Health and Time -
A Problem of Discounting

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HEALTH AND TIME - A PROBLEM OF DISCOUNTING

BY

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Preface

This report, carried out at the Economic Research Institute, is submitted as a doctor's thesis at the Stockholm School of Economics.

The author has been entirely free to conduct her research in her own ways as an expression of her own ideas.

The Institute is grateful for the financial support, which has made this research possible.

Stockholm in September 1996

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Professor in Economic Psychology
Head of the Center for Risk Research

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Monica Örtendahl

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HEALTH AND TIME - A PROBLEM OF DISCOUNTING

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SUMMARY

The importance of time is increasingly stressed as a basis for judgments and decisions. The present thesis investigated psychological aspects of delay behavior and addictive behavior. The effects of expected delay of reward on preferences for gambling offers were studied using the functional method of measurement.

The judgments were based on the three factors of
-value of outcome
-probability of outcome
-time of outcome.

In the first five studies (I-V) different models were tested, an additive, an multiplicative, and a discounting model. The models tested the influence of these three factors on delay behavior.

The studies were:

I. Delay of outcome and preference for different courses of action
II. A comparison between scales in information integration task
III. Context effects on delay processes
IV. The relationship between age and delay behavior
V. Expected time of the outcome of offers to gamble.

All the studies gave evidence that the stronger models EV, EU and SEU did not give a good description of the judgment process. The studies showed that a multiplicative model gave a better fit (except in study III) when describing delay processes. This rule indicated rational judgments. However, the effects of time were weaker than the effects of probability and value. In the developmental study (IV) no difference was obtained indicating a preference for smaller and immediate rewards among the younger children. A tentative explanation presented is the use of different judgment strategies in different age groups. Multidimensional scaling analyses of similarity data for gambling offers gave the same dimensions as those functional in the preference data but with different weights.

The purpose of studies VI-VII was to study the effect of time on addictive behavior in order to obtain a basis for introducing the time perspective in a broader sense into the area of health. Addictive behavior could be regarded as a temporal preference where there is a preference for the immediate satisfaction of, for example smoking a cigarette, to some remote goal of a smoke-free healthy life and a non-addictive behavior. Both anticipated waiting

time and actual waiting time were studied. The study encompassed two weeks.

Data were collected from young pregnant and non-pregnant women. Four different groups were included:

A. Smoking pregnant women, did not try to quit smoking.
B. Smoking pregnant women, tried to quit smoking.
C. Smoking non-pregnant women, did not try to quit.
D. Smoking non-pregnant women, tried to quit smoking.

The studies were:

VI. Addictive behavior as a decision with future consequences
VII. Coping mechanisms and attitude changes over time.

The subjects, design, method and procedure were identical in the two studies. In study VI two different models, the Value Model and the Action Model were tested. The Value Model presented by Ainslie describes addictive behavior by discounting of values following a hyperbolic function, giving a crossing of curves for the reward values of Smoking and Not Smoking. With a time delay and a decrease in reward value a reversal of choice and a relapse follows. The Action Model presented by Sjöberg describes addictive behavior as based on emotional arousal, causing twisted reasoning and a shortened time perspective, allowing relapses and temporal exceptions from the decision to quit. Increased belief value correlations as postulated by the Action Model, positive for the Smoking alternative and negative for the Not Smoking alternative, were not obtained. Thus, no strong support for the Action Model was obtained. Nor was any strong support for the Value Model obtained. Different explanations of the result are discussed, such as varying subjects included and different context effects. For all the groups there was a decline in difference starting on day 3 between the alternatives of Smoking and Not Smoking. This reduction was tentatively explained by short-term withdrawal symptoms caused by nicotine.

In study VII it was found that all groups became more negative in attitude towards smoking during the study. The variable of trying to quit/not trying to quit was more important for the attitude than the factor of pregnant/not pregnant. Those who tried to quit had a larger number of earlier quitting attempts than those not trying to quit, indicating that quitting smoking is a dynamic process. Coping mechanisms most used implied some kind of diverting strategy.

All the studies showed that judgments and decisions varied as functions of time. The need for taking the effects of time into full account within the health area is stressed. Health promotion works with remote goals, and many preventive situations include a trade-off between costs today and benefits in the future. Preventive programs try to change behavior and save for the future

instead of consuming today, implying a relative evaluation of immediate and delayed outcomes.

