

# DISCOUNTING AND SELF-CONTROL

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ABSTRACT. An agent's intertemporal choices depend on a variety of factors, most prominently, their valuation of future payoffs as encapsulated in a discount function. However, it is also clear that factors such as self-control may also play an important role, and given the similarity of impact, a confounding one. We explore the literature on this issue as well as examining what occurs when those with higher time-preference (whether arising from discounting or self-control) also enjoy their consumption more.

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*... then must you speak  
Of one that loved not wisely, but too well;  
Of one not easily jealous, but, being wrought,  
Perplex'd in the extreme; of one whose hand,  
Like the base Judean, threw a pearl away  
Richer than all his tribe; ...*

*– Othello, The Moor of Venice*

## 1. INTRODUCTION

The exercise of will, especially in the form of self-control, has long been recognized as central to human existence, experience, and morality. Over the last few decades there has been increasing interest in the issue from a scientific perspective. At the same time, it has also long been appreciated that humans (and other animals) make trade-offs between the present and the future – as well as between different points in the future, and that events taking place closer to the present are given greater weight than those which are more

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distant. Traditionally, at least in economics, this type of behaviour has been subsumed under the heading of discounting.

Both of these factors, self-control and discounting, affect behaviour, and choices, in relation to outcomes which do not (all) take place in the present. However they are distinct. Specifically, consider a very simple case of two outcomes A and B where B occurs after A (for example, A might be one ice cream today and B an ice cream and a doughnut tomorrow). Self-control issues arise where one *prefers* B over A but is *unable to execute* on this preference and therefore actually takes ('chooses') A. By contrast, in the discounting case A is actually *preferred* over B and therefore is chosen (freely) by the decision maker.

It would seem important to keep these two aspects of decision making clearly separated. While lack of 'self-control' is usually seen as disadvantageous and a reason for adopting various 'commitment strategies' – for example, by opting to remove various items from the choice set (having no cigarettes in the house) – the simple preference for the present over the future incorporated in the discounting model would seem to generate no such difficulties.

However, empirically it may prove rather difficult to do so. As shown by the simple example above the same observed 'choice' for A (one ice cream today) over B (ice cream plus doughnut tomorrow) can be the result of two very different processes. Thus if we only observe choices, and not the underlying preferences and/or the process by which the choice is arrived at, it may be impossible to distinguish the two.

It is perhaps for this reason that these distinct aspects are sometimes conflated. Consider, for example, Mischel et al. (1989) which is entitled "Delay of Gratification in Children" and summarizes much of Mischel's pioneering work on this area. Mischel's approach is clearly more oriented along the self-control aspect, and this is borne out in the types of experiments conducted (more on this below). Nevertheless they state (p.934) "The obtained concurrent associations [between treatments and delay] are extensive, indicating that such preferences reflect a meaningful dimension of individual differences, and point to some of the many determinants and correlates of decisions to delay (18)." Here the orientation towards self-control has become a general "decision to delay" and this is borne

out by the associated footnote (18) which references related literature in other disciplines and is worth quoting in its entirety:

Researchers in other areas, beyond the scope of the present article, have pursued somewhat parallel problems in self-control. In one direction, a large operant conditioning literature has investigated self-control in lower organisms by using analogous situations to those in the present article. Typically, a pigeon in a Skinner box has to choose among alternatives varying in the amount and delay of the reinforcer. This research indicates that organisms sharply discount future rewards as a function of the temporal distance from the time of choice [... cites removed]. Preference for a small, immediate reward, over a larger, more delayed one, reverts as the time between choice and delay of rewards increases (Rachlin and Green, above; Logue, Rodriguez, Pena-Correal, Mauro, above). Moreover, by using analogs to the self-imposed delay of gratification situation described in this article, parallel results also were reported with pigeons [J. Grosch and A. Neuringer, *J. Exp. Anal. Behav.* 35,3 (1981)]. In a second direction, economists have studied how delayed outcomes affect economic decisions and savings behavior of humans, again with interesting parallels to the research reported here [I. Fisher, *The Theory of Interest* (Macmillan, London, 1930); H. M. Shefrin and K. I-I. Thaler, *Econ. Inq.* 26, 609 (1988)].

This quote demonstrates the general conflation of Mischel's own work, which is primarily about self-control, with the general literature in Economics and elsewhere on 'discounting', that is the simple preference for payoffs closer to the present over those more distant.

Turning to more recent research in Economics one also finds a blurring of this distinction between self-control and simple time-preference in much of the recent literature on time-inconsistency and modified discounting models (such as the hyperbolic model). For example, Laibson (1997) considered a consumer with hyperbolic (and hence time-inconsistent preferences) who has access to a commitment device (an illiquid asset) and showed that such commitment can be valuable (i.e. welfare improving). Here it is not clear whether the time-inconsistency arises from the hyperbolic discounting (as assumed) or an

ability to stick to a particular decision (self-control) – though in either case commitment is valuable (at least from the perspective of ‘now’).

