Overeating and time preference

Why consume towards overweight?

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1 Introduction

1.1 Background

Overweight is a growing health problem throughout the developed countries in the world. Its societal costs in terms of health-care and productivity losses are worrying many politicians and economists. The problem is worst in the U.S where over 30 percentages of the population is obese. In Sweden, that number is 10 percentages. However, according to researchers at the Institute for Health and Health Care (IHE) in Lund, the Swedish scenario in 15 years could be the same as the American situation today. Furthermore, in 2003 the Swedish healthcare costs associated to some widespread diseases caused by overweight was estimated to exceed SEK 3 billions. (Persson et al., 2005)

The major costs, however, falls upon the overweight individual himself. Still, many of us consume food towards this detrimental condition. This phenomenon is interesting out of the perspective of behavioural economics. Possible theoretical explanations to overeating are explored in the essay.

1.2 Questions at issue

The aim of the essay is to explore what triggers individuals to overeat. Out of an economist's viewpoint, the immediate answer must be that the benefits of overeating exceed the costs of the extra weight. But what makes some individuals find it *worthwhile* to overeat, while others don't?

It is commonly recognized, however, that overweight individuals are unhappy with their condition. They wish they could eat less but have difficulties to commit to a diet. Consequently, it is important to find explanations to why individuals overeat albeit valuing the benefits *less* than the costs.

1.3 Method

The questions at issue are investigated as the problem of overeating is assessed on theoretical models for individual economic behaviour. The essay exclusively employs models regarding individual time-preferences. The fact that overeating is an activity that brings instant utility which has to be weighted against future costs account for the chosen class of models. Another motive for the focal point is that high time preferences and overweightness seem to be related to the same socioeconomic groups. Studies confirm that overweight is negatively related to income and education (Lakdawalla and Philipsson, (2001); Chou et al., (2003); Sundqvist, (2003)). There are only a few studies that include both individual time-preferences and socioeconomic variables. However, Emily Lawrance (1991) show on a negative relationship to schooling and income and Fuchs (1982) reported a negative effect of schooling.

There are several models that concern time-preference. The classical DU-model is primarily presented as a reference model in the essay. The others are included because they contain important anomalies to the reference model and because they are capable of providing some interesting insights into the reasons for overweightness.

1.4 An overview of the essay

The individual costs of overweightness are presented in chapter 2. Chapter 3 aims at explaining discounting. Table 1.1 presents the chapters which contain the models and summarizes the motives for selecting the models.

Chapter 10 present methods used to elicit discount rates and some suggestions on how to test the empirical hypothesis that are stated throughout the essay. A summary of the conclusions is presented in chapter 11 and a final discussion is found in chapter 13.

Cha pter	Model	Violation of the DU-model	Application to the problem of overweight
4	Samuelson's DU-model	-	How overeating can be worthwhile
5	Endogenous discount factors (Becker and Mulligan)	Discount factors are unstable over life-time and are affected by utility levels	How overweightness can cause low discount factors and thereby enworsen the problem.
6	Loewenstein's model of anticipation	Consumption affects utility in preceding periods	Elucidates the diet difficulty
7	Hyperbolic discounting (Mazur's function)	Non-exponential discount function.	The problem of self-control
8	Hyperbolic individuals (Cutler et.al.)	Discount factors differ across goods	The problem of self-control
9	Preference for sequences (Loewenstein and Prelec)	Inseparability of utility levels	The problem of self-control

Table 1.1: Overview of the chapters presenting the models.

1.5   Essential assumptions and definitions

According to neoclassical economic theory, individuals maximize their utility of consumption when the marginal benefits equal the marginal costs. They are assumed to act rationally in order to maximize their utility. Furthermore, individuals are perfectly informed about all costs and benefits that come along consumption of a good. These assumptions of individual behaviour are essential throughout the essay.

The assumption of perfect information leads way to straightforward analysis. *Overeating* can be defined as the caloric intake that exceeds an individual's caloric expend at optimal body weight. Caloric expend depends on physical activity and basal metabolism. The latter include the expenditure of calories required for bodily functions when the body is at rest. As basal metabolism increases with body-weight (Cutler et. al., 2003), overeating has to go on in order to keep a steady state of overweightness. Thus, overeating lead to either weight gain or maintenance of overweight. However, when an individual engages in this activity, he is perfectly aware of the

amount of weight he will put on and the costs of this extra weight. The conventional definition of overweightness, a BMI[1] above 25, is applied.

Perfect information is a quite strong assumption. Individuals may not be perfectly informed of the caloric content of foods and their physical expend of calories. Furthermore, the knowledge of the many health costs and psychic costs of overweight may be inadequate. It is, however, reasonable to assume that individuals are acquainted with that weight gain follows excessive food consumption and that overweight is detrimental for health.

Another important assumption is that overeating is not addictive. Sugar addiction is currently debated among researchers[2]. A renowned study carried through at Princeton University showed sugar dependence in rats, but the results are still unable to classify sugar as addictive (www.princeton.edu).

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[1] Body Mass Index (BMI) = (bodyweight in kilograms) / (height in meters)^2
[2] Contributions to this debate are found on www2.lakartidningen.se

2 Personal costs of overweight

Overweight has a strong negative effect on longevity because of the impairment of health (Kopelman, 2000). Individuals with a BMI above 30 are defined as obese, which is an especially severe state of overweightness. Overweight increases the risk for several diseases. Some of them, e.g. arthrosis, is a direct effect of the extra weight while are others are caused by high blood sugar, high blood fat etc. which follow the extra food-intake. Further costs are presented in table 2.1.

Disease	Association to overweight and weight gain
Premature death	Increased risk of premature death among overweight individuals. For the obese, the risk increases with 50%-100%.
Heart disease	Increased incidence of heart attack, congestive heart failure, sudden cardiac death, chest pain, abnormal heart rhythm and high blood-pressure
Diabetes	A weight gain of 11-18 pounds double the risk of type 2 diabetes. 80% of the people with diabetes are overweight.
Cancer	Increased risk for various types of cancers.
Breathing problems	Interrupted breathing while sleeping and asthma is a frequent condition among obese
Arthritis	Gaining 2 pounds increases the risk with 9-13%
Reproductive complications	Increased risk of birth defects, death during pregnancy and complications during labor and delivery. Increased risk of impotence and infertility

Table 2.1: Impairments of health associated with overweightness
(source: www.surgeongeneral.gov)

Some diseases that follow a weight-gain, especially heart disease, can be eased through loosing the weight (www.surgeongeneral.com). Some argue, however, that the health benefits of loosing weight are uncertain.

Other costs of overweight are allied to social disadvantages. Overweight people are objects to many prejudices. An american study found that children who were asked to describe a silhouette of a plump individual used phrases like "lazy", "stupid" and "get teased" etc (Staffieri, 1967). A later study found that physicians usually described obese patients as "weak-willed", "ugly" and "awkward" (Maddox and Liederman, 1969).

Social discrimination can also affect individuals' economic prospects. Baum and Ford (2004) accomplished a study in which they confirmed, after controlling for several variables, a wage penalty on the job market for obese individuals. Another study established that income differences between obese women and normal weighted women are primarily caused by their lower potential to find an economically favourable partner on the marriage market (Averett and Korenman, 1996).

It can be concluded that the costs of overeating are many. The actual price of the extra food items appears to be infinitesimal in comparison to the future costs of impaired health, social discrimination and lowered economic prospects.

3 What is discounting?

Most people's valuation of a reward or a loss depends on the point in time it is available. For example, imagine a choice between having SEK 1,000 immediately and some amount (1,000+x) in a year from now. If you require the later amount to be higher than SEK 1,000 in order to favor it, you valuate future money less than immediate money[3]. This is equivalent to having positive time-preferences. If the opposite is true, that is, x is less then zero; the preference for the present is negative. For now, consider the most commonly observed positive time-preferences.

3.1 Important definitions

The rate of time-preference or the *discount rate* is elicited when the amount of x generates indifference between the two choices given above. x* denotes this decisive level throughout the essay. If SEK 1,050 (x*= SEK 50) generate indifference between the choices, the *rate of time preference* for SEK 1,000 is 5 %. In this *trade-off point of indifference*, the present value (*PV*) of the later reward is equal to 1,000SEK. The weight put on the future amount is called *the discount factor*. It determines the discounted value which is equivalent to the present value. In this example, the discount factor is about 0.952 (0.952 * 1,050 = 1,000). The calculations of these

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[3] It is assumed that the immediate money cannot be invested in the capital market and gain interest during the year.

factors are presented in (1). Let $(c)_t$ refer to a specific amount of money (or consumption) that can be obtained immediately, $t=0$, or next year, $t=1$. It is evident in (3.1) that the more an individual require in order put off consumption, the higher is the rate of time preference and the lower is the discount factor.

The rate of time preference; the discount rate:
$$\delta = \frac{(c+x^*)_1}{(c)_0} - 1$$

The discount factor:
$$\beta = \frac{1}{1+\delta} \qquad (3.1)$$

The trade-off point of indifference:
$$\frac{PV(c+x^*)_1}{PV(c)_0} = \frac{\beta(c+x^*)_1}{(c)_0} = 1$$

The valuation of consumption decreases when it is deferred, given positive time preferences. Thus, the discounting motivates individuals to postpone losses and require compensation (a reduction of the loss) if it is hastened. A gain or a loss for an individual is not necessarily monetary, it can also be outcomes of health or other more intangible utilities, such as dining at a restaurant or receiving a kiss from a movie star. Hence, c and x^* can be anything that influence on individuals' utility.

4 The classical DU-model

Samuelson (1937) introduced the discounted utility (DU) model in 1937. The model entails a discount factor that is constant across all sorts of consumption and all time periods. This makes the model very easy and elegant. For example, a person who discounts SEK 1,050 in one year with a rate of 5 % is assumed to have the same discount rate for SEK 1 or SEK 105,000. It is also effortless to calculate the discounted value for consumption that occurs sooner or further into the future than a year: The present value for SEK 1,050 in two years is simply $1,050 \cdot 0.952^2 = 952.38$. Thus, according to the DU-model, the valuation of any future consumption is simply the value of the consumption multiplied by the discount factor raised with the time delay. This is called *consistent exponential time-discounting*.

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Under the standard assumptions of transitivity, completeness and continuity in preferences,[4] Samuelson's model presumes perfectly informed and rational individuals to plan a consumption path as to maximize the sum of life-time utility, V. The restriction is that total consumption do not exceed life-time earnings, A. The maximization problem of the functional form of lifetime utility, V, follows,

$$V = \sum_{i=0}^{T} \beta^t \cdot f(c_t) \text{ subject to } \sum_{t=0}^{T} c_t \leq A \qquad (4.1)$$

in which T indicate the length of life, t denote time period and $f(\cdot)$ is the instantaneous utility function for consumption, c. This function increases with consumption at a decreasing rate, hence $f'(c) > 0$, $f''(c) < 0$. The diminishing utility of increased consumption in each period motivates individuals to spread consumption over time in order to maximize V. However, the discount factor, β, have the opposite effect and motivate to step up consumption into the present. Thus, the distribution of consumption over life-time depends on two opposing forces; the curvature of the utility function and β.

It is assumed that the level of β is stationary over life-time. This bears out that the consumption path decided upon in one period is not to be altered or regretted in the following period for the given amount of resources. The relative present value of each period is consistent with the perspective in every time period. For example, if a 20-year old person with positive time-preferences receives a lump sum of money to spend over life time, he would set aside more money for his early years than for his later. When he turns 30 he has less money to spend than he had as a 25-year-old, and he faces a future of constantly decreasing consumption. He does not, however, want to change the spending of the remaining money because the plan made ten years ago is still optimal.

