

The relationship between addiction and reward bundling: an experiment comparing smokers and non-smokers

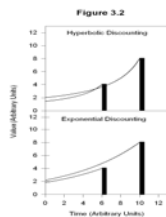
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Addiction and standard consumer theory of the person as a unified agent (Becker and Murphy)

- The rational addict earns unusually high utility from consumption of her addictive target. Such consumption shifts her capital stocks so that at any given point it is rational for her to indulge rather than abstain, even though her welfare declines with time in consequence.
- Then why do most addicts eventually quit? 2 possible answers: (i) change in tastes; (ii) they acquire new information about the costs of addiction.
- Reverting to (i) is throwing up explanatory hands. If (ii) is right, then why do most addicts *struggle* to stop – i.e., repeatedly relapse? Possible answer: they periodically stop in order to reduce their tolerance, thus temporarily improving the c/b ratio from addictive consumption. This implies a profound difference between the psychology of unsuccessful quitting attempts and successful ones. There is no evidence for such a psychological hypothesis, and much against it.

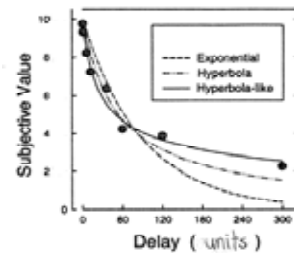
Preference Reversal

- Unless constrained by special institutional forces, some people (and other animals) consume in accordance with melioration rather than expected utility maximization.
- Therefore, people (and other animals) sometimes reverse preferences as a function of temporal distance to choices among rewards.



Three discounting functions

Much literature in behavioural economics comparatively tests three families of discount functions: exponential, hyperbolic, and "quasi-hyperbolic" or " β - δ ". The latter two functions predict preference reversal, the former does not. Empirical data due to Andersen *et al* (2006) show that it's a mistake to impose any one of these on data: each function best fits a subset of all aggregate choice data that's been examined. We don't know whether there are 3 types of discounters, or 3 types of <person, situation> vectors.



Reward Bundling

The person can notice that present choices predict future ones. Suppose she now makes a *personal rule*: I'll only smoke at parties. If she obeys the rule this predicts she'll continue to obey it. If she violates it she wrecks it - and loses a *presently* valuable asset *now*. Thus she might overcome intertemporal preference reversal - achieve exponential discounting - because her personal rule is a commitment device. (There are alternative interpretations of this: framing and self-signaling. The difference is interesting, but we'll gloss over it here.)

Bundling in Rats and Humans

Ainslie and Monterosso (2003):

- Rats' preference for LLR is greater when reward was delivered 3 times in succession following 1 choice than when it was delivered after each of 3 separate choices.

Kirby and Gustello (2001):

- Majority of subjects chose LLRs over SSRs when they were presented as a series.
- 1/3 of subjects who could choose on each occasion reversed their preference for the LLR.

Experiment: subjects

- 61 University of Cape Town students
- 31 regular smokers, 30 non-smokers
- Screened for possible secondary addictions; possible alcohol, drug and gambling addicts excluded

TABLE I
SUMMARY STATISTICS

Variable	Mean	Std. Deviation
Bundled Choice	0.66	-
Smoke	0.51	-
Male	0.54	-
Income	2524.59	2463.96
Strict Preference	31.23	13.88
English	0.84	-
White	0.43	-
Black	0.41	-
Age	21.08	2.44

Notes:
Summary statistics computed from a sample of 61 subjects across 4 waves of the bundling experiment.

Experimental Design

- The experiment was designed to elicit a strict preference for a SSR over a LLR in the immediate vicinity of a subject's indifference point.
- Subjects were then placed into one of three bundling conditions where the salience of the linked nature of the rewards varied
- This allows us to determine whether there are differences across bundling conditions and whether smokers and non-smokers bundle rewards differently

Intertemporal preference elicitation

- We elicited subjects' strict preferences for an SSR to be delivered in 1 day over an LLR to be delivered in 10 days.
- Size of LLR fixed at R50.
- Titration software implements a binary search algorithm that splits the difference between a subject's choices. If S faces the choice between R25 to be delivered in 1 day and R50 to be delivered in 10 days and S chooses LLR, then the next choice is between R37.50 in 1 day and R50 in 10 days. If instead S chooses SSR in this example her next choice is between R12.50 in 1 day and R50 in 10 days. By this procedure we converge on S's indifference point between SSR in 1 day and R50 in 10 days. Titration terminates when the algorithm is called upon to halve R0.50.
- We used a 1 day front-end delay (FED) to hold subjects' subjective transaction costs constant for SSRs vs. LLRs (Coller and Williams 1999). FED also removes the possible influence of a visceral or "β" incentive that has been claimed to be a special source of temptation to choose imminent rewards (*e.g.* McClure *et al.*, 2004).