1 INTRODUCTION

The purpose of this thesis is to analyze judgments and decisions as functions of perceived time. The major thrust is to use psychological research when trying to describe judgments and decisions. Economic research will be mentioned, but not used for the theoretical analysis.

How to value or devalue costs and benefits that occur in the future is not a new issue. Neither is it a strictly economic one. In recent years the problems of behavior change have to a large extent been related to a time discounting effect.

According to conventional economic theory individuals mostly exhibit positive time preference. This is indicated by the circumstance that for the same commodity they are indifferent between consumption of a smaller amount in the present and a larger amount in the future. This factor has increasingly been stressed as a basis for decisions.

Previously, the time effect has not been extensively taken into account in attempts to explain decisions taken. The present paper, therefore, deals with the time aspect in decision making.

First, different models are tested for taking time and the discounting factor into account. The judgments were based on factors of
-probability of outcome
-the value of outcome
-the time of outcome.

In the first five studies the discounting effect on monetary values is investigated. Three different models are tested for describing the judgments. The purpose of the last two studies is to broaden the field of application and develop a model for preventive health work based on the effect of the time factor.

Prevention requires procedures that improve future health. Many situations imply a choice between cost today and future benefits. However, the final goal of good health may seem so distant, that the immediate satisfaction is chosen.

What is needed is an analysis of how to reach this final goal, and of mental phenomena related to will and volitional problems (Sjöberg, 1993). The concept of motivation is according to Sjöberg related to the generation of goals, and decision making is restricted to the start of the process. The journey made before reaching the goal is long, and the engagement is supposed to diminish with time distance. Hence the importance of time, in

several aspects, for goal directed behavior and the realization of long-term commitments.

2 BACKGROUND

2.1 Difference between money and health in time discounting

In the following differences between money and health in time discounting are discussed. A main issue is whether there are any differences in time discounting between different problem areas.

Previous research has mostly focused on time discounting and monetary values (e.g. Chapman, 1994). However, health problems, such as those due to addictive behavior and the difficulties of implementing preventive measures, have become increasingly important.

Many medical situations concern the exchange of present-day costs for future benefits. The evaluation of routine preventive care, population screening programs, and therapies for chronic disease are medical situations that depend in part on the relative valuations of immediate and delayed outcomes (Redelmeier & Heller, 1993; Redelmeier, Heller & Weinstein, 1994).

Preventive care includes health measures that improve future health. However, the benefits often occur so far in the future that they seem of little value relative to the immediate costs. If individuals prefer to live for the present rather than save for the future such a preference might not maximize utility.

Temporal discounting implies that the value of a future outcome diminishes because of the time factor. Examples of temporal discounting in a medical preventive context, earlier described by among others Chapman (1994), are smoking, drinking and over-eating. These are all situations where there is a choice between the immediate pleasure of for example a cigarette, and the future benefits of good health.

The acceptance of a current cost for future benefits could be regarded as an investment. This is an opinion initially developed by Becker (1964) with the theory of investments in human capital, and with the application of this theory by Grossman (1972) specifically to health. This gives a framework for explaining differences in willingness or ability to make health investments due to different time perspectives.

Grossman (1972) found a strong relationship between schooling and health. The observed relationship might be explained by both schooling and health as depending on time preferences. Schooling could also affect time preference,

and more schooling may increase willingness to invest at a low rate of return, also in health.

The result by Fuchs (1982) supported a strong effect of schooling on health. Health behaviors, however, showed interindividual variation. With imperfect capital markets individuals may demand different rates of interest, and this may be related to health behavior. Perfect correlations between different health-related behaviors could therefore not be expected. The reason is probably that these behaviors are influenced by other factors in addition to time preference. The influence of other factors might also be of relevance as an explanation of the diversified results obtained in the present study.

Fuchs (1982) assessed subjective discounting rates for money and also self-reported health behaviors and found very little relation between the two. Health behaviors were more likely to be correlated with implicit discount rates for health outcomes than for monetary outcomes.

Another finding by Fuchs is a difference between a compound interest rate and a single interest rate. Implicit compound rates gave supposedly consistent responses, whereas inconsistent responses seemed mainly to have been given to a simple rate. The relationship between alternative measures of time preference showed positive but low correlations. As an explanation Fuchs stressed influence of the specific context on intertemporal choices. The choice of method of measurement of time preference, as investigated in the present study, is another possible explanation of the results.