The discount factor reveals the preferred consumption profile. Diagram 4.1 illustrates how these profiles differ between individuals who are identical in all respects but their time-preferences. Individual A has a rate of time-preference equal to zero. The diminishing utility of consumption

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[4] A clarification of these axioms is found in Nicholsson (2002:66)

in each period is therefore his only motive which results in an even spreading of consumption. The other two individuals, B and C, have positive time-preferences and design declining consumption profiles.
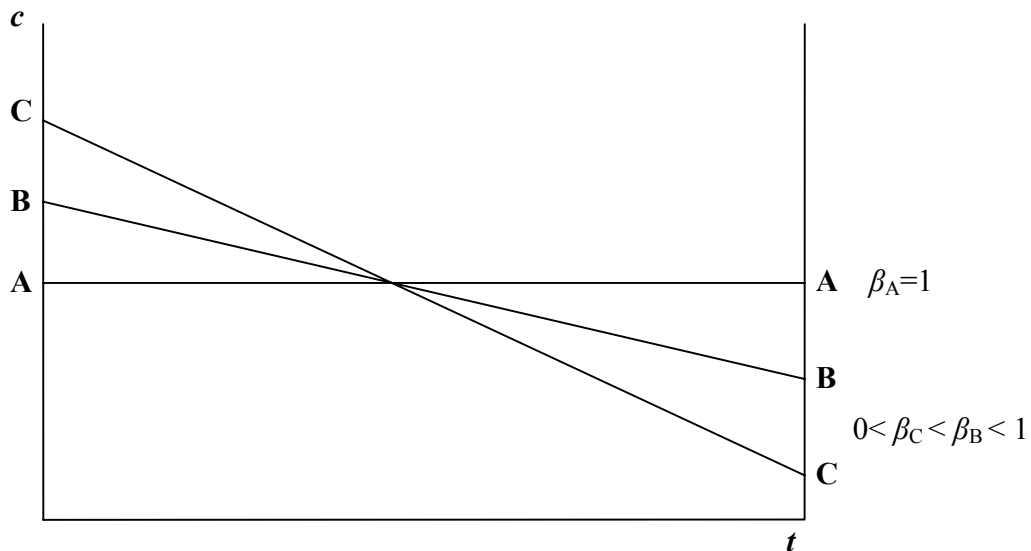
Diagram 4.1: Preferred consumption profiles for individuals with different time-preferences

4.1 How can the DU-model explain overweight ?

Hypothesis 4.1: Individuals who have a low discount factors are more inclined to overeat.

Jon Elster (1985) presents profiles for life-time utility that illustrate how discounting determines the valuation of utility that takes place in different time periods. It is appropriate to illustrate the problem of overweight in a similar way with assistance of diagram 4.2.

The level of utility that is obtained if overeating and weight gain never occurs is represented by the horizontal, dashed, reference line. To overeat throughout life causes a constant overweight. For now, assume that overweight does not affect length of life. The health costs of overweight are

supposed to increase with the length of time in the condition while the benefits of overeating are the same in every period. For this reason, the utility profile illustrating a life with overeating is declining (the solid line in 4.2). It is evident that overeating is assumed to provide a net gain of utility in early periods and a net loss of utility in periods subsequent to t^* in diagram 4.2. Therefore, the utility profile of a life with overeating is declining.

The negative effects of over-eating are assumed to be larger than the gains (*gained U < lost U*) and overeating is thereby assumed to lower total life-time utility. Hence, a person with time-preferences that equals or are close to zero would never find it optimal to overeat. On the other hand, if the rate of time-preference is high, it is worthwhile for the individual to over-eat if the lost utility after time t^* is weighted low enough in relation to the weight put on the utility in earlier periods. In other words, an individual with high time-preferences may reason "I don't care if plumpness make me worse off in the long run. The pleasure I experience now of eating cakes makes it worth it!"
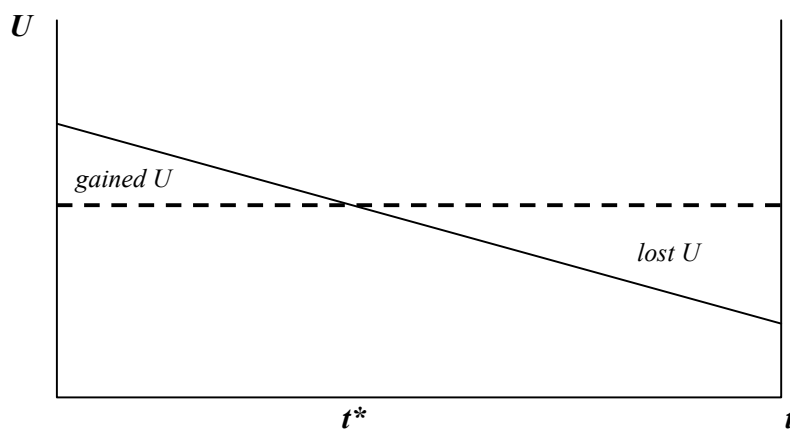
Figure 4.2: Utility profiles
The solid line illustrates how over-eating affects the utility (*U*) over life-time relative to the utility obtained without over-eating. The latter is represented by the dashed line.

It is assumed in figure 4.2 that the choice to live a life with overeating and overweight is irreversible. Otherwise, it would be optimal eat until $t=t^*$ and then stop in order to avoid the low utility levels in later time-periods. Irreversibility may appear to be an impracticable assumption, especially since overeating is considered as non-addictive. There are, however, many costs that

are irreversible and do not vanish with a weight loss. Arthrosis and diabetes are two examples of irreversible health costs that typically worsen with age. Furthermore, there are social costs that are likely to be increasing and irreversible. The unfavourable economic prospect that comes with less lucrative partners and working careers are likely to be permanent consequences of overweight in early life.

4.2 Summary

Samuelson's DU-model assumes discount rates that are constant across goods and time periods. The utility function is concave over consumption and independent of previous and future utility.

According to the DU-model, high time-preferences motivate decreasing utility-profiles. Therefore, it is suggested that individuals who prefers profiles with high utility in early periods are more likely to find that the benefits from over-eating exceed the increasing costs.

The validity of the DU-model has been criticized by several economists and psychologists and Samuelson himself was rather sceptical about the models applicability on individuals in real life. Interestingly, one of Samuelson's many doubts concerned the constant rate of time preference . The model in chapter 5 revises that assumption.

5 Endogenous time-preference

Becker and Mulligan (1997) were pioneers to create a model with time-preference as an endogenous variable in the life-time utility function. The authors argue that many individuals recognize high time-preferences, or impatience, as a shortcoming they need to overcome. Becker and Mulligan claim that individuals can learn to appreciate the future by making it more vivid through purchases of newspapers, history studies, visiting their aging parents etc. Accumulation of such goods and efforts are examples of investments in what the authors entitle future-oriented capital. An individual's discount factor increases with the stock of future-oriented capital. The model predicts how the incentives for optimal amount of investments of that kind vary with education, age, income and personal characteristics. Accordingly, Becker and Mulligan explain why time-preferences differ not only between but also within individuals.

5.1 The model

Let $\beta(S)$ denote the discount factor as a function of the stock of investments in future oriented capital, S;

$$\beta(S) > 0, \quad \beta'(S) \geq 0, \quad \beta''(S) \leq 0, \quad \text{for } S \geq 0.$$

Individuals are assumed to maximize the life-time utility function, V, depending on the utility of consumption in each t:th time period, $f_t(c_t)$, the weight put to each period $\beta(S)^t$ and the length of life, T;

$$V = \sum_{t=0}^{T} \beta(S)^t \cdot f_t(c_t) \tag{5.1}$$

Under the assumption of a perfect capital market, the budget constraint equals the present value of life-time earnings and assets,

$$\sum_{t=0}^{T} R_t c_t + \pi S = A_0 \qquad (5.2)$$

R_t denotes the interest rate factor in each period, and π is the price of S which, for simplicity, is equal to one and constant over time and individuals. S is assumed not to depreciate with time. This gives the familiar first order condition for consumption, adjusted by a discount factor and an interest rate factor, where the marginal utility of c_t is equal to the marginal utility of wealth, denoted by λ_0. The first order condition with respect to S is written;

$$\beta'(S) \left[\sum_{t=0}^{T} t [\beta(S)]^{t-1} f_t(c_t) \right] = \lambda_0 \qquad (5.3)$$

The condition in (5.3) establishes that the optimal amount of S is increasing with the marginal effect on the discount factor, $\beta'(S)$, the length of life, the level of the discount factor and the level of future utilities.

5.1.1 Future utilities' effect on the discount factor

The main proposition by Becker and Mulligan is that the incentive for individuals to invest in patience increases with wealth. Wealth affects the optimal amount of S for two reasons; firstly, it reduces the cost of S since the marginal utility of wealth decreases, and, secondly, it increases the amount of future utilities and thereby the return of investment. It is emphasized in the article that increased wealth commencing from a higher wage rate could raise the time cost of S since the opportunity cost of time increases. However, a high wage rate is in general a result of a person's increased productivity. This increase should be equally eminent in the production of S and thereby offset the effect of higher time costs, Becker and Mulligan argue. If high productivity results from education, a direct positive effect of schooling on the productivity of S is declared. This reasoning is aligned with Grossman's position in his classical paper from 1972. He articulated positive effects of education on the productivity of producing health capital (Grossman, 1972).

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Becker and Mulligan conclude that a wealthy person will have more patience and thereby a higher consumption growth over the life time than a less wealthy person. Models with fixed exogenous time preferences, like the DU-model, usually assume that patience causes wealth while the model by Becker and Mulligan assert a dual direction of causality.

It is not merely wealth that affects the discount rate. Becker and Mulligan write; "… anything that raises future utilities without raising the marginal utility of current consumption will tend to lower the equilibrium discount on the future." (1997:739) This complementarity between time-preferences and future utilities provides an explanation to the high rate of time-preference often found within addicted individuals. Addictive substances found in drugs, tobacco and alcohol increase the immediate utility of the consuming the goods whereas the consequences of misuse decreases the average level of future utilities. Becker and Mulligan conclude that this lowers the returns of investments in S and it is therefore rational for addictive individuals to have a lower discount rate in equilibrium.

5.1.2 The endowed discount factor

Another interesting outcome from the condition in (5.3) is the effect of the level of the discount factor. Becker and Mulligan discusses how differences in the endowed discount factor, $\beta(0)$, can affect the optimal amount of S. If the endowed discount factor differ by a multiplicative constant, $B \cdot \beta(0)$, the optimal amount of S will increase with B because of the increased returns of investment.

5.1.3 Another specification of the model: State-specific future-oriented capital.

Becker and Mulligan accentuate the model's usefulness in explaining why people often put less weight on future events that are unpleasant and unsure. To see this, consider an individual who lives for two periods. In the second period, there are N possible states of nature, each weighted according to its probability, p_j, and its state-specific rate of discount, $\beta(S_j)$. S_j represent the effort

or the accumulated investments made to appreciate each j:th state. The maximization problem follows;

$$\max_{c_0, c_1, \{S_j\}_{j=0}^N} \left[f_0(c_0) + \sum_{j=0}^N \beta(S_j) p_j f_1(c_1 - x_j) \right], \ \text{ subject to } c_0 + R_1 c_1 + \sum_{j=0}^N S_j = A_0. \quad (5.4)$$

It is obvious from (5.4) that the expected return of investing in future oriented capital is greater for states with high probability, p_j, and high utility, $f_1(c_1 - x_j)$. Under the assumption of constant consumption levels across all states, the future utility depends on x_j, which denotes the hazard in each state. The expected return of investments in S_j increases with the utility level and the probability of the j:th state. Consequently, individuals are expected to put more effort into appreciating states of nature that are more probable and more pleasant.

It is reasonable that state-specific discount rates are not merely affected by S_j, Becker and Mulligan emphasize. They suggest that the specific rates of discount is influenced by a stock of general future-oriented capital (S) such as

$$\beta_j = \beta(S) \cdot S_j. \quad (5.5)$$

Since the two sources of future-oriented capital are multiplicatively separable, the general capital can be factored out. Unfortunately, there is no light put on possible determinants for S in the article.

5.2 An application on the model: Possible links between overweight and discount rates

The Becker and Mulligan model lead way towards some theoretical applications for the relationship between discount rates and overweightness. To begin with, assume that a low discount factor causes overweight. The ground for this assumption is that high time preferences make an individual predisposed to overeating because less weight is put on future utilities from physical well-being. In other words, impatient individuals are expected to sacrifice less

immediate consumption in order to avoid future overweightness. This is consistent with Fuchs (1982) theory about time-preferences and health related behaviour

5.2.1 Overweightness as an exogenous outcome

Hypothesis 5.1: Low income and education causes overweightness indirectly.