3 conditions

FREE CONDITION:

- "[As you know]* I will be calling you every 2 weeks for 6 to 10 weeks. Every second week I will be asking you to choose between SSR in 1 day and R50 in 10 days. Which would you like me to give you this week: SSR in 1 day or R50 in 10 days?"

SUGGESTED CONDITION:

- "[As you know]* I'll be calling you every 2 weeks for 6 to 10 weeks. Each week I will be asking you to choose between SSR in 1 day and R50 in 10 days. Each time you are offered this choice you will be in the same situation that you are now, facing a choice between SSR in 1 day and R50 in 10 days. Therefore, the choice you make now is the best indication of how you will choose every time. What somebody chooses on one week is often what they go on choosing on later weeks, but you'll be completely free to choose between these two options every 2 weeks. Which would you like me to give you this week: SSR in 1 day or R50 in 10 days?"

FORCED CONDITION:

- "You will now make a choice between sets of rewards. If you choose SSR in 1 day then you will receive SSR in 1 day and SSR every two weeks after that for 6 to 10 weeks. If you choose R50 in 10 days then you will receive R50 in 10 days and every two weeks after that for 6 to 10 weeks. Which would you prefer: SSR in 1 day and every two weeks after that or R50 in 10 days and every two weeks after that?"

Procedure

- After S made her initial choice in the presence of the experimenter she was contacted telephonically three more times and offered the same choice in intervals of two weeks.
- The two week interval was used to reduce the possible impact of wealth effects across choices.
- Sample attrition = 0, so 61-subject panel is balanced across 4 time periods.

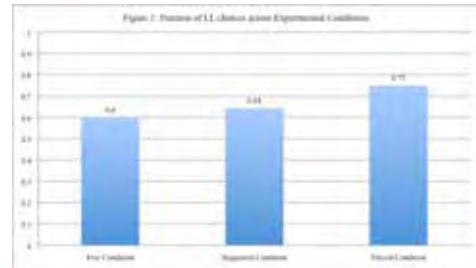
Predictions

- We expected frequency of LLR choice to increase as the salience of the linked nature of the choices increased. Thus we expected more choices consistent with reward bundling in the forced condition than in the suggested condition and more choices consistent with reward bundling in the suggested condition than in the free condition.

Influence of addiction?

- Non-addicts are likely to bundle rewards habitually more than non-addicts
- Addicts may be more likely to respond to opportunities to bundle when these are made salient
- Thus, non-addicts will initially demonstrate greater patience (higher strict SSR preferences) than addicts
- But addicts will increase their patience more than non-addicts in at least the suggested and forced conditions

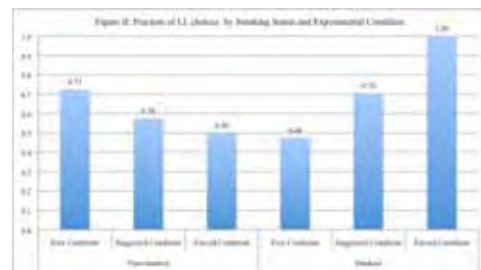
Experimental Effect



Comparing addicts and non-addicts: first impressions

- The mean strict preference for SSR over LLR among smokers is R28.77 (std. deviation = 12.32) whereas for non-smokers it is R33.78 (std. deviation = 14.95). (Non-parametric Mann-Whitney test: $Z = 3.49$, $p = 0.0005$).
- Thus smokers are willing to accept a smaller reward to receive it sooner than non-smokers.
- A larger proportion of smokers chose to select LLR than did non-smokers ($\chi^2 = 4.33$; $p = 0.04$).
- Smokers are better bundlers?