Weinstein (1990) highlights the relationship between money and health, especially in preventive medicine. Money and health do not refer to the same goal. The goal is to improve health at a reasonable price, not to make money for the payers of health care. In return society gets a large number of years of healthy life.

According to discounting utility theory (Chapman & Elstein, 1995) the discount rate should almost always be positive, and the same discount rate should be applied to all decisions. Temporal discount rate is by Chapman (1994) defined as 'the extent to which people diminish the value of future outcomes.' Moreover, the same author points out, when goods are freely exchangeable, all decisions should employ the same discount rate.

Positive discount rates for health outcomes suggest that good health many years in the future is valued so little that many people may choose not to engage in preventive behaviors. High discount rates would amplify this effect and may also help to explain the practical difficulties experienced in attempting to implement programs of prevention.

Consequently, we would expect that in general people with lower implicit discount rates would be more likely to quit smoking, eat a healthy diet, exercise, use condoms and take prescribed medication (Chapman, 1994).

The cause of individual variation in health-related behavior is not well understood. Today, the time perspective is often stressed, when it comes to preventive programs. These programs involve trade-offs between current costs and future benefits. Discounting future health benefits, however, should not be regarded in the same way as discounting of money (Ganiats, 1992). Discounting might somehow diminish the value of life, and is therefore a controversial subject. The implication is not that the future outcome in itself is less important. It only concerns the present valuation of the future outcome.

Issues, such as whether people mostly prefer present health to future health are introduced below. Another issue discussed is whether the uncertainty and risk of a health program affect the discount rate.

According to the normative discounted utility theory, the same discount rate should be employed for both health and money if they are fungible at an exchange rate that stays constant across time. If goods are exchangeable, the same temporal discount rate should be applied to all outcomes. This model has been developed by Loewenstein and Prelec (1992).

It is sometimes contended that health benefits should be left undiscounted or be discounted at a lower rate than monetary items (e.g. Parsonage & Neuburger, 1992). The more the time profiles of health benefits differ, the more important is the discount rate for the recommended ranking between competing program-mes, and thus for priority setting in health care (Olsen, 1993). Olsen also points out the paralyzing effect on decision makers if the benefits are left undiscounted. For any attractive program, there is always a superior delayed program which should be funded first. Therefore, the result is that no program with a definite starting point can be selected.

It is also reported by Redelmeier, Heller and Weinstein (1994), that health cannot easily be distributed across time, in that there are few effective methods for accepting less health today for more health tomorrow.

Cropper, Aydede and Portney (1994) discuss different reasons for always preferring to save lives today. One reason is that it is better to live for today, to solve today's problem. Another reason is that improvements in technology will allow future lives to be saved more cheaply than lives today. Finally, the future is uncertain.

Chapman (1994) develops the viewpoint, that unlike money, health cannot be invested or saved for future consumption. The only risk to enjoying guaranteed future health is the risk of death. Consequenly, according to Chapman, one might argue, that in decisions with only small risks of dying before the delayed outcome occurs, discounting of health should be small or even zero. When health can be traded for money or other goods, it should be discounted at the same rate as money.

However, there might be differences in the perceived replaceability of health and money and differences in how sequences of health and money are usually experienced. Decision makers may use different discount rates for health and money because they do not view health and money as fungible. Normative theory only prescribes the same discount rate in all domains if outcomes from each domain can be freely traded for those in other domains (Ganiats, 1994). He has reviewed different misconceptions when it comes to time discounting in the health area. One misconception is pointed out implying that health is equivalent to wealth. Society does not allocate all its health care resources to only the most efficient program. Instead, he argues, society puts its resources into programs that have acceptable levels of efficiency (cost-effectiveness). Sufficiently efficient programs are implemented this year, even if some programs will be more efficient next year.

There is no a priori reason to believe that there must be a constant relationship between dollars and health. Instead, other resources are often limiting factors in acute situations. Examples mentioned are transplantation organs or dialysis machines as limiting factors in acute situations. Although some of these resources have monetary values, they are finite and may be more limited than dollars.

It has also been pointed out by Ganiats (1994), that there might be different roles of emotions in health and money decisions. An individual's preference for present dollars over future dollars involves more than the investment potential of the present dollars. Several psychological and social factors are also important, e.g. specific attitudes and specific intentions (Sjöberg, 1993).