Studying the current model, some possible explanations appear for the prevalence of the condition in certain socioeconomic groups. It is recognized previously in this essay that serious overweight, or obesity, is associated with low income and low education. These variables inflict on the discount factor; income affects future utilities and education affects the efficiency in producing future-oriented capital (see 5.1.2 for further clarification). Thus, these variables could cause obesity through their effect on time-preferences as illustrated in figure 5.1. It is likewise probable that differences in body weight origin in heterogeneity in the endowed discount factor, B_i, which is included as an exogenous variable in figure 5.1.
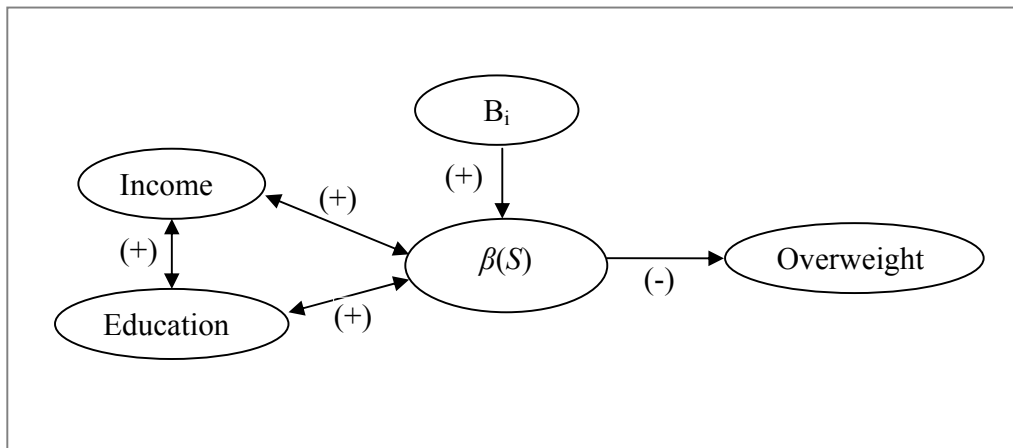

Figure 5.1: Overweight as an exogenous outcome of the discount rate.
The arrows illustrate the direction of causality. (+) and (–) denotes the sign of the effect.

5.2.2 An endogenous relationship

Hypothesis 5.2: Overweightness causes low discount factors.

Reverse causality between overweight and the discount factor has not yet been considered. However, using the model provides theoretical support for overweight being not simply an outcome of impatience, but also an endogenous variable in the determination of the discount factor. Overweightness has two likely effects on the optimal amount of S. Firstly, it reduces the length of life, (T in (5.3)). Secondly, if overweight causes a wage-penalty in the labour market, as recognized by Baum and Ford (2004) (see chapter 2), it reduces life-time earnings and increases the marginal cost of future-oriented capital (λ_0 in (5.3)). Both these effects make it rational for individuals to invest less in S. Figure 5.2 illustrates the possible endogeneity between the variables.
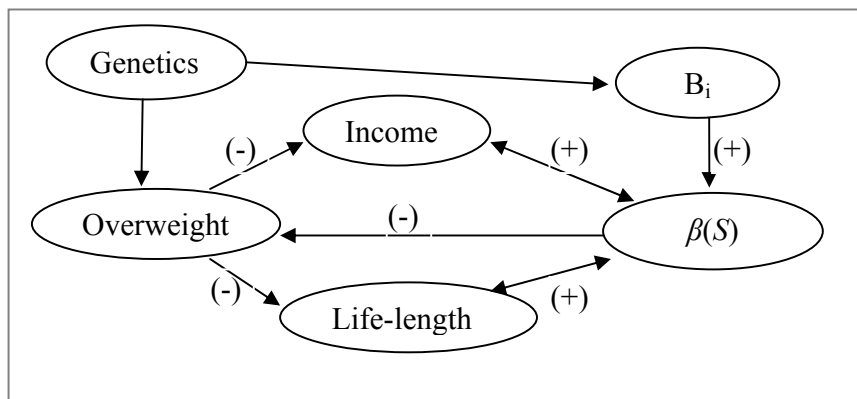
Figure 5.2: Overweight as an endogenous variable in the determination of the discount factor

This implies that initial individual inequalities in body-weight or the endowed discount factor, possibly caused by genetic differences, will expand as a result of the endogenous relationship between these variables. In other words, an initially overweight individual will be less inclined to resist overeating because of his lower discount rate in equilibrium.

(Observe in figure 5.2 that if time preferences does not affect overweightness, which is contrary to the previous assumption, obesity could be an exogenous variable in the determination of the discount rate.)

5.2.3 The effect of overweight on state-specific discount factors

Hypothesis 5.3: Heavy individuals have incentives to appreciate future states-of-nature that become more probable with overweightness.

It is recognized in 5.1.3 that even when effects on wages and longevity are ignored, which is equivalent to hold consumption levels constant across individuals, the future utility is still expected to decrease for obese people because of the increased risk of various utility-decreasing hazards. These hazards can be associated with health, i.e. diabetes, or social wellbeing, i.e failure in the marriage-market and discrimination at the work-place. Recognize that obesity only increases the probabilities, p_j in (5.4), for these states, while all people are more or less exposed to them. How can the increased risks create individual differences in the discount rates for specific states? The following example provides a possible answer to that question.

Consider two individuals. The first one is of normal body weight and the second is heavy. Presume that the only consequence of overweight is an increased risk of diabetes in period two in equation (5.4). Thus, the states of nature (c_1-x_j) in period two are constant across the individuals, but the probability of each state (p_j) deviates because the second individual suffers an increased risk of a state with diabetes. Consequently, all the states without diabetes become less probable for the heavy individual if the probabilities are mutually independent.[5] The model predicts the second individual to invest a lesser amount of state specific future oriented capital (S_j) for states he is less likely to experience. Concurrently, the second individual should invest more than his lighter friend in lowering the discount factor for a state with diabetes. The increased weight put on future costs of overweight creates an incentive for the second individual to oppose his condition since the future returns of the effort become more precious. This brings out that the effect of overweight on the discount factors should not worsen the condition as suggested previously in 5.2.2. Instead the effect should be negative. These relationships are illustrated in figure 5.3.

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[5] Under the assumption that all probabilities equals one. This assumption is not explicit in Becker and Mulligan (1997).
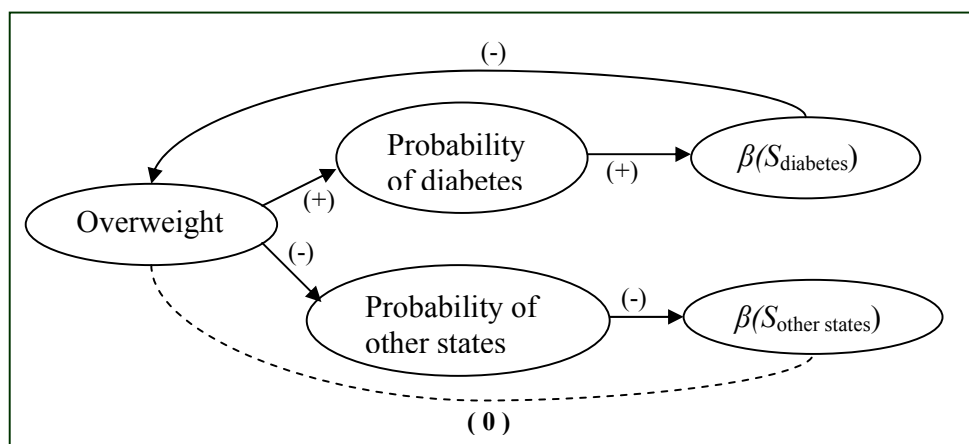
Figure 5.3: The effect of overweight on state-specific discount factors.
A state with diabetes, for which the probability increases, becomes more salient and the feed-back on the overweight is negative. The discount factors for states uncorrelated with overweightness are negatively affected. The appreciation of these states, however, is not expected to affect the overweight.

How does this differ from Becker and Mulligan's discussion of harmful consumption? To begin with, their article never concern how individual differences in discount rates can feed back on behavior and create differences in other areas. In addition, Becker and Mulligan consider a situation where the *overall level* of future utilities is low and affect the *general* discount factor negatively. In contrast, the analysis in this essay entails the specification of the model that involves specific discount rates. An overall low level of future utilities in that model is equivalent with decreasing the value of *all* states of nature in the second period in equation (5.4). Assuming such effects in the previous example, the second individual would have a lower utility in all the possible states. Undoubtedly, this would decrease the level of *every* S_j in equilibrium.

However, I argue that the future consequences of harmful consumption are not definite. Instead, consumption causes an alteration in the probabilities of ending up in the possible states. This argument is likely to hold for the examples used by Becker and Mulligan as well. Similarly to over-eating, use of cigarettes, alcohol and drugs is associated with increased risk of utility-decreasing hazards like cancer, hypertension, diabetes and several social disadvantages. Like overweight individuals, addicts have incentive to raise the discount factor for states of nature related to their addiction. This should impact on the consumption negatively since the future costs are perceived as higher. It is, however, important to take note of one essential difference between overeating and the examples used by Becker and Mulligan. For addictive goods, the taste for the

good, or the immediate utility of the good, increases with consumption. This effect on the utility function might overshadow the impact of increased valuation of the specific future states. Nevertheless, I still argue that the increased discount factors for the states at risk should lessen the incentives for the destructive behavior.

The absence of details for the determinants for the general future oriented capital (S as explained in 5.1.4) is a shortcoming in Becker and Mulligan's article. However, a reasonable conjecture is that S is a positive function of the sum of all S_j:s ($S = f(\sum S_j)$). Using this definition of S make the function for state-specific discount factors quite different from the one in (5.5) since the general discount factor, β, is partly a function of S_j. Hence, S and S_j are not separable.

Assuming this relationship between the general discount factor and S_j is contradictory with hypothesis 5.3. Recognize that the total sum of S_j:s is expected to be lower for addicts and overweight individuals since the change in probabilities results in higher weights for low utility states at the expense of the weights put on high utility states. In other words, the average level of the state specific discount factors is lower. For this reason, heavy individuals have, ceteris paribus, a lower discount rate than other individuals for states-of-nature that become more probable with their condition only if the effect from the increased S_j dominates the negative effect of a lower S.

5.3 Summary

This application of the Becker and Mulligan model has aimed at finding explanations to the individual heterogeneity of in body-weight and in the level of discount rates. It is found that variables associated with over-weight, such as income and education, are important determinants for the discount rate in the model. Overweight's effect on life-length and income suggest endogeneity in the relationship with the discount factor. This correlation predicts initial inequalities to increase. A countervailing tendency to this conclusion is found when allowing for state-specific future-oriented capital. Obese individuals have incentives to increase discount-rates for risks that increase with overweightness. If the general discount factor is included as a determinant for state-specific discount rates, the effect is ambiguous.

6 Dread and savouring

6.1 Background

Loewenstein (1987) carried through an illustrative study which provided some interesting results regarding intertemporal preferences. In the study, 30 undergraduate students revealed the maximum amount of money they would pay to obtain or avoid pleasant and unpleasant outcomes with a specific delay instead of immediately. Five different time delays were given for the following outcomes: obtaining $4, losing $4, losing $1,000, receiving an electric shock and, finally, obtaining a kiss from a movie star. Recall that the DU model predicts the present value to decrease with delay. Loewenstein calculated the proportional present value, *prPV*, when analyzing the results. If *x* is the maximum payment that is required or offered to experience an outcome, *c*, at a specific future point in time instead of immediately, the *prPV* is calculated:

$$prPV = \frac{c}{c + x}$$

In example, if a respondent required $3 (= *x* in (1)) to postpone a gain of $1 now (= *c* in (1)), he is ready to pay $3, or 75 percentage of the current value, to receive the money instantly. DU theory expects respondents to require money (*x* > 0) to defer positive consumption (*c* > 0) and be willing to pay (*x* < 0) in order to defer negative consumption (*c* < 0). Hence, the results are consistent with the DU-theory if the proportional present value is less than one and decreases with time. However, the results from the study presented in figure 1, show that the proportion of current value increases with time for two of the outcomes.
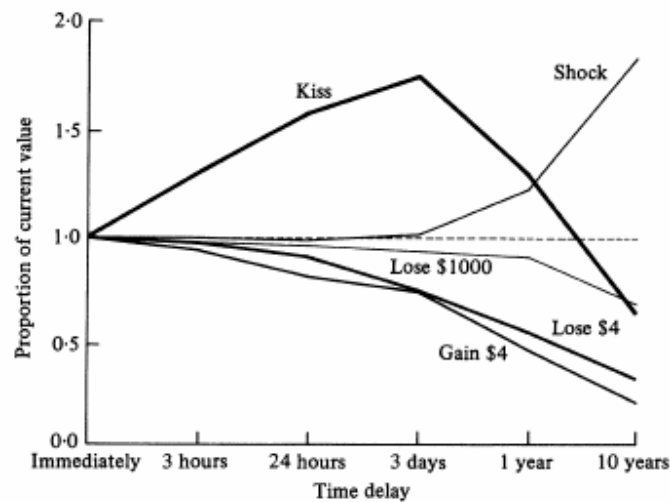
Figure 6.1: Proportional present values of outcomes that occur at specific points in time.
(Source: Loewenstein 1987:667)

Loewenstein argue that utility from anticipation of consumption is the explanation for these results. Including "savouring" for positive consumption and "dread" for negative consumption brings out a function in which the present value can increase with delay. He therefore suggests that the participants in the study wanted to pay to avoid the dread which comes with delaying the electric shock. Similarly, a kiss from a movie star was perceived as more valuable if the receiver could enjoy the anticipation for a while.

