{\frac{1}{\sigma}}+\left(\delta^2\right)^{\frac{1}{\sigma}}} \\
c_2 &= (\delta)^{\frac{1}{\sigma}} c_1 \\
c_3 &= \left(\delta^2\right)^{\frac{1}{\sigma}} c_1
\end{aligned}
$$

- No time inconsistency: period i agent will stick to the plan of period $i-1$ agent
- Only exponential discounting function has this feature [Strotz 1955]

Consumption and Savings with Quasi Hyperbolic Discounting

- Now assume that the agent has a quasi-hyperbolic utility function: agent k chooses c_k to max

$$U(C) = u(c_k) + \sum_{i=k+1}^{2} \beta\delta^i u(c_i) \text{ st } c_k \leq s_{k-1}$$

- Now the solutions are different:
- Need to decide what k_0 assumes about k_1's behavior

Consumption and Savings with Quasi Hyperbolic Discounting

- Under commitment

$$
\begin{aligned}
c_0 &= \left(1 + (\beta\delta)^{\frac{1}{\sigma}} + \left(\beta\delta^2\right)^{\frac{1}{\sigma}}\right)^{-1} 3y \\
c_2 &= \delta^{\frac{1}{\sigma}} c_1
\end{aligned}
$$

- Without commitment, but with sophistication

$$
\begin{aligned}
\bar{c}_0 &= \left[1 + \left(\frac{\beta\delta}{\left(1 + (\beta\delta)^{\frac{1}{\sigma}}\right)^{1-\sigma}} + \frac{\delta\,(\beta\delta)^{\frac{1}{\sigma}}}{\left(1 + (\beta\delta)^{\frac{1}{\sigma}}\right)^{1-\sigma}}\right)^{\frac{1}{\sigma}}\right]^{-1} 3y \\
\bar{c}_2 &= (\beta\delta)^{\frac{1}{\sigma}} c_1
\end{aligned}
$$

- Without commitment, period 2 consumption lower relative to period 1 consumption
- Period 0 consumption can be lower or higher

Consumption and Savings with Quasi Hyperbolic Discounting

- If subject is naive

$$
\begin{aligned}
c_0 &= \left(1 + (\beta\delta)^{\frac{1}{\sigma}} + \left(\beta\delta^2\right)^{\frac{1}{\sigma}}\right)^{-1} 3y \\
c_2 &= (\beta\delta)^{\frac{1}{\sigma}} c_1
\end{aligned}
$$

- Period 0 consumption will be the same as commitment case
- Period 1 consumption will be unambiguously higher
- Period 2 consumption will be unambiguously lower

Observing Time Inconsistency in a Consumption/Savings Problem

- Spotting time inconsistency if we only obsere consumption and savings is tricky
- Under log utility they are identical
- This result is general [Barro 1999]
- However, a (sophisticated) time inconsistent agent will exhibit demand for commitment
- Strotz model - no self control

Fudenberg and Levine [2006]

- Q-hyperbolic model still difficult to solve for many periods
- Game between two long run players
- Multiple equilibria [Laibson 1997, Harris and Laibson 2004]
- Fudenberg and Levine come up with a simpler model

Fudenberg and Levine [2006]

- Long run self plays a game against a sequence of short lived self
- Short run self gets to choose what action to take $a \in A$
- Long run self chooses 'self control' $r \in R$ which modifies utility function of short run self
- State y evolves according to some (stochastic) process depending on history of y,a and r
- $\Gamma(y)$ available options in state y

Fudenberg and Levine [2006]

- Each short run player chooses an action a to maximize

$$u(y, r, a)$$

- Long run player chooses a mapping from histories h to maximize

$$\sum_{i=1}^{\infty} \delta^{t-1} \int u(y(h), r(h), a(h)) d\pi(h)$$

where

- $r(h)$ is the strategy of the long run player
- $a(.)$ is strategy of each short run player
- $y(.)$ is the state following history h
- π is the probability distribution over h given strategies

Fudenberg and Levine [2006]

- Define $C(y,a)$ as the self control cost of choosing a in state y

$$C(y,a) = u(y,0,a) - \sup_{r \text{ s.t. } u(y,r,a) \geq u(y,r,b) \ \forall \ b \in \Gamma(y)} u(y,r,a)$$

- Then we can rewrite long run's self problem as a decision problem
- choose strategy to maximize

$$\sum_{i=1}^{\infty} \int u(y(h),0,a(h)) - c(y(h),a(h)) d\pi(h)$$

Fudenberg and Levine [2006]

- Further assume that self control costs are
  - Linear
  - Depend only on the chosen object and most tempting object in choice set

$$c(y, a) = \lambda(\max_{b \in \Gamma(y)} u(b, 0, y) - u(a, 0, y))$$

- This is a Gul-Pesendorfer type model
  - Reducing choice set reduces self control costs