2.2 Discount rates and discounting biases

The relatively large discount rates generally used by subjects may suggest why it is often difficult to implement preventive health measures that improve future health. In fact, in decisions involving actual consequences and very short delays (1 to 8 weeks) teenagers made tradeoffs that implied annual discount rates averaging 630 percent (Loewenstein, 1988).

Christensen-Szalanski (1984) found that discount rates for long delays were lower than rates for short delays (dynamic inconsistency bias). This indicates that patient preferences measured at any time may not be representative of long-term preferences. Rose and Weeks (1988) did not, however, find evidence for this bias. Instead, they found that discount rates for health states one year in the future and 10 years in the future were the same.

In the health area median discount rates of 4.7 percent for worker safety improvements and 12.8 percent for traffic safety improvements have been estimated (Horowitz & Carson, 1990).

Cairns (1992) compared discount rates for health and money, and found that the discount rate for health decisions was lower than that for monetary decisions. Financial and health losses (depression) were used in this study, whereas usually gains (full health) have been studied in other work.

Redelmeier and Heller (1993) obtained discount rates for adverse health states (ex blindness, depression) that were quite low, averaging 3 percent annually. Their result also showed dynamic inconsistency.

Discount rates for health and money have been compared, and Chapman and Elstein (1995) obtained discount rates for health (124 percent) that were higher than for money (99 percent). They concluded, that subjects generally were more impulsive for health outcomes than for monetary outcomes. Decision makers thus did not conform to discounted utility theory, but instead used different discount rates for different domains. If health can be traded for money, then applying different discount rates to health and money leads to inconsistencies and preference reversals.

When decision analysis employs large magnitudes of both health benefits and monetary costs, and also involves the long delays common in preventive programs, the use of the same discount rate for both health and money may reflect constituent preferences fairly accurately.

Unlike previous studies, in a recent study by Chapman (1994) it was found that discount rates were not higher for health (49 percent) than for money (51 percent). Evidently, they were about the same.

Hence, time discounting as it comes to monetary values and health has been empirically tested, and it could be concluded, that discount rates for both health and money are fairly high. Moreover, differences between the two domains have been found, and it seems as if judgments in most cases are more impulsive for health outcomes than for monetary outcomes.

Thus, it is fairly well-established that less importance is attached to saving lives in the future compared to the present. Two issues arise:
- Programs may save lives at different times. Should a life saved in the future be counted as equivalent to a life saved today?
- Programs may prevent deaths at different ages, and therefore save different numbers of life-years.

Less importance to saving older persons than younger persons has been found by Cropper et al. (1994). When compared to strictly weighting by life expectancy more weight was placed on saving young persons. Eight persons 60 years old were equivalent to one person of age 20.

Cropper et al. (1994) also found that discount rate increased with age, and that it was higher for blacks than other races. The number of old persons who must be saved for each younger person was higher for male respondents and

those with a college degree, but was unrelated to age. Finally, there was less variation in discount rates for money than for human lives. Those with high monetary discount rates had a high discount rate for life-saving.

Economic reality sets limits to priorities made, which influences the risk in medical settings. Moreover, economic restrictions may have an impact on the time period for the risk to occur. This gives an interaction between time and risk.

It is evident, that the relationship between time and money is intricate, with an impact of different factors, such as time and risk. The impact of different factors applies both to individual and societal level.

2.3 Health models and time

In a recent review by Eriksson (1993), it is concluded that there is broad knowledge of public health and its determinant factors, but that the knowledge of different methods for practical public health work is limited. Some models that could be applied to this area are also described by Eriksson.

The *Preventive Model* is focused upon helping individuals to perform responsible decisions. This model, which is considered to be a variant of the Medical Model has, however, been critized for being unethical and ineffective as it disregards the environmental causes of bad health.

Within the *Radical Political Model*, the focus is not on the individual but on different social, economical and political factors.

Finally, the third model described by Eriksson, the *Self-Control Model*, has been developed from educational models and assumes that information and knowledge seldom lead to a change in behavior. To achieve behavior change it is necessary to make the individual 'stronger'. There are considerable individual differences as regards the adoption and maintenance of health behavior. The theory attempts to describe the process by which people change detrimental health habits and abstain from risky habits. Within this theoretical framework, actions, plans and action control to carry out appropriate behavior and to prevent relapse are included.

Thus, much research has been performed on health and health-related behavior and different models have been proposed to explain this behavior. The *Health Belief Model* was formulated in the 50's and 60's and assumes that individuals base health behavior on rational thinking. The likelihood of action is then determined by individual perceptions and different modifying factors (Rosenstock, 1966).