It should be emphasized that "anticipation" is different from what Becker and Mulligan denote "appreciation". Anticipation is assumed to be costless utility in Loewenstein's model. Appreciation does not provide utility by itself, but is a costly strategy to accumulate utility in future periods.

6.2 The model

Previous to Loewenstein, only a few economists have discussed the effect of expectations on individual's wellbeing[6]. Loewenstein (1987) created a model which enriches the utility function

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[6] Loewenstein brings up theories of Bentham (1789), Marshall (1891), and Jevons (1905) (Loewenstein 1987:666f)

with anticipation utility. Following this model, the present value of consumption, *V*, is written as below in a simplified, additive form.

$$V = \alpha \sum_{t=0}^{T} \left[\beta^t \left(\gamma^{T-t} \right)\left(1 - \gamma^L \right) \sum_{t=T}^{L} \beta^t U^c \right] + \sum_{t=T}^{L} \beta^t U^c , \quad 0 < \gamma < \beta < 1 \qquad (6.1)$$

$$\underbrace{\hspace{5cm}}_{\text{Anticipation utility}} \qquad \underbrace{\hspace{3cm}}_{\text{Direct utility}}$$

Starting with the last term in (6.1), consumption yields *direct utility, U^c*, in each period from the start of consumption, *T*, until the end in period *L*. When the beginning of consumption is delayed, the present value of direct consumption is discounted exponentially ($PV(\sum U^c) = \sum \beta^t U^c$ for all T<t<L), identically to the discounting formula in the DU-model. Thus, deferment *decreases* the PV of the *direct* utility unambiguously. The *anticipation utility* occurs in periods preceding the start of consumption (all $t \leq T$) and creates a motive for postponement if the consumption is positive and hastening if negative. This part of the utility function depends primarily on the direct utility, but also on the imaginability or vividness of the expected event, *α*, and the individual's concern about the future, *γ*, which function as a sort of discount factor. Within squared brackets, the *γ*-factor stipulates that the anticipation utility is higher in time periods closer to the beginning of consumption. In other words, anticipation increases in an accelerating way as the distance *T − t* declines. In example, a vacation from work that occurs in July provides more anticipation utility in June than in May. In the second term in brackets, *γ* makes anticipation a positive function of the length of consumption. The longer the vacation is, the more it is anticipated. Furthermore, the *β*-parameter clarifies that Loewenstein assumes anticipation utility to be discounted with the same rate as the direct utility.

At *t* = 0, the individual schedules the beginning of consumption with regard to maximize (if U^c is positive) or minimize (if U^c is negative) the present value of total utility. Deferring consumption has two different effects: Firstly, the direct utility becomes more heavily discounted which affects *V* negatively. (Recall that lower direct utility also decreases the anticipation utility). The second

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effect is positive because deferring provides more periods of anticipation. This effect is decreasing since *T-t* gets larger in each added period.

When is anticipation expected to affect intertemporal choices? It is worth to postpone or speed up consumption only if $V'(T) > 0$. Loewenstein's work prove that this condition is likely when α is large, which is quite intuitive when studying equation (6.1).

Loewenstein also shows that the positive effect of increasing L is dominated by the discounting of U^c. For this reason, intertemporal planning for permanent or prolonged consumption is less likely to be affected by anticipation than consumption that is fleeting. (Loewenstein 1987:672).

Figure 6.2 and 6.3 illustrates the net present value of beginning consumption at different times. As the maximum net present value occurs at T_m, the positive consumption will be delayed to that time period in 6.2.
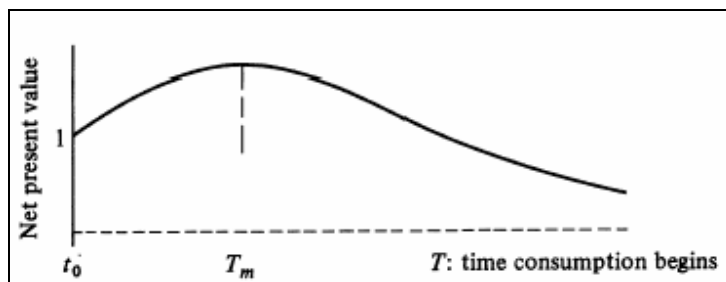

Figure 6.2: The net present value as a function of the start of consumption.
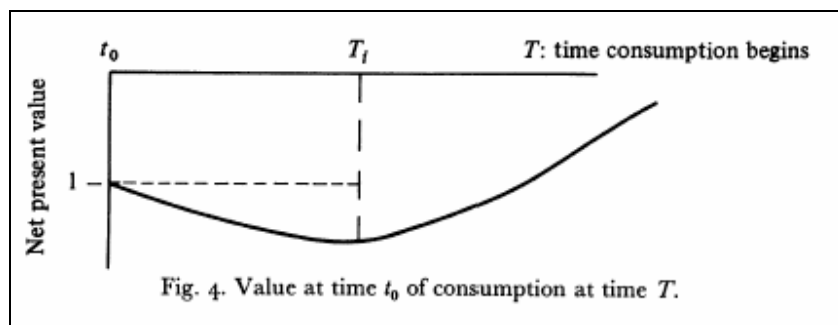(Source: Loewenstein 1987:671)

Fig. 4. Value at time t_0 of consumption at time T.

Figure 6.3: The net present value of a negative outcome.

(Source: Loewenstein 1987:673)

Figure 6.3 illustrates the net present value for different T when consumption is negative. Here, the anticipation utility lowers the total consumption utility since a delay causes a flow of dread. The critical period here is T_i , in which the individual is indifferent between delaying and deferring the start of consumption. However, observe in graph 6.3 that when the choice to begin consumption is open, the decision maker would prefer to delay it as much as possible. But if the choice is restricted to the time interval between t_0 and T_i, the definite optimal choice is to consume immediately. Loewenstein exemplify with the decision to have a dental or a medical treatment. These treatments tend to be postponed as long as possible, but when the dentist or the physician call, i.e. send a card, a maximum delay is imposed and many people ask to get the first available appointment to get it over with.

With Loewenstein's utility function, the effect of discounting is separated from anticipation. When not taking account for anticipation utility, the *devaluing* of consumption, as illustrated in 6.2 and 6.3, is incorrectly interpreted as inconsistent discounting. However, the model's discounting of utility is identical to the DU-model's. For this reason, Loewenstein's model is anomalous to the classical DU-model in its specification of the utility of consumption.

6.3 The importance of the α-parameter

Loewenstein suggest that many educational programs intend to make specific outcomes more vivid. This is equivalent to increasing α in the model. A Swedish example of this is the ANT[7]-education provided by many schools. Students are informed about the consequences of using harmful substances in order to increase dread and lower the benefits of consumption. Examples of efforts to manipulate α are presentation of pictures of damaged lungs and staging former addicts who tell about their past. These methods do not simply present facts which, in economic terms, intend to decrease the problem of imperfect information about the costs of consumption. Instead, they give emotional meaning to outcomes that are otherwise difficult to imagine. Examples of increasing savouring are found in other areas, i.e. in AMF:s[8] recent TV-commercials

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[7] Alcohol, Narcotics and Tobacco
[8] AMF is a Swedish insurance company

where a young person "visits" his or her future self. This aims at making people imagine their retirement which increase the value of saving in AMF's pension-funds when the anticipation value of a good retirement is higher.

6.4 Explaining the problem of overweightness through the insights from the model

6.4.1 The diet difficulty

Hypothesis 6.1: The treatment of overweightness is likely to be postponed indefinitely

Most overweight people perceive the cure for their condition as rather painful. One may well reason that the inclusion of negative anticipation should motivate individuals to speed up the launching of the treatment. However, such eagerness is not commonly observed. Contrary, consistent postponement of the diet is a familiar behavior. Interestingly, this planning is consistent with Loewenstein's model for the reason that the treatment consisting of diet and exercise is long and uncomfortable and typically require an everlasting change of life-style. The scheduling of such negative consumption for which L is large is rather unaffected by anticipation. Hence, dread should not motivate acceleration of the beginning of the treatment.

If the treatment was painful but quick, the Loewenstein model predicts that overweight individuals would go through the procedure as soon as possible to minimize the dread that comes with delay. Unfortunately for the heavy, this is not the case.

Hypothesis 6.2: Anticipation is important for the attractiveness of a diet plan.

People do start diets, often after periods of postponement. The motivation for a diet is often improved health and better looks which occurs after some period of restricted food consumption. I argue that anticipation utility from this outcome is crucial for an individual's decision to engage in a diet plan. This will be illustrated with an example. Assume an individual who eats cake every

day after dinner and is therefore unable to fit in his favorite jeans. He realizes that if he changes life-style and skips the cake he will be able to wear his jeans again. If he starts a diet he will loose the utility from the dessert, but he will gain utility every period he can wear his jeans.

a)

b)
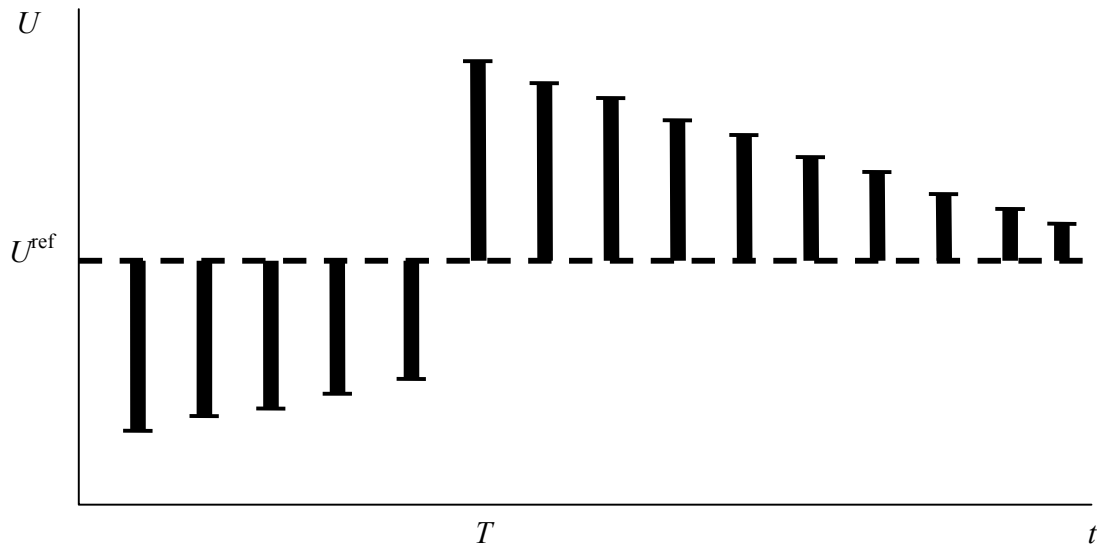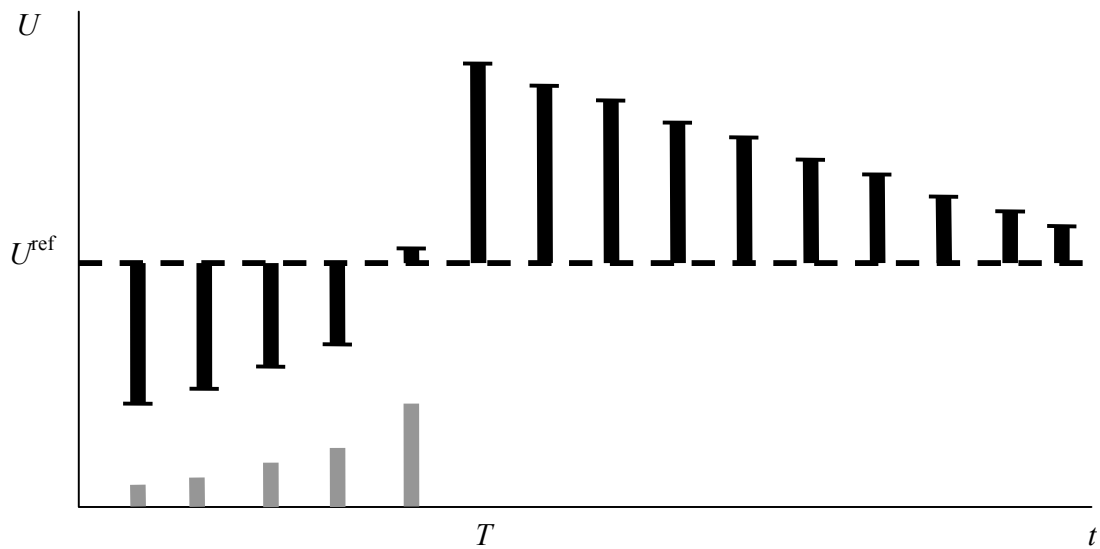
$\blacksquare$ = net utility change = $U^{diet}+U^{jeans}+U^{a}$ $\blacksquare$ = utility from anticipation = U^{a}