Smokers and non-smokers



Interpretation

- When offered the chance to pre-commit to a series of LLRs, all smokers chose pre-commitment whereas only 50 percent of non-smokers did. However, when subjects were not primed to think of the rewards as being part of a series (in the free condition), non-smokers were better able to bundle the rewards and thereby select LLRs.
- Increased salience of reward linkage was significantly related to LLR choice only among smokers.

Econometrics

- We built binary choice estimation models to explore the effects of bundling condition, smoking status and wave of the experiment on subject choices while conditioning on other variables:
 1. an LPM estimated over the pooled choices;
 2. a probit model that pools the data and thereby neglects the panel structure of our experiment;
 3. a random effects probit model that explicitly incorporates the panel nature of the data and models the distribution of the unobserved individual heterogeneity conditional on subject characteristics as following a normal distribution with mean 0 and variance σ_u^2 .

TABLE III
BINARY CHOICE ESTIMATION FRAMEWORKS CONDITIONING CHOICES ON
DEMOGRAPHICS, STRICT PREFERENCES, WAVES AND CONDITIONS

Variable	LPM	Probit Pooled	
		Probit Pooled	Probit Pooled
		Coefficient Estimates	
Suggested Condition	0.012 (0.071)	0.010 (0.24)	0.071 (0.55)
Forced Condition	0.12* (0.067)	0.32** (0.24)	1.01* (0.59)
White	0.060 (0.062)	0.27 (0.23)	0.31 (0.51)
Male	-0.053 (0.055)	-0.22 (0.19)	-0.28 (0.45)
English	0.27*** (0.079)	0.83*** (0.26)	1.32** (0.62)
Age	-0.0043 (0.012)	-0.032 (0.035)	-0.047 (0.084)
Income	0.00036*** (0.00012)	0.00015*** (0.000059)	0.0002** (0.00013)
Strict Preference	-0.013*** (0.0021)	-0.066*** (0.0080)	-0.069*** (0.019)
Wave 2	0.098 (0.078)	0.36 (0.26)	0.56* (0.33)
Wave 3	0.082 (0.076)	0.31 (0.26)	0.47 (0.33)
Wave 4	0.11 (0.076)	0.44* (0.26)	0.68** (0.33)
Smoke (=1)	0.047 (0.056)	0.18 (0.20)	0.18 (0.45)
Constant	0.71*** (0.27)	1.08 (0.80)	1.23 (1.94)
Observations	244	244	244
F-stat / Log Likelihood	6.43	-120	-104
ρ			0.62
Likelihood ratio test ($p < 0$)			32.2***

TABLE IV
BINARY CHOICE ESTIMATES FOR SMOKERS AND
NON-SMOKERS

Variable	Coefficient Estimates	
	Smokers	Non-Smokers
Suggested Condition	0.07** (0.34)	-1.08* (0.57)
Forced Condition	0.28** (0.10)	-0.28 (0.36)
White	0.40 (0.40)	0.70 (0.43)
Male	0.34 (0.37)	-0.72** (0.34)
English	1.15*** (0.46)	0.19 (0.41)
Age	0.26* (0.11)	-0.11* (0.057)
Income	0.00011 (0.00017)	0.00040** (0.00016)
Strict Preference	-0.039* (0.021)	-0.051*** (0.011)
Wave 2	0.97** (0.45)	0.076 (0.39)
Wave 3	1.09** (0.46)	-0.046 (0.38)
Wave 4	1.09** (0.45)	0.22 (0.38)
Constant	-5.57*** (2.68)	4.02*** (1.20)
Observations	84	120
Log Likelihood	-41.4	-56.4

Conclusions

- Smokers discount the future more steeply than non-smokers who have been screened for other common addictions. This confirms a result that has been widely reported in previous studies (Bickel *et al* 1999), though many of these, in not using a FED, cannot distinguish between impulsivity based on immediacy per se—due to “viscerality” or conditioned appetite—and temporary preference based on hyperbolic discounting
- When the salience of current choices to similar future choices was either suggested or imposed on subjects, smokers made more patient choices than they did in the free condition, where this salience was not suggested
- Non-smokers did not show this effect, but their greater patience at baseline suggests that they may have already been in the habit of viewing current choices as part of larger categories.