In the *Behavioral Intention Model*, health behaviors are assumed to be under volitional control. According to this theory the person develops an intention to

engage in health behavior or disengage from a risk behavior by a motivational process. An intention is regarded as a behavioral disposition with high predictive power. This theory has been tested on different types of behavior, among them smoking cessation (Sutton, 1987).

The Behavioral Intention Model has been extended to the *Theory of Planned Behavior* (Ajzen, 1988) in the case of incomplete volitional control. According to this model, goal attainment not only depends on the strength of an intention but also on nonmotivational factors such as resources and obstacles.

Indeed, intention is not a good predictor of addictive behavior and recent developments in attitude theory (Bagozzi, 1992), in addition to efficacy, emphasize the control dimension in accounting for intention and behavior, and the fact that some behavior may be only partially under volitional control (Ajzen, 1985). Perceived control thus seems to add important power to the prediction of behavior. It has been found (Taylor, 1989) that those who believe they can control events in the environment are most likely to practice good health habits. Moreover, the specific belief that one can effectively engage in a particular healthy habit greatly enhances the likelihood that one will actually practice it (Wallston & Wallston, 1982).

For some serious diseases, successful efforts to exert control have resulted in effective efforts to promote good mental and physical health. For example, cardiac patients exert direct control over their illness by stopping smoking. Diabetes patients exert control by maintaining their blood sugar level. These efforts are both medically and mentally beneficial as they enable the patients to achieve a sense of mastery over their adverse circumstances.

The *Protection Motivation Theory* aims at investigating the effects of persuasive messages on the adoption of recommended health behaviors (Rippetoe & Rogers, 1987). Sources of information and resulting coping modes are supposed to be modified by a cognitive process.

From these theories the *Health Action Process* Approach (Schwarzer, 1992) has been developed where an explicit distinction is made between a decision-making or motivation stage and an action or maintenance stage. An important feature of this model is that the time perspective is added. According to this theory a global intention can be specified by action plans which contain proximal goals and action sequences. Effort and persistence are necessary to suppress health-detrimental actions. When there is an intention to quit smoking, planning is important to reach the goal. One example is when there is a desire to avoid high-risk situations (Marlatt, 1985). With small steps and proximal subgoals the probability for reaching the ultimate goal increases.

The Health Action Process Theory takes into account the fact that good intentions are not always followed by corresponding actions and stresses the importance of understanding the processes by means of which the intentions are completed into actions. To follow a delay of gratification pattern requires

adaptive behavior and volitional strength. Blachly (1970) earlier characterized maladaptive behavior by, among other things, short-term gain and long-term punishment.

The importance of time on the value of remote outcomes should to a larger extent be taken into consideration in attempts to explain addictive behavior. In the Health Action Process Model (Schwarzer, 1992) explanations of the transition from the motivation phase to the action phase are included. The model also stresses the importance of expectancies and self-regulatory processes, such as the delay of gratification pattern.

In summing up the development of health theories, it seems as if time is an important factor in explaining addictions and health-related behavior. The relevance of time is increasingly stressed as a factor in behavior change. Lisspers and Öhman (1996) have related principles in intervention to the time factor in a model for rehabilitation and secondary prevention of coronary heart disease. This perspective has also been discussed when it comes to eating habits and relapse prevention (Sjödén, 1992).

2.4 A theory of addictive behavior

Self-regulatory processes are increasingly supposed to form an explanatory basis of addictive behavior. In these processes there is a time component. Loewenstein and Prelec (1992) have presented a theory of addictive behavior with an attempt to reconcile the self-destructive consequences of addiction with the economic assumption that human actions imply rational pursuits of self-interests.

An observation made is that paradoxes will arise if general utility maximizing of behavior is assumed. Addiction is perceived as harmful to the person consuming the substances. Addicts want to change their behavior, but are usually unsuccessful in their attempts. Thus, their stated preference is inconsistent with preference revealed through their behavior. According to the same paper economic theory can deal with addictive behavior in four ways:

1. Addiction is regarded as a disease, and is not a choice.
2. Addiction as rational self-medication.
3. The addict believes that there is little risk for lose control. The latent costs of addiction are initially hidden and the underlying behavioral process is incapable of making rational choices.
4. The self is divided, as the same individual has varying preferences with time.