Diagram 6.4: The utility of a diet plan. a) illustrate the utility when $0 < \beta < 1$ and $\alpha = 0$ and b) illustrate the utility when $0 < \beta < 1$ and $\alpha > 0$

In diagram 6.4 a, the dashed line is a reference line which refers to the utility that is obtained if he doesn't change his diet. The black bars signify the present value of the net utility change in every period during a diet. It stands clear that after time period T, in which the jeans fit, the utility change is positive. This is because the utility of wearing the jeans (U^{jeans}) is larger than the lost utility of having dessert (U^{cake}). Before T, the utility change of the diet is negative because the jeans can't be worn. The bars are decreasing because the individual has positive time preferences. (If there was no discounting, the utility changes would have been equally large in every period before T, as would the changes after T).

In 6.4 b, anticipation utility (U^a) is added to consumption utility ($U^{jeans} + U^{cake}$). It is assumed in this example that the anticipation utility before each cake-dessert is infinitesimal[9], but the anticipation of wearing the jeans is quite high. Consistently with formula (6.1), the anticipation is increasing as T emerges. This increase is assumed to exceed the discounting of the anticipation utility. Observe the positive effects on the net utility change in the dreary periods before the jeans fit.

For these reasons, I argue that the ability to anticipate the positive outcomes of a diet makes the venture much more appealing.

6.5 Summary

Including dread and savouring in the utility function give some new insights in the problem of overweightness. The characteristics of the treatment of overweight motivate deferment of the action according to the model. On the other hand, savoring is likely to increase the attractiveness of a diet plan.

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[9] It would be theoretically wrong to define it as non-existing. The emotional feeling of having dessert should be quite imaginable which implies a high α-parameter. In addition, having dessert is fleeting consumption.

7 Hyperbolic discounting

Hyperbolic discounting is interesting because it expounds why individuals over-eat even though they find the future costs to be higher than the instant benefits.

7.1 The common difference effect

The classical DU-model model predicts that the relative difference in PV between two outcomes that are separated by a fixed amount of time is stable and independent of when the first outcome is available. That is, an individual who is indifferent between a reward, c, in period i, and a later larger reward, $c+x^*$, in period $i+t^*$, is also indifferent between these choices if they are assigned further into the future, to period i' and $i'+t^*$;

$$\frac{\beta^i f(c)}{\beta^{i+t^*} f(c+x^*)} = \frac{\beta^{i'} f(c)}{\beta^{i'+t^*} f(c+x^*)} \qquad (7.1)$$

Hence, according to the DU-model, the choice is only affected by the separation in time, t^*, and the difference in the level of utility, x^*. However, it is commonly observed that preferences change when the earlier reward is, ceteris paribus, available further into the future. When this distance, $(i'-i)$ in (7.1), influence on the relative value, the *common difference effect* is identified.

A classical example is that one apple today is preferred to two apples tomorrow, while two apples in 52 days are preferred to one apple in 51 days (Loewenstein and Prelec, 1992). Intertemporal choices of that kind reveal dynamically inconsistent preferences.

7.2 Hyperbolic discounting causes problems of self-control

The intertemporal change in time preferences is explained by a discount rate function that increases in an non-exponential, accelerating way as the delay to the available good abridges. Thus, the discount factor is not simply dependent on a constant, β in (4.1), raised with an exponent that equals the time delay, as suggested by Samuelson's DU-model.

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Ainslie (1991) discusses the consequences of such discounting on individuals' economic behaviour. He uses Mazur's hyperbolic function for the present value at time t of a good that is available in time T.

$$(PV(c))_t = \frac{c}{\zeta + \Gamma(T-t)} \qquad (7.2)$$

In (7.2), c is the amount of the good, ζ is a constant that determines the value at zero delay and Γ is a constant that modifies the steepness of the delay gradient. T is the time at which the good is available and t is the time when $PV(c)$ is calculated. The function is simplified by setting the constants equal to one. Ainslie (1991) uses a clarifying example on how such discount rates results in problems of self-control because decisions are reversed. In this example, the choice between having one unit of the good in an earlier time period and having two units of the good three units of time later depends on the distance to the first choice. If the distance is five time units, the larger good is preferred since the present value from that choice is the highest. Inserting the values in (7.2) asserts that 2 / (1+5+3) > 1 / (1+5). However, if the sooner option is only delayed by one time period instead of five, it will be preferred to the later option as 2 / (1+1+3) < 1 / (1+1). This explains scenarios in which the larger later reward is initially preferred, but as the smaller sooner reward draw near, it increases in relative value and win over later rewards.

The sudden increase in value that comes along hyperbolic discount functions are closely related to feelings, such as urges and sudden temptations. In a later paper by Ainslie (2003), this is illustrated with a person planning to skip dessert in order to get a more valuable good - a fit body. If the person discounts future outcomes with a constant discount rate, as in the DU-model, he would follow his plan and not have dessert since the proportional values of the two choices is constant (figure 7.1a). With a hyperbolic discount function (figure 7.1b), the individual would initially choose the fit body, but the sudden increase of the dessert-value causes him to suddenly (at $t=t^*$) prefer the dessert over the still heavily discounted value of the more distant fit body. For this reason, he changes his plan and eats the dessert. The hyperbolic discounting cause inconsistent choices; he first prefers the fit body over the dessert but reverse his choice as the

delay to the first option decreases. Ainslie refers to the expression "the Devil made me do it" and illustrate the rapidly increased value of the dessert as an action of a devil.
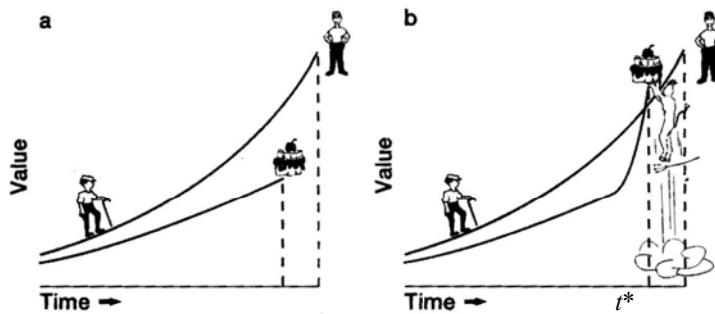

Figure 7.1: Exponential discounting (a) compared to hyperbolic discounting (b).
In (a), the relative value between the goods is constant. In (b), the sudden increase in value reverses the preferences at time t^*. Source: Ainslie (2003:5)

7.3 Methods to achieve self-control

Ainslie (1991) state that an individual who has reversed his choices often enough should realize his problem of self-control and try to overcome it. He emphasizes the importance of recognizing the divergence between ones current and future motivational states. The next example aims at explaining how an individual can perceive his intertemporal choices as an intrapersonal repeated prisoner's dilemma[10].

An individual who wants to stay in shape for an upcoming pool-party is just about to have supper. His utility from having a fit body on this party corresponds to value of 1000 each hour during the four hour tarzan-tanga dance. One of the rich cake-desserts makes him put on enough weight to decrease the value of the tarzan-tanga dance with 100 units of utility per hour. He has to plan eating a cake one hour in advance because it has to unfreeze. Thus, when he makes the

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[10] This example principally follows the construction of the examples by Ainslie (Ainslie 1991:336ff).

decision to eat the cake, the discounted value of the cake, which is one hour into the future, has to be larger than the alternative value of a better figure at the pool-party. During the hour he eats and digests the cake, it provides him 20 units of utility.

The individual's hyperbolic discount function is identical to Mazur's in (7.2). Both ζ and Γ equals one and t corresponds to hour. At the moment of choice ($t=0$), he has to take the decision whether to unfreeze the cake or not. The total present value of eating it equals the discounted value of the tanga-dance added to the discounted value of the cake. The tanga-dance takes place in hour 92, 93, 94 and 95 ;

$$PV_{eat} = PV_{cake} + PV_{party}$$

$$PV_{cake} = \frac{20}{1+1} = 10, PV_{party} = \sum_{t=92}^{95} \frac{(1000-100)}{1+t} \approx 38.1 \Rightarrow PV_{eat} \approx 48.1$$

The value of resisting the cake is only derived from the party

$$PV_{resist} = PV_{party} = \sum_{t=92}^{95} \frac{1000}{1+t} \approx 42.3 .$$

At $t=0$, he calculates the PV_{eat} versus the PV_{resist} for the future nights. He believes that the cake will not win over the extra fitness on any future nights. To see this, calculate the relation between the values for the subsequent nights seen from the perspective $t=0$. I.e., he finds that the relation between the choices at $t=24$ is $PV_{eat} \approx 0.77+38.1 \approx 38.87 < PV_{resist} \approx 42.3$, and so forth. Thus, he makes this plan considering his *current motivational states* in future time-periods. He reasons that "Since I don't find it worthwhile to have cake any other night, I can eat tonight and the effect on my figure won't be that serious."

However, every night he is about to make the cake-decision, eating the cake is the optimal choice *out of the perspective in that time-period*. I.e., seen from the perspective at $t=24$ hour, the relation between the options is $PV_{eat} \approx 10+45.4 \approx 55.4 > PV_{resist} \approx 51$. It stands clear that his *future*

motivational state is different from the current. It is crucial to realize this divergence in order to confront the problem of self-control.

7.3.1 An intrapersonal prisoner's dilemma

Table 7.2 presents the present values out of the perspective at t=0 of different series of choices as an intrapersonal prisoner's dilemma. It is obvious that the choice now depends on the individual's perception of future choices. If he believes that all cakes in the future can be resisted, the optimal strategy is to eat now and collect the highest possible amount of utility, 48.1. However, if he can foresee the alteration of preferences, or his future motivational states, it stands clear that he can end up eating every night and only collect 36.8 utility units. He therefore has incentives to take action against ending up in that series of choices. Ainslie suggests that the relative value of resisting temptations and collect will-power increases if the current choice is perceived as a precedent of future choices. Consequently, if the choice now determines the future choices, only two series maintains in table 7.2. The dominating choice is thereby to resist the cake now in order to resist it in the future. This series of choices provides 42.3 units of utility. The other choice, which results in eating every night, only collects 36.8 units of utility.

		future	
		eat	*resist*
now	*eat*	11.4 + 25.4 = **36.8**	10 + 38.1 = **48.1**
	resist	1.4 + 29.6 = **31**	0 + 42.3 = **42.3**

Diagram 7.2: An intertemporal intrapersonal prisoner's dilemma.
The present values of different series of choices. $\sum PV_{cake} + \sum PV_{party} = \textbf{\textit{PV}}_{\textbf{\textit{serie}}}$

7.3.2 Alternative strategies

In the previous example, the individual could overcome his problem of self-control through setting his first choice in another "framing", that is, as a precedent to other choices. Elster (1985) put light on two additional methods to gain self-control. The first is to make it physically impossible to give into the temptations. A lock on the freezer would be a line of attack within that category. It would restrict future choices in order to behave consistently with the current

motivational state. It should be emphasized that with constant exponential discounting, as in the DU-model, individuals have no incentives to reduce future choices.

The second is to change ones preferences. If the individual could start to dislike cake, it would be unproblematic to achieve the fit-body. An extreme method of bringing about preference change is found in a recent study in which people were given false memories of having been sick as a child after eating certain foods. Once false memories had been implemented, the subjects in the study started to dislike foods they previously liked (www.livescience.com).