A Consumption/Saving Example

- State y represents wealth
- a is fraction of wealth saved
- Return on wealth is R
- Instantaneous utility is log

$$u(y, 0, a) = \log((1 - a)\, y)$$

- Temptation utility in each period is $\log(y)$
- Objective function becomes

$$\begin{aligned} & \sum_{i=1}^{\infty} \delta^{t-1} \left[\log((1-a)\, y_i) - \lambda(\log(y_i) - \log((1-a_i)\, y_i)\right] \\ = & \sum_{i=1}^{\infty} \delta^{t-1} \left[(1+\lambda) \log((1-a_i)\, y_i) - \lambda(\log(y_i)\right] \\ & \text{subject to} \\ a_i \in & \; [0,1] \\ y_{i+1} = & \; R a_i y_i \end{aligned}$$

- Solution. It turns out (see web appendix) that optimal policy is constant savings rate, so $y_i = (Ra)^{i-1} y_1$

$$\sum_{i=1}^{\infty} \delta^{t-1} \left[\begin{array}{c} (1+\lambda) \log((1-a) + (i-1) \log Ra + \log y_1) \\ -\lambda((i-1) \log Ra + \log y_1) \end{array} \right]$$

$$= \quad (1+\lambda) \frac{\log(1-a)}{(1-\delta)} + \frac{\log y_1}{(1+\delta)} + \frac{\delta \log(Ra)}{(1-\delta)^2}$$

- FOC wrt a

$$\frac{(1+\lambda)}{(1-\delta)(1-a)} = \frac{\delta}{(1-\delta)^2 a}$$

- $$a = \frac{\delta}{1 + (1-\delta)\lambda}$$
- As self control costs increase, savings go down
- As δ increases, effect of self control increases

Evidence for Sophistication

DellaVigna and Malmandier [2006]

- Test whether people have sophisticated beliefs about their future behavior
- Examine the contract choices of 7978 healthcare members
- Also examine their behavior (i.e. how often they go to the gym)
- Do people overestimate how much they will go the gym, and so choose the wrong contract?λ

Evidence for Sophistication

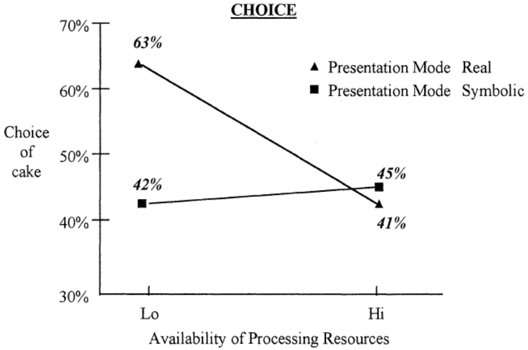
DellaVigna and Malmandier [2006]

- Three contracts
  - Monthly Contract – automatically renews from month to month
  - Annual Contract – does not automatically renew
  - Pay per usage
- Puzzles
  - 80% of customers who buy monthly contracts would be better off had they paid per visit (assuming same number of visits)
  - Customers predict 9.5 visits per month relative to 4.5 actual visits
  - Customers who choose monthly contracts are 18% more likely to stay beyond a year than those who choose annual contract

Willpower Depletion

Shiv and Fedorkhin [1999]

- Subject enters room 1
- Asked to remember a number to be repeated in room 2
- Walks to room 2 via a tray of snacks
- Containing 2 types of snack
  - Chocolate Cake
  - Fruit
- Four treatments:
- Available processing capacity
  - High (2 digit number)
  - Low (7 digit number)
- Presentation mode
  - Real
  - Symbolic


CHOICE
70%
60%
50%
40%
30%
Choice of cake
63%
42%
45%
41%
▲ Presentation Mode Real
■ Presentation Mode Symbolic
Lo
Hi
Availability of Processing Resources

Willpower Depletion

Galliot et al [2007]

- Procedure
  - Measure glucose level
  - Watch video of woman talking (no sound)
  - One syllable words appear in bottom left corner of screen
  - Two treatments
  - Watch normally
  - Ignore words
  - Glucose measured again
- Result: ‘Self Control’ reduced glucose
  - Glucose levels dropped significantly for ‘Watch normally’
  - Not from ‘watch normally’ group
  - Fall in glucose level associated with worse performance in Stroop task

Willpower Depletion

DeWall et al [2012]

- Procedure
  - Subjects either consume a glucose drink or placebo
  - Watch video of woman talking (as before)
  - Four treatments
  - Glucose vs placebo
  - Watch normally vs Ignore words
- Subjects listened to an interview :
  - Young woman described how her parents were recently killed
  - Only one to care for her younger siblings.
  - Would have to drop out of college without help
- Participants were then told that the study had ended
- Before they left, asked if they would help young woman
  - Participants the opportunity to help woman by volunteering time to complete various tasks (e.g., stuffing envelopes)
- Asked to Indicate the number of hours they were willing to help, ranging from 0 to 9

- Results:
- Placebo condition
  - Those in depletion condition significantly less likely to help
- Glucose condition
  - No effect
- Looking within depletion condition, those who took glucose significantly more likely to help