Finally, four criteria of addiction are presented:

1. Addiction is the result of a long stream of choices, rather than a single action.
2. Addictive behavior has negative side effects, such as costs.
3. The benefits are generally more immediate than the costs.
4. Addictive behavior exhibits temporary preference.

2.5 Final comments

From above is evident, that time is being taken into account in the area of health. The thesis treats the effect of time on judgments with monetary values (I-V), and health values (VI-VII). In attempts to explain addictive behavior time effects have to an increasing extent been utilized.

When it comes to health behavior a distinction must be made between anticipated waiting time and actual waiting time (cf. Sjöberg, 1983). In the first five studies (I-V) anticipated waiting time was investigated. In health there is often also an effect of time passing, with changes over time during the actual waiting. In studies VI-VII these effects are taken into account.

Time in the area of health has so far been a neglected area. The present thesis is restricted to problems related to addiction. However, time aspects have a large impact on health problems in general.

Working within the field of health this problem has relevance when deciding on a diagnosis and also on deciding on a treatment. For how long has the patient had the symptoms, and for how long will the treatment last? The patient can stand the potential aversive complications of a treatment for a limited time period, which might be decisive for the treatment chosen.

The time perspective of the doctor might differ from the time perspective of the patient, both in an objective and subjective way. With a discrepance in time perspective the compliance of the patient to the treatment might be affected. A not unusual way of treating patients is to just let time pass to observe the outcome. Expectancy then becomes a kind of treatment.

Doctors sometimes exhibit an interindividual and sometimes also an intraindividual variation in judgments. The issue then arises, what causes this variation? Potential sources of variation in the judgments are the value of the outcome, the probability of the outcome and the time of the outcome. Interactive effects between these three variables is another potential source of variation. In order to improve judgments within the area of health further studies are of importance.

During time periods with health, changes in the indivual, in this case the patient, are supposed to occur. The measurement of these changes are

relevant for a positive outcome. A comparison must then sometimes be made for both the absolute levels and the relative levels of a factor. The measurement of changes is not performed without problems. How to quantify a change, for example within the area of radiology? The quantification is a special problem within health, (Shryock, 1961) where the time aspects are salient.

Time has an impact on individual levels as well as societal levels within health. When allocating resources, economical or personal, time periods must be studied. An issue is, for example, whether the resources are most important in the beginning or in the end of different diseases.

All these problems discussed above, stress the importance of time. According to the opinion of the present author, we are only at the very beginning of this field of research. In studies of these broad health areas results obtained within the field of addictive behavior could be used as a theoretical basis.

3 THE HEALTH PROBLEM OF THE ADDICTIVE BEHAVIOR OF SMOKING

Health and addictive behavior is a problem and a focus of interest in much current research, but the strategy may in the future preferably be changed to inter-disciplinary projects which focus on the time aspects of individual behavior. The impact of programs on changing and maintaining positive health habits can only be assessed over time. However, recent reviews of the long-term effects of health promotion programs to suggest minimal if any effects. The present study illustrates the necessity of taking into consideration changes over time.

Studies VI and VII focused on cigarette smoking. The role of cigarette smoking in accounting for cardiovascular disease and different kinds of lung diseases is today generally accepted.

The need for additional research with a different approach is motivated by such facts as nine of the ten leading causes of premature death in the United States having been shown to be linked to six risk behaviors: cigarette smoking, alcohol abuse, lack of exercise, unsafe driving, poor dietary habits and uncontrolled hypertension (Shi, 1992).

In the nineteen seventies and eighties, a large number of broad-based health programs were initiated (e.g. Filer, Lauer & Luepker, 1994; Pierce et al., 1994). It was anticipated that such education and information programs would produce positive results in terms of behavior change. However, subsequent evaluations of the programs suggested that the effects of these health training efforts are minimal at best, and completely absent in some cases. Moreover, any reported effects appear to last only for a limited time.

As consumers, adults are increasingly aware of and sensitive to the factors acknowledged to have an influence on the status of their health). According to a review by Moorman and Matulich (1993) an estimated 817.2 billion dollars were spent in United States in 1992 on health-promotion activities. Preventive health programs were included in these activities. They also point out that despite the awareness of health behaviors and the large sum of expenditures made to date, credible theories of health behavior and resistance to change have been hard to formulate. Shiffman (1993) also affirms that reliable research data on behavioral approaches to changing health and addictive behavior are difficult to find.