7.4 The hypothesis

> **Hypothesis 7.1: Overweight individuals have more hyperbolic discount functions.**

The more the individual discount factor decreases with delay, the more probable are problems of inconsistent time-preferences. Thus, there are reasons to believe that overweight individuals have discount factors that increases faster as the good becomes closer in time. I therefore expect to find higher values of the constant Γ (see equation 7.1) in overweight individuals' discount functions. To see this intuition, consider the previous example. If the individual had a much lower value of Γ, e.g. 0.2 instead of 1, eating would never win over resisting in the first period given the length of delay (one hour) for eating cake.

> **Hypothesis 7.2: Individuals who perceive their future choices incorrectly are more harmed by hyperbolic discounting.**

An individual who can't foresee the failure of a plan will not undertake available strategies against temptations of the moment.

7.5 Summary

Hyperbolic discounting explains why individuals change their preferences over time. This becomes a problem of self-control. The more hyperbolic the function of the discount rate, the more severe is this problem.

If the problem of self-control is recognized by the individual, he has incentives to make efforts to oppose it. Perceiving the immediate choice as a precedent to future choices boosts the value of resisting temptations of the moment. Other strategies involve physical restriction and preference change.

It can be argued that individuals who don't see the relation between future and current motivational states are less apt to combat their lack of self-control.

8 Hyperbolic discounters

8.1 A result of discount-rates that varies across outcomes

Cutler et al. (2003) define hyperbolic individuals as people who discount hedonic pleasures in the future with a higher rate than they discount the costs of the pleasures. The model differs from the previous because the discount rates are constant over time but vary across sources of utility. However, the problem resulting from discount rates that differ across time and discount rates that differ across outcomes is the same – deficiency of self control.

Consider two individuals who put the same value and exponential discount rate on the costs of eating cake. Individual H puts a higher value on the dessert than individual N. He furthermore discounts the cake with a higher exponential rate than he discounts the costs. This behaviour makes him a hyperbolic individual according to the previous definition. It is illustrated in diagram 8.1 how these individuals' perceptions of their future choices differ. In 8.1, C is the sum of the present values of all instant and future costs at time t. D is the instant pleasure of eating dessert and t denotes day
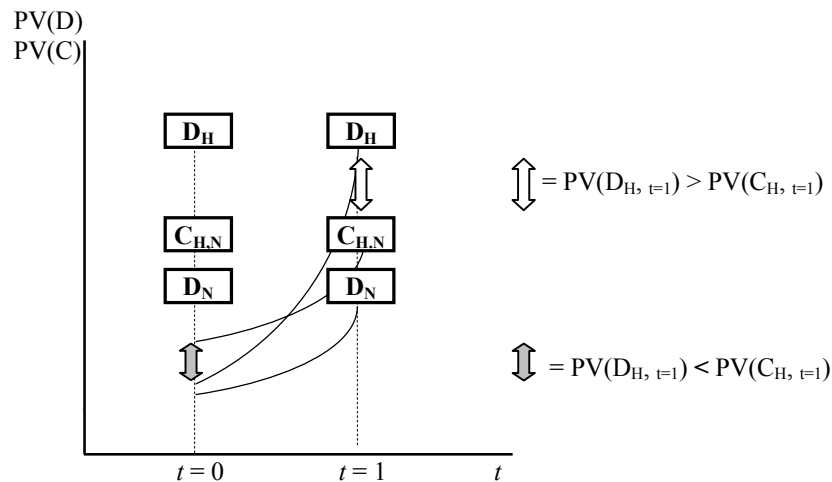
Diagram 8.1: The present value of costs (C) and benefits (D) for a non-hyperbolic (N) and a hyperbolic (H) individual. The arrow points out the crucial differences in value for H

The hyperbolic person will eat and assume that he resists the dessert next time because by then the costs exceed the benefits (see grey arrow in diagram 8.1). The dessert today is the last one ever according to the PV at t=0 of future desserts. But the condition for the cookie-decision tomorrow is the identical to the immediate (pointed out with the white arrow in diagram 8.1) and the diet-plan fails. A hyperbolic individual always thinks that "I can eat today and start a diet tomorrow".

8.2 The hypothesis

Hypothesis 8.1: Individuals who discount instant pleasures at a higher rate than other outcomes are more inclined to become overweight.

The reasoning behind the above proposition is quite explicit in section 8.1.

Hypothesis 8.2: Immediate access to food results in more severe problems of self-control.

Hyperbolic individuals, who discount the benefits of eating heavily, experience a drastic increase in the value of eating when the preparation time is close to zero. The short delay between the

choice to eat and the eating makes it more probable that the present value of the benefits exceed the present value of the costs. In diagram 8.2, t corresponds to minutes. It is assumed that a small change in preparation time can cause a preference for the immediate pleasure. If the choice to have a good, i.e. a cake, has to be made previous to t^*, eating will not win over resisting. On the other hand, if the decision doesn't has to be taken until after this critical point, eating will win.
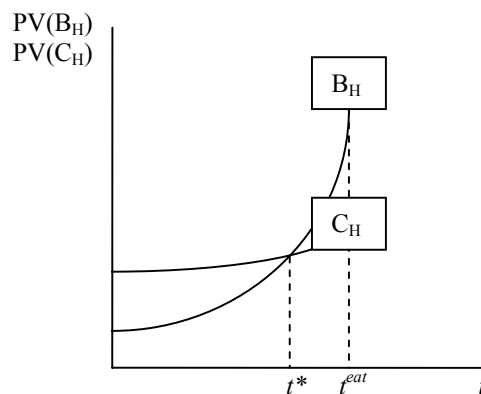
Diagram 8.2: The benefits of delay. If the waiting time between the choice to eat and the access to the cake exceed the critical delay ($t^{choice} > (t^{eat} - t^*)$), the cake will be resisted.

This is also true when the discount rates have the hyperbolic formula presented in chapter 5. Recall the example in the same chapter. If the cake-preparations took 10 hours instead of one hour, the decision to have cake would never be optimal.

The disadvantage of too much *monetary* liquidity for individuals with hyperbolic discount rates is investigated by Laibson (1997). His modelling results in an optimum with restricted access to monetary resources. In the same way, restricted access to food might help hyperbolic individuals to obtain a higher utility level with less overweight.

9 Sequences of outcomes

According to the DU-model, the value of some outcomes that occurs in a period is simply the sum of their individual values. Loewenstein and Prelec (1993) put light on an anomaly to this assumption. Supported by results from of several studies, they point out the importance of the order of the outcomes for the total value of a sequence.

9.1 Background

An individual behaving consistent with the DU-model would find it optimal to experience the best outcomes first and the worst last. In many studies, this is true for separated single outcomes, but preferences are different when several outcomes take place within a sequence. Studies have revealed a tendency to prefer sequences that are improving over time, which is in contrast with the assumptions of the DU-model. Reasonable explanations for such preferences are anticipation value (see chapter 5) or negative time-discounting. These two motives are prevalent when evaluating single outcomes as well as sequences of outcomes. However, Loewenstein and Prelec accentuate two additional effects that motivate a stronger preference for improvement when outcomes take place in a sequence. First, individuals tend to adapt to different utility levels and evaluates new outcomes relative to their current level of utility. Hence, the *adaptation effect* causes a desire to experience improving departures from the adaptation level. Furthermore, *loss aversion*[11] makes declining sequences especially unattractive because it is experienced as a series of relative losses. These additional effects indicate that positive time-discounting is more likely to be dominated by other motives when outcomes are experienced in a sequence. Second, loss aversion may well be one of the reasons for people's preference for sequences in which the outcomes (gains or losses) are spread uniformly over time. If individuals were behaving consistently with the DU-model, they would schedule gains in early periods and losses in late periods.

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[11] Loss averse individuals obtain more disutility from a loss of a certain magnitude than utility from a gain of equal magnitude. See Khaneman and Tversky (1979) for detailed explanation and modelling.

9.2 A model with two motives

9.2.1 The deviation terms determines the gestalt properties

Thus, Loewenstein and Prelec emphasize two motives that affect individuals' valuation of sequences: the preference for improvement and the preference for uniform spreading. In their model, they denote a value, d_t, to each period in a sequence depending on the forthcoming utility relative to the already experienced utility. If the average value of the passed periods is lower than the average value in the future periods, the improvement variable takes a positive value and vice versa. The calculation of d_t is written as below.

$$d_t = \frac{t}{n} \sum_{i=1}^{n} u_i - \sum_{t=1}^{t} u_i \qquad (9.1)$$

The first term is a reference variable which shows what the amount of collected utility in period t would have been if the total utility was perfectly, uniformly spread within the sequence. If the utility that has actually been collected (the second term (9.1) is lower than the first term, improvement is expected in period t and d_t becomes positive. The sum of all deviation terms (d_t) provide some details concerning the gestalt properties of the sequence;

$$\sum d_t > 0 \Rightarrow \text{ improving sequence}$$

$$\sum d_t < 0 \Rightarrow \text{ deteriorating sequence}$$

$$\sum |d_t| = 0 \Rightarrow \text{ uniform sequence}$$

$$\sum |d_t| > 0 \Rightarrow \text{ non-uniform sequence}$$

The authors suggest that the value of a sequence is dependent on the total utility, the net improvement and the deviation from uniform utility spreading. These factors are represented respectively by each term in the following formula;

$$Value = \sum_{t=1}^{n} u_t + \theta \sum_{t=1}^{n} d_t + \sigma \sum_{t=1}^{n} |d_t| \qquad (9.2)$$

The previous discussion about preferences for sequences gives way for some predictions regarding the value of the parameters. If improvement is important, positive $\sum d_t$ would provide additional value to the sequence and θ would be larger than zero. If uniform spreading is crucial for the liking of a sequence, deviations from such distribution ($\sum |d_t| > 0$) should decrease the value, and σ would be negative.

9.2.2 Interpretation of the model's parameter values

Loewenstein and Prelec (1993) present another specification of the model that enables a systematic interpretation of the parameter values:

$$Value = \sum_{t=1}^{n} u_t + (\theta + \sigma) \sum_{t=1}^{n} d_t^+ + (\theta - \sigma) \sum_{t=1}^{n} d_t^- \qquad (9.3)$$

The negative and positive deviation terms are now separated so that $\sum d_t^+$ measures improvement and $\sum d_t^-$ measures deterioration or decline. It is now possible to find the stronger of the two motives. To begin with, consider the predicted values $\theta > 0$ and $\sigma < 0$. Since $\sum d_t^+$ signifies improvement, it should have a positive effect on the value and the preceding term $(\theta + \sigma)$ must be positive. Therefore, $\theta > -\sigma$. This further result in a definite negative impact of $\sum d_t^-$ in (9.3). (As $(\theta - \sigma)$ is positive, the effect of the negative term $\sum d_t^-$ is negative.) This is intuitive since the negative deviations, $\sum d_t^-$, causes *both* deterioration *and* non-uniform spreading. It is straightforward that the preference for improvement is weaker than the loss-aversion as $(\theta - \sigma) > (\theta + \sigma) > 0$. Hence, when the parameters take on the predicted values, loss aversion dominates and the major motive is to spread gains and losses evenly over time while improvement is of minor importance. However, Loewenstein and Prelec (1993) emphasize the possibility that individuals depart from this pattern of preferences. Figure 9.1 demonstrates combinations of

parameter values and the corresponding motives in terms of savoring, risk aversion and impatience.
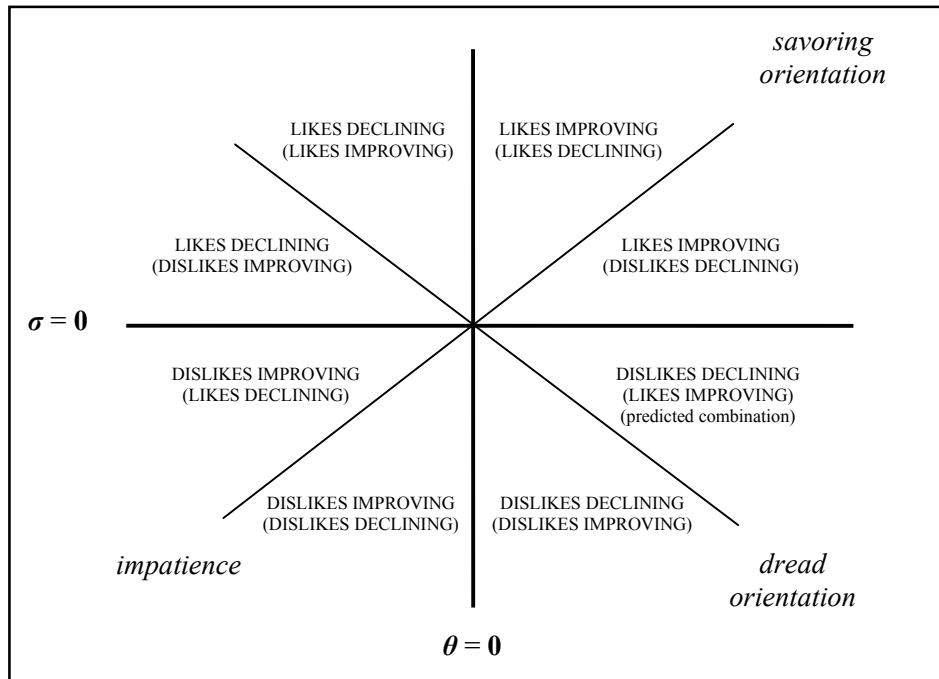

Figure 9.1: Parameter sign–magnitude combinations and the corresponding major and (minor) motives (source: Loewenstein and Prelec 1993:99)

An individual who is only concerned with total utility takes no notice of the deviation terms and his parameter combination (θ =0 and σ=0) is found in the centre of figure 9.1. For other combinations, individuals are expected to be willing to give up some total utility in order to experience a sequence with certain properties. Values on the vertical axis are associated with concern about uniform distribution of utility but indifference to time. (If θ=0 and σ=0 in (9.3), the effect of both positive and negative deviations is definitely negative.) Points along the horizontal axis are related to preference for the future ($\theta > 0$) or the present ($\theta < 0$) but no concern about the distribution as $\sigma = 0$.