At the same time, more recent work has explicitly acknowledged this distinction. For example, Berns et al. (2007) clearly distinguish four separate aspects of intertemporal choice: discounting, anticipation, self-control, and representation. Given these multiple influences that potentially affect choices between now and the future we should ask ourselves several questions. First, as discussed above, at least in terms of choice, it can be difficult to distinguish them. Does this matter? In particular, is it important to distinguish discounting from self-control effects? Above, we suggested this distinction is important, not least because it suggests different pathways by which the effect operates, and hence different strategies for addressing the effect (should one wish to). However, one could argue that, say, a hyperbolic discount function is not really about discounting per se but is simply a reduced form way of encapsulating intertemporal trade-offs by whatever mechanism they arise.<sup>1</sup> Second, if the distinction does matter, we should ask how can we distinguish different effects in the data? The work of Mischel, already cited above, gives some guidance on this issue as does other work in psychology, neuroscience and economics.

## 2. MODELS

Let us consider, as above, the simplest choice between two outcomes A and B with A nearer in time than B. A choice of A over B could be because of:

- A preference for A over B. This in turn could arise from:
  - Correct evaluation of A and B (in terms of payoffs/utility etc) plus preference for A over B.
  - An incorrect computation of the payoff of A over B resulting in A being chosen even though with correct computation B would be chosen (bounded rationality).
- A lack of self-control that results in the choosing in A even though B is preferred over A.
  - Again the preference for A over B could be either ‘correct’ or ‘incorrect’ (based on inaccurate calculation). However generally one would assume that a lack of

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<sup>1</sup>For example, the immediacy parameter  $\beta$  in the classic ‘quasi-hyperbolic’ discounting model could be seen either as representing an impulsivity (i.e. lack of self-control) or an actual preference for ‘now’.

self-control could not result in A being chosen over B when B was inaccurately preferred.

Considering attention (analysis) and will (execution) both as scarce resources in the brain it seems natural to label the 3 resulting cases as follows:

- Correct Analysis + Correct Execution (Correct)
- Incorrect Analysis + Correct Execution (Bounded Rationality)
- Correct Analysis + Incorrect Execution (Bounded Will)

We can also visualize them in a matrix:

		Analysis		
		Correct		Incorrect
W	Correct			
i		-----	+	-----
l				
l	Incorrect			

2.1. **Neuroscience Speculation.** Two brain centres:

- A choice-maker
- An executor

Alternatively different choice centres which are (sometimes) in ‘conflict’ (cf. the right-brain/left-brain literature).

- Module 1: more long-term, less impulsive. (left-brain?)
- Module 2: more immediate, and impulsive. (right-brain?)

Executor integrates these two, leaning more towards module 1. Occasionally module 2 overrides module 1 and we get ‘impulsivity’ or general lack of self-control.

Whatever the setup the crucial question is: “Can we distinguish between preferences and self-control whether in experiments or in the real world?” As discussed above the difficulty is that either genuine preference or a lack of self-control can result in a choice of

a more immediate pay-off over a more distant one. However, there are ways to proceed that offer some promise and it is to these we now turn.

### 3. EMPIRICS

**3.1. Self-Control.** The experiments discussed by Mischel et al. (1989) are especially interesting in relation to the self-control issue. This is because their design was such as to make it highly likely that the observed variation in choices between ‘now’ and the ‘future’ largely resulted from variations in self-control and not in preferences. This is because Mischel and his co-authors focused on variations in the experimental setup likely to affect the children’s ideation (what they thought about) rather than their preferences over outcomes. Furthermore, it was found that delay-of-gratification (here likely related to self-control) was strongly correlated *a decade later* with a variety of outcomes such as academic and social competence, SAT scores, self-assurance, and verbal fluency.

The basic setup that Mischel et al consider is one in which young children are shown two sets of rewards (usually food and with one set being clearly preferential to the other). In order to obtain the one they prefer the children must wait for the experimenter to return,<sup>2</sup> however they may obtain the less preferred reward at any time by summoning the experimenter using a bell. A variety of possible experimental treatments were then considered each in some way related to ideation. In the:

... first study varied systematically whether or not the rewards were available for attention while the children were waiting (19). For example, in one condition they waited with both the immediate (less preferred) and the delayed (more preferred) rewards facing them, exposed. In a second condition, both rewards were also present but obscured from sight (covered), and in two other conditions either the delayed reward only or the immediately available reward was exposed during the delay period.

The results were unexpected. Attention to the rewards, rather than increasing delay time, decreased it. The preschool children waited ‘an average of more than 11 minutes when no rewards were exposed, but they waited less than 6 minutes on average when any of the rewards were exposed during delay.’

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<sup>2</sup>This occurred after around 15m. However it is not clear from the description in the paper whether this period is known to the children.