A reason for the inconclusive research data available to date may be that in order to understand health behavior we need to engage in an interdisciplinary approach to research in this area. This would or could include such fields as social psychology, personality psychology, health education, preventive medicine, public health, epidemiology, sociology and economics. With an interdisciplinary approach, the results of preventive efforts might be more conclusive.

The damaging effects of cigarette smoking are apparent and it has been estimated that the life of a smoker is shortened by an average of five years (Svärdsudd, 1987; Isacsson, 1987). It is, however, pointed out that for some groups of the population, for example younger women, the shortening of life is much larger. According to the review by Pierce et al. (1994) the total loss for all groups caused by smoking is 15 potential life years.

The discussion of the detrimental effects of smoking has mostly been focused on the airways, but the effects on the heart and artery system do, in fact, cause most of the increased death and disease among smokers. Contrary to what applies to the lung effects, the cardiovascular effects are most pronounced among individuals who are already affected by, for example, arteriosclerotic disease, high blood pressure, diabetes and high cholesterol. This emphasizes the possibility of advice to quit smoking as a very potent means for remedy.

From 1974 to the present, the prevalence of cigarette smoking in the United States has declined at a steady rate. The decline in smoking prevalence has occurred across all race, gender, and educational categories, although at a slower rate for women and lower educational groups. The rate of decline in smoking prevalence has been twice as fast among higher-educated groups (Pierce et al., 1989). However, as 95 percent of the attempts to quit are self-initiated (Carmody, 1992) findings from studies of participants in smoking cessation programs may not be applicable to the majority of smokers attempting to quit. What these data do not show is the relapse rate among those smokers who quit either on their own or with outside help.

Most people who quit smoking do it by themselves. The reasons for this action are apparently related to worry for their health, anxious relatives, pressure

from the working place and cost. Apparently the more reasons for change, the easier it is to quit. The reasons reported for quitting range from 7 percent for those who are following the advice of a physician to 42 percent for cardiac disease patients (Viswesvaran & Schmidt, 1992).

In Sweden approximately 25 percent of the males and 30 percent of the females in the age interval 30-55 years smoke cigarettes daily (Ramström, 1994). In the Western World tobacco smoking is the largest preventable cause of disease (Ramström, 1991).

It is a well-known fact that smoking is extremely difficult to change despite increasing social pressure to do so. Studies on relapse (Schwartz, 1987) show that up to 80 percent of those smokers who initially succeed in stopping smoking, eventually relapse over the 12 month period following initial cessation (Lichtenstein et al., 1986). This figure is consistent with relapse rates for most addictions, with a range from 50 percent to 90 percent (Marlatt & Gordon, 1985). Brownell et al. (1986) stressed an increasing emphasis on commonalities as the rates for relapses appear so similar. Moreover, Potocky et al. (1991) found nearly identical patterns of relapse in alcoholics, heroin addicts and smokers. This result has also earlier been obtained by Sjöberg and co-workers (e.g. Sjöberg, 1980).

Attempts to modify individual behavior to enhance the effectiveness of health care (Viswesvaran & Schmidt, 1992) have been made but success rates with light and heavy smokers do not appear to be striking. With increasing societal awareness of the hazards of smoking, knowledge of the effectiveness of different intervention programs becomes important. A study by Viswesvaran and Schmidt (1992) showed an average observed success rate across all programs to be 25 percent but only 18.6 percent after adjustment for the control group success rate.

The effectiveness of different intervention programs has been investigated. The review by Viswesvaran and Schmidt (1992) suggested that the content and not the source of information is important in determining success. The results for different methods showed that instruction-based programs (28 percent) are comparable to aversive techniques in general (29 percent) and these are more effective than drug-based programs (17 percent). Educational methods that passively transmit factual knowledge have a success rate of 24 percent. They argue that traditional didactic approaches that ignore social norms and self-esteem enhancement are not as effective as instructional methods incorporating those factors. Self-care has only a 15 percent success rate. The conclusion is that on average, formal intervention methods have been more effective than self-care methods. Moreover, the most successful methods appear to be instructional and condition-based, whereas drug-based and medically sponsored programs appear to be least effective. The results reported above could also be related to the time dimension, with varying results depending on the period of time for the intervention.

Self-change and self-improvement has been discussed with programs of therapy as a basis (Seligman, 1994). Certain damaging behaviors could be unlearned. This change could be accomplished within different areas, such as anxiety, depression, sexual dysfunctions and alcoholism. In trying to attain psychological or physical changes the importance of identifying the limits is stressed.