Any parameter combination within the lower left field is associated with a primary concern with receiving utility as soon as possible. *Impatience* is therefore the characteristic associated with this segment of the figure. Points along the diagonal line through this segment are combinations that generate indifference to deterioration ($\theta = \sigma \rightarrow (\theta - \sigma) = 0$). Combinations above and below that

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line respectively reveal a liking ($\theta < \sigma \rightarrow (\theta - \sigma) < 0$) or a disliking ($\theta > \sigma \rightarrow (\theta - \sigma) > 0$) of decline. These motives, however, are dominated by the dislike for improvement since the sign combination ($\theta < 0$, $\sigma < 0$) makes the parameter for deterioration less than the parameter measuring the impact of improvement. In other words, the magnitude of ($\theta + \sigma$) is always larger then ($\theta - \sigma$) in equation (9.3).

The lower right area in figure 9.1 covers the parameter values that make *risk aversion* the major motive. Risk averse individuals are primarily concerned with avoiding deterioration which is measured in $\sum d_t^-$ in (9.3). Finally, individuals who highly appreciate to savor good times, but still aren't very affected by declining utility, would have parameter values within the upper right field. Loewenstein and Prelec do not find any intuitive explanation for combinations within the upper left field (1993:98).

9.3 How can preference for sequences of outcomes affect overweightness?

The following example aims at explaining how certain preferences for sequences can be supportive for individuals with self-control problems. Consider an individual who greatly enjoys having cake after dinner, but knows that for every night he has engaged in this pleasure, he has to have a light dinner without cake to avoid gaining weight. His utility from a cake-dinner is 1 and 0 for a light dinner. To split the cake and have one half every night is not an option for this person since such tiny piece only makes him want more and doesn't provide any utility. As he is about to portion these cake nights over eight days, he is firmly determined not to have gained any weight by the end of the period since staying fit is the most valuable outcome. The question to be investigated is how he designs this sequence depending on probable preferences. Now, look into the valuation of some possible sequences established in (9.4). In these sequences, a "1"corresponds to a dinner with cake-dessert and a "0" to one without. The deviation terms are calculated according to formula (9.1).

$$a : (0,0,0,0,1,1,1,1) \rightarrow \sum d_t^+ = 8$$

$$b : (1,1,1,1,0,0,0,0) \rightarrow \sum d_t^- = -8$$

$$c : (0,0,1,0,1,0,1,1) \rightarrow \sum d_t^+ = 5 \qquad\qquad (9.4)$$

$$d : (1,1,0,1,0,1,0,0) \rightarrow \sum d_t^- = -5$$

$$e : (0,0,1,1,1,0,0,1) \rightarrow \sum d_t^+ = 1.5, \sum d_t^- = -0.5$$

Consider three combinations of parameter values which generate indifference to one motive and a like or dislike to the major motive. Indifference to a motive occurs when the parameters has the same absolute value. (When $|\theta| = |\sigma|$, either $(\theta + \sigma)$ or $(\theta - \sigma)$ equal zero). These combinations are found on the diagonal lines in figure 9.1.

If he is a savoring oriented person, $(\theta + \sigma) > 0$, who is indifferent to decline, $(\theta - \sigma) = 0$, he would diet the first four nights and then eat cake. This pattern corresponds to sequence a in (9.4) which maximizes the sum of the positive deviations. The positive effect on the sequence's value is obvious when the sum of the deviation terms is inserted in equation (9.3) as below. Since $(\theta + \sigma) > 0$, a savoring oriented individual aims at maximize $\sum d_t^+$ in order to maximize the value of the sequence.

$$Value = \sum_{t=1}^n u_t + (\theta + \sigma) \sum_{t=1}^n d_t^+ + (\theta - \sigma) \sum_{t=1}^n d_t^- \qquad\qquad (9.3)$$

$$Value = \quad 8 \quad + (\theta + \sigma) \cdot 8 \quad + (\theta - \sigma) \cdot 0 \qquad\qquad (9.3')$$

If the individual is an impatient nature, sequence a would be dreadful because the high value of $\sum d_t^+$ would decrease the value as $(\theta + \sigma) < 0$ for this individual. Since he is indifferent to negative deviations, he would rather experience sequence e but first and foremost b or d. To plan the cake-eating in that manner is out question if risk aversion is the major motive, $(\theta - \sigma) < 0$. Instead, the plan would be to avoid negative deviations which would make sequence a or b the preferred ones.

9.4 The hypothesis

> **Hypothesis 9.1: For individuals who lack self control, it is advantageous to have a preference for improving sequences.**

I suggest that individuals who strive for improvement or detest deterioration are less likely to become overweight. They would never set up a plan like *b*, but the impatient individual would. To eat first and then pay is a risky plan if an individual lacks self-control as a result of hyperbolic discounting.

Figure 9.2 illustrates two plans; a) corresponds to sequence *a* in (9.4) and is set by a savoring oriented or risk aversion oriented individual. Plan b) corresponds to sequence *b* in (9.4) and is set by an impatient individual. The fit body is the most valuable good from the perspective at $t=0$, but as dinner-time draw near, cake eating win over the fit body. Since the plan set at $t=0$ is not irreversible, the individual may give in to his temptation and eat cake on a night he had planned no to do so. It is nevertheless possible to have four cakes and four light dinners without compromising with the fit body.

It is reasonable to assume that the sudden change of the most valuable good is apparent for the individual only on nights when he has planned to resist the cake and have a light dinner, but finds out that he can't resist the cake. He will by then understand that his inconsistent time-preferences make his plan unrealistic and take action as discussed in chapter 6. Notice in 9.2 that the recognition of the weakness occurs early, at t^*, for an individual who tries to implement plan a). For an impatient individual who tries to implement plan b), t^*, or the realization that his plan will fail, doesn't occur until he has had several cake-dinners and the damage has come to pass.
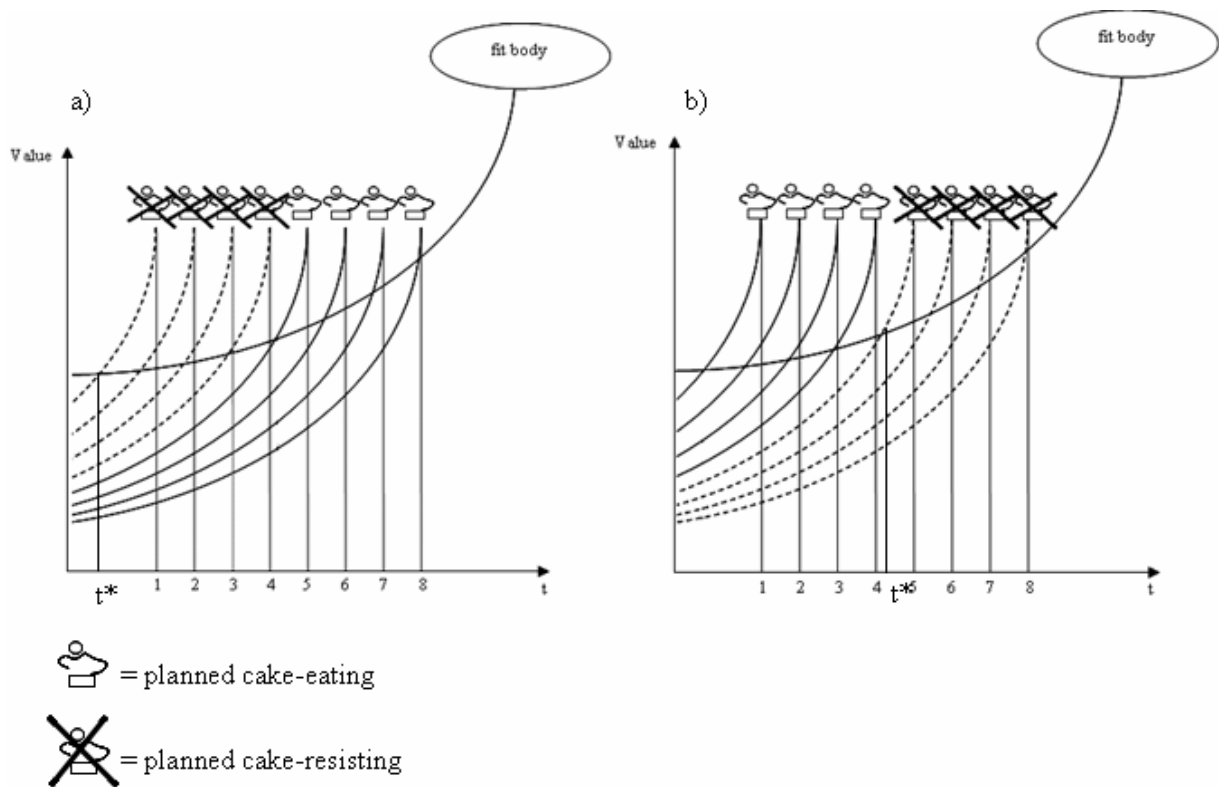
Figure 9.2. Two different sequences with different timing for the realization of the self-control problem (*t**).

It is problematic for the impatient individual because he prefers to "pay" for the cake dinners after he has had them. Since this is the difficult part of the sequence, which results in reversing previous choices, he has already failed to spot the fit body. In plan a), the costs are payed in advance and the individual realizes that he will have a hard time to pay for his cake-desserts before he has had any dessert.

If a group of respondents were to rank sequences of delightful and less delightful dinners, I expect those who are over-weight to reveal parameter combinations that fit in the lower left field (the *impatience* field) in figure 8.1. However, such combinations are rare according to the results of the studies presented by Loewenstein and Prelec. If the parameter combinations are constant across individuals, the current model is still important because individuals may differ in another aspect:

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Hypothesis 9.2: Individuals who become overweight are less inclined to frame outcomes as a sequence.

It is discussed previously how savoring orientation and risk aversion orientation can ease problems of self control. These motives only exist if outcomes are framed as sequences, within which the deviations from improvement and uniform spreading are crucial. When outcomes are perceived as separate events, these preferences are not affecting the planning and positive time-discounting will dominate.

The framing of outcomes is likewise important if the individual discount rate is exponential as in chaper 2. If, for instance, the whole life-time is perceived as a sequence, a savoring- or risk-aversion oriented individual has motives to avoid declining utility profiles like the one in figure 2.2. With such preferences, the cost of over-eating increases because of the negative deviation terms and make the activity less valuable. On the other hand, if outcomes are only framed as sequences a few days ahead of time, deterioration of utility is not included as a cost of overeating.