Having established this, perhaps rather surprising, result the experimenters introduced a new set of treatments which focused explicitly on ideation: children were encouraged to have particular types of thoughts while waiting. Specifically, either it was suggested that they think about the rewards or to think about some enjoyable, but unrelated, objects. In the first scenario where thoughts focused on the rewards, it was found (see Fig. 1 in the paper) that waiting time was short – irrespective of the presence of the rewards themselves. In the second scenario, children waited for over 10 minutes, again irrespective of the reward exposure.

The children's behaviour during the delay-period was particularly interesting:

Observation of children's spontaneous behavior during the delay process also suggested that those who were most effective in sustaining delay seemed to avoid looking at the rewards deliberately, for example, covering their eyes with their hands and resting their heads on their arms. Many children generated their own diversions: they talked quietly to themselves, sang, created games with their hands and feet, and even tried to go to sleep during the waiting time. Their attempts to delay gratification seemed to be facilitated by external conditions or by self-directed efforts to reduce their frustration during the delay period by selectively directing their attention and thoughts away from the rewards (11). [p. 935]

The final set of experiments discussed focused on the effect of the form of representation of the rewards. The children now either faced the real reward or a pictorial representation (slide-images about twice the normal size). Children presented with the slide-images delayed approximately twice as long as those who either viewed slides of control objects or blank slides. Taking this further the experimenters taught the children to convert, in their heads, real rewards into pictorial representations and vice-versa. It was found that the form of representation used by the children had a very large effect on outcomes: 'children facing pictures of the rewards delayed almost 18 minutes, but they waited less than 6 minutes when they pretended that the real rewards, rather than the pictures, were in front of them. Likewise, even when facing the real rewards they waited almost 18 minutes when they imagined the rewards as if they were pictures.' [p. 935]

Taken as a whole these set of experiments provide strong evidence for the role of self-control in inter-temporal choice – at least over short time periods. The structure of the experiments just described are such as to make it impossible to relate the effects to differences in time-preferences. Rather, differences in reward exposure, or in the form of ideation, must be seen as acting on the ability to ‘execute’ on the underlying preferences.<sup>3</sup> As such, the effects found in these experiments must be ascribed to self-control and not to discounting. There are several important implications.

First, the experiment shows that one can disentangle self-control and discounting – at least in the laboratory. Second, self-control effects can be as large, if not larger, than the effects of (pure) discounting. Third, given the different pathways by which the effects are modulated (ideation affects self-control but not discounting) it would appear important *not* to conflate the two effects in some reduced form discount function (as appears to be the case sometimes).

This last point is particularly important when we are linking inter-temporal choice outcomes to individual attributes such as IQ. Often inter-temporal choice is reduced to a discount rate and this rate is then correlated with IQ, gender etc. The evidence of Mischel et al suggests that these connections operate via the impact of those attributes on self-control and not on discounting per-se. This distinction appears important both from an analytical and a policy point of view.

**3.2. Discount Factors.** A substantial literature has grown up in Economics, particular in recent times, calculating (exponential) discount rates for different time periods and relating these to different individual attributes such as IQ and age.

Discount factors have also been interacted with other aspects of personality such as risk-aversion. It is important to note that, even in cases where uncertainty has not been explicitly introduced, the very nature of time makes it likely that there is some degree of implicit greater riskiness (‘the world might end’, ‘the experimenter might cheat’) associated with greater delay.

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<sup>3</sup>Alternatively they require us to make preferences context dependent. My preferences to two marshmallows now versus two marshmallows plus three pretzels is dependent on whether I am being exposed directly to these rewards. While a feasible option, this approach creates more difficulties than it resolves. Preferences are now context dependent to such an extent – dependent not just on your surroundings but on your current thoughts! – that they are likely to be of little value whether as theoretical or empirical constructs.



It is generally agreed that the exponential form, while a useful, and tractable starting point, exhibits a relatively poor fit to the empirical data Frederick et al. (2002). Various alternatives models have been proposed most notably discounting using a hyperbolic functional form (e.g.  $\frac{a}{1+bt}$ ).

As the literature on discounting is now voluminous, for a general overview the reader is referred to one of the existing overviews such as Frederick et al. (2002); Chabris et al. (2008).

#### 4. SELF-CONTROL, DISCOUNTING AND UTILITY

In classical models of the utility function and discounting a lower discount rate (i.e. a higher weighting on the future compared to the present) always equates to a higher total utility – with instantaneous (or per-period) utility functions the same, then discounting future payoffs less heavily must imply that total utility is higher. Similarly, it is generally assumed that, all other things being equal, those ‘lacking’ in self-control would necessarily be better off were they able to exercise more will. However, in both cases one must wonder that all other things are not equal. In particular, at least up to a point, those who ‘live for today’ (for whatever reason), might also get more enjoyment out any given piece of consumption. Conversely the extreme ‘puritan’ who is ever happy to delay ‘gratification’ may (perhaps as a result) derive very little enjoyment when at last they do receive the reward for their patience.

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