9.5 Summary

Preferences for outcomes are different when they are placed within a sequence and valuated in relation to each other. It is proposed that certain preferences may help individuals who have low self-control as a result of hyperbolic discount rates. Furthermore, the work of Loewenstein and Prelec enlighten the importance of the framing of outcomes because different motives operate if they are considered as sequences or as separated outcomes.

10 Methods used to elicit individual discount rates

There are several approaches for eliciting discount rates found in the literature. This section intends to describe the different methods and give examples of studies that have applied them. Weaknesses and strengths are discussed in brief. The subsequent section aims at in a few words propose ideas on how the hypothesis that have been stated throughout the essay can be tested empirically.

10.1 Experimental studies

The most common approach is experimental studies with questioner surveys. The simplest questioners consist of *choice tasks*. The respondent is asked to make a choice between an instant reward and a later reward. Thus, *x* is fixed. This method can never elicit the exact discount rate; if SEK 1,000 is preferred over SEK 1,050 in a year it is observed that the annual rate of time preference for SEK 1,000 is *as a minimum* 5%. With *cascade questions*, the level of the immediate or the later reward is revised depending on the choice. With this method, the amount of SEK 1,000 would be lowered, or the level of *x* would be raised, until the respondent amends his choice. In the same way, the time separating the options can be modified. (Fuchs, 1980) A problem with this technique is that the first pair of options affects the future choices. For example, a respondent is more prone to give up the instant SEK 1,000 for SEK 1,050 if the first choice was between SEK 1,000 and SEK 1,005 than if it was between SEK 1,000 and SEK 1,100. For this reason, the elicited discount rate becomes biased towards the one imputed rate in the first choice. This is called the anchoring effect. (Frederick, 2001)

In *open ended questions* or *matching tasks*, the respondents are asked to state their point of indifference for hypothetical rewards. Subjects specify either *x** for a delayed reward or the amount of the immediate reward that would make the later reward just as attractive. Petter Lundborg (2005) included a matching task in a questioner given to Swedish adolescents;

> "Imagine the following event: You bought a lottery ticket that turned out to be a winning ticket. The money prize is SEK 100,000 but it is not paid out until one year from now. If someone would like to buy your winning ticket, so that you can get money immediately instead, what is the lowest amount you would be willing to sell the ticket for?" (Lundborg 2005:13)

The answer to this question reveal the respondent's x^* and thereby his or her exact discount rate (see (3.1)). Chapman (1996) and Van Der Pol and Cairns (2000) used the same method to elicit the discount rates for health. The subjects in Van Der Pol and Cairns' study were given a description of a state of illness that would somewhat impede on daily activities. They were then asked to make the two outcomes in the following question equally valuable;

> "Imagine that you will be ill (as described above) starting 2 years from now for 20 days. There is a minor one-off treatment available that will postpone this spell of ill-health to a point further in the future.
> 1. If the ill-health would then start 4 years from now, what is the maximum number of days of ill-health that would still make the treatment worthwhile?" (Van Der Pol and Cairns 2000)

When the time-difference is not equal to one year (as in the question above) the annual discount rate is calculated

$$\delta = \left(\frac{c_{t+n} + x^*}{c_t} \right)^{1/n} - 1$$

where n stands for the amount of time in years that separate the options. If the answer to the question is 25 days ($x^* = 5$), the annual rate of time-preference for health is approximately $11.8\% \approx ((25/20)^{1/2} - 1)$. In some matching tasks, the respondents state the length of delay that would generate indifference between two rewards, i.e. SEK 1,000 today = SEK 1,050 in __ years. The number of years filled out in the empty space equals n^*.

With *pricing tasks*, the study investigates the willingness to pay in order to obtain or avoid an hypothetical outcome at a specific point in time. Questioners with *rating tasks* inquire subjects to put a value on a reward or a loss that occurs with different delays across subjects. These two

latter techniques have one advantage over the previous alternatives; they do not call attention to time. It has been argued that matching tasks and choice tasks influence subjects to discount because the composition of the questions makes the time-component very important. Because time is only manipulated between subjects, there is no such effect with prizing tasks and rating tasks; each subject is only concerned with the evaluation of one single outcome. (Frederick 2001)

10.2 Field studies

Although experimental studies dominate in the literature, there are a few field studies that attempt to extract intertemporal rates of preference from individuals' actual choices in real life. The ecological validity and the absence of self-presentation bias which might be present in answers to hypothetical questions are the main benefits of field studies. However, the studies can never control for all the factors that influence on individual decision making (Frederick 2001). Hausman (1979) observed consumers' trade-off between the instant purchase prize of air-conditioners and the future costs of running the appliance. Hausman's study has been criticized because the choices from which the implicit discount rates were revealed might be influenced by imperfect information about the electrical costs. The trade-off between quality of life and life-length concerned Moore and Viscusi in studies where they used wage-data for different jobs (Viscusi and Moore 1989, Moore and Viscusi 1990). The extra payment (or increase in quality of life) required by a worker to take on a risk that decreases expected life-length, elucidates his preference for the present. Lawrence (1991) estimated time-preferences over lifetime when she analyzed consumption growth from household data. A natural experiment took place in the early 90's when over 60,000 military employees were offered a choice between a lump-sum payment and an annual payment. The sum of the latter payout vastly exceeded the lump-sum and its option value in the capital market. In spite of the differences in value, more than half of the employees preferred the instant payment. Warner and Pleeter (2001) studied the choices and could set lower or upper bounds for individual discount rates. There is one downside of this study; it is reasonable to suppose that the enlisted personnel regarded their instant utility of money as especially high since they would spend some time in unemployment. They might have assumed they would have an income further into the future which lessens the comparative impact of the annual payment on their total utility.

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10.3 Ideas for testing the hypothesis

Hypothesis 4.1: Individuals who have a low discount factors are more inclined to overeat.

I suggest that studying people's investments in their utility in late life is indicative for individuals' preferred life-time utility profiles. Looking into investments in pension funds is one way of finding indications. How large are the investments in relation to the respondents' current incomes? If it is found that overweight individuals invest less in future utilities than those of healthy body weight, there is support for the hypothesis.

Hypothesis 5.1: Low income and education causes overweightness indirectly.

Hypothesis 5.2: Overweightness causes low discount factors.

Hypothesis 5.3: Heavy individuals have incentives to appreciate future states-of-nature that become more probable with overweightness.

These hypotheses concern the direction of causality. This can be investigated through using the instrumental variables (IV) technique. Petter Lundborg (2005) describe this method in detail in his empirical work about time-preference and heavy drinking.

Testing hypothesis 5.3 require the subjects' state-specific discount rates for diseases following overweightness. Since the incidences of these diseases are assumed to be perceived as risks, it is important to control for risk aversion when calculating the discount rate. I recommend the model of Gafni and Torrance (1984) in order to take account for the effect of risk aversion.

Hypothesis 6.1: The treatment of overweightness is likely to be postponed indefinitely

Hypothesis 6.2: Anticipation is important for the attractiveness of a diet plan.

Under the assumption that Loewenstein's model (1987) is valid, which include exponential time-discounting, any postponement of good outcomes and speed up of bad outcomes can be interpreted as an effect of anticipation utility. Hypothesis 6.1 could be tested through giving

subjects the choice to start a twelve months strict diet in, for example, one, two or three weeks. If one week is preferred, it indicates that the subjects do get negative utility from dreading the diet. If such preferences are found, hypothesis 6.1 is contradicted.

To test hypothesis 6.2, I suggest a study in which the respondents are faced with the following scenario. "Assume that you are overweight and want to loose weight[12]. Out of magic, you loose the extra pounds three months from now. How much do you think it is worth to become aware of this sudden weight loss three months in advance in comparison to experience it without anticipating it?" The answer to this question would reveal an estimate of the impact of the α-parameter. If overweight individuals put a lower value on anticipating the weight loss, the hypothesis is supported.

Hypothesis 7.1: Overweight individuals have more hyperbolic discount functions.
Hypothesis 7.2: Individuals who perceive their future choices incorrectly are more harmed by hyperbolic discounting.

A method to reveal the shape of individual discount rates is well presented in van der Pol and Cairns study (2002). In brief, subjects state their preferences for outcomes that are separated with the different amounts of time. These preferences reveal whether the discount functions are best described with a hyperbolic or an exponential function. Furthermore, the parameters in these functions (β in the exponential function, equation (4.1) and ζ and Γ in the hyperbolic equation (7.2)) can be estimated. If hyperbolic functions are overrepresented within overweight individuals, this speaks in favour of hypothesis 7.1. Furthermore, if hyperbolic discount functions are found within most individuals, a significantly higher Γ for overweight individuals verifies hypothesis 7.1.

Following the study of self-control performed by Ameriks et. al (2004), an indication of the awareness of the self-control problem can be found. Subjects are simply asked how they *prefer* to make a number of choices within the near future and how they *expect* they will actually choose. Then, when the near future has passed, they are asked how they *did make* their choices. If

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[12] For the overweight respondents, this is already the case.

awareness of a the self-control problem, (that is, a divergence between what subjects wish they could do and expected they would do[13]), helped subjects to stick with their preferred choices to a larger extent than those who didn't realize this problem, the hypothesis 7.2 is supported. That is, realizing the problem enforces strategies to overcome it.

Hypothesis 8.1: Individuals who discount instant pleasures at a higher rate than other outcomes are more inclined to become overweight.
Hypothesis 8.2: Immediate access to food results in more severe problems of self-control.

The first hypothesis in 8.1 is tested when comparing the impact of delay on the value of different goods, possibly by using one of the methods described in 10.1. I.e. a matching task such as; How much of the cake would you give up in order to have today instead of tomorrow? How many pounds would you put on the otherwise optimal body in order to have it today instead of tomorrow? Through these questions, $x*$ is identified for the different outcomes and the rate of time-preferences can be calculated as in (3.1).

I suggest that the effect of increasing the delay to a food item can be investigated through controlled experiments. For example, let all the employees at a company report how they wish they could eat their lunches and how they actually eat their lunches. Then, let everyone make an irreversible order for their lunch three hours in advance every work day. If this made people eat lunches that are more consistent with their wishes, the delay effect has been advantageous for those with problems of self-control.

Hypothesis 9.1: For individuals who lack self control, it is advantageous to have a preference for improving sequences.

Loewenstein and Prelec (1993) give a detailed presentation of some surveys and data-analysis through which they have elicited values of the θ- and σ-parameters. In the studies, the subjects rank sequences with different values of the variables $\sum d_t^+$ and $\sum d_t^-$ in equation (9.2). I suggest a

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[13] If there is no divergence between what is preferred, expected and done, there is, obviously, no problem of self-control.

similar study including subjects who have revealed hyperbolic discount rates for single outcomes. If preference for improvement and dislike for deterioration are correlated with being of normal weight, hypothesis 9.1 is supported.

11 Conclusions

There are many theories of time preference that are relevant for the problem of overweight. The DU-model explains how declining utility profiles can be consistent with an individual's preferences. Such profiles are achieved through overeating and overweight.

Through applying overweightness on Becker and Mulligan's model (1997) with endogenous time preferences, possible directions of causality are investigated. It is concluded that overweight may well cause low discount factors. When considering state-specific discount rates, the possible directions are many and contradictive.

The problems many people face with getting started with a diet is explained through a model which includes anticipation of outcomes. It is suggested that the utility an individual derives from anticipating future outcomes may be crucial for starting a diet.

Lack of self-control is a frequently stated reason for over-eating. Discount functions that are hyperbolic or differ across goods cause inconsistent time-preference which make people reverse their choices and give in to temptations. Thus, people who continue to overeat although they find that the costs are too high may well have hyperbolic discount functions or different discount rates for different goods. The affect of promptly available food items is predicted to be harmful for hyperbolic individuals.

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Finally, framing outcomes within sequences reveal preferences that overshadow the effect of discounting. It is found that preference for improving sequences and deterrence of declining sequences may help people with self-control problems.

There are several approaches to investigating these conclusions empirically.

12 Discussion

There are many aspects to be considered when dissecting the problem of individual over-eating. From an economic point of view it is important to investigate the information and knowledge about the costs that comes with the activity. Furthermore, it would be interesting to assess the problem of over-eating on economic models concerning risk aversion, habit formation and rational addiction. Examples of such modelling are found in Khaneman and Tversky (1979), Carillo (2002) and Becker and Murphy (1988) respectively.

However, I find the theoretical indications for the importance of individual time-preference to be rich, strong and convincing. It is certainly a subject for empirical research which could yield vital evidences necessary for future interventions aiming at defeating the growing problem of overweightness.

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