4 STUDIES PERFORMED

The studies are referred to by Roman numerals (I-VII).

I. A study of delay of outcome and preference for different courses of action.

II. A comparison between scales in an information integration task.

III. Context effects on delay processes.

IV. The relationship between age and delay behavior.

V. Expected time of the outcome of offers to gamble.

VI. Addictive behavior as a decision with future consequences.
A study of quitting smoking by pregnant women.

VII. Coping mechanisms and attitude changes over time.
A study of quitting smoking by pregnant women.

The purpose of the present studies was to investigate delay behavior and the effect of time discounting. The first five studies focused on a delay of gratification pattern where the outcome was related to monetary values.

Within decision research the time variable has not been investigated to the same extent as the variables of probability and value. Therefore, time of outcome as a determinant of judgments and decisions was investigated and reported in five different studies. The variables of probability, value and time of outcome were studied in gambling offers. The delay period was defined as the time elapsing between the occurrence of the decision and the first of its consequences.

4.1 Studies I-V

Each study dealt with different aspects of delay behavior, that is supposed to be one component of an individual's processes of self-control.

One subject of the research was the relationship between the variables and the laws that describe the usage and combination of information from these variables. It has earlier generally been supposed that there are interactions between these factors and many investigations have obtained empirical support for this assumption. In these investigations, the time of outcome was supposed to have an effect through the other two factors of value and probability of outcome. Stressing a more direct effect of time a linear model was tentatively supposed to give a good description of the process of judgment and decision.

4.1.1 Model testing

An additive and a multiplicative model were tested. In general, support for a multiplicative combination of the value and probability components had earlier been found (e.g. Tversky, 1967). This model is defined

$$U = \Psi_1 U(\$)_1 + \Psi_2 U(\$)_2 + \ ... \ + \Psi_n U(\$)_n \qquad (1)$$

where U denotes the favorableness of a course of action, Ψ_i subjective probability and $U(\$)_1$ the utility of an outcome.
If the information units from probability, value and time are assumed to be multiplied the model becomes

$$U = \Psi_1 U(\$)_1 \tau_1 + \Psi_2 U(\$)_2 \tau_2 + \ .... \ + \Psi_n U(\$)_n \tau_n \qquad (2)$$

where τ_1 is subjective time. This model was denoted as SEU_t.

The multiplicative model was tested in its raw form and its log linear form. The multiplicative model (2) in log form becomes

$$\log U = a \log p_1 + b \log v_1 + c \log t_1 + ... + a \log p_n + b \log v_n + c \log t_n \qquad (3)$$

where a, b, and c are the regression coefficients of log objective probability, value and time. Objective values of probability, value and time are denoted p, v and t.

In some investigations, however, an additive model has been found to give a good description of the judgment process based on value and probability (e.g. Sjöberg, 1968; Slovic & Lichtenstein, 1968). If time is introduced as an additional factor and the units are still assumed to be added the model may be written as

$$U = \Psi_1 + U(\$)_1 \pm \tau_1 + \Psi_2 + U(\$)_2 \pm \tau_2 + ... + \Psi_n + U(\$)_n \pm \tau_n \qquad (4)$$

A test was made of a further model, called a discounting model; in it time could be expressed as percentage of the payoff discounted per hour.

$$U = \Psi U (\$)(1-\gamma)^t \quad (5)$$

where γ is discounting per each hour and t is objective time.

4.1.2 Methods of analysis

A method developed by Anderson (1970, 1974) was used to test the models; this has been called a functional method of measurement, and briefly involves testing possible models to establish the psychophysical law on the basis of the established model. The usual method for testing model equations, ANOVA, relies on a factorial design, but in the present studies an incomplete design was used that combined the values of the independent variables, making it necessary to apply another method of analysis.

Multiple regression analysis, being based on a linear model, could be used for this purpose. The use of regression analysis involved splitting up the residual sum of squares into lack of fit and pure error, so that lack of fit could be tested against an estimate of pure error (Draper & Smith, 1966; Cohen, 1968; Sjöberg, 1971). Tests of improvement in fit were also performed when the parameters for probability and value had been introduced.

The stimuli used in all investigations, reported above, were lotteries. Offers to buy lottery tickets in lotteries were chosen as stimuli as they could be varied naturally in the three relevant variables of time, probability and value of outcome.

Multidimensional scaling was also performed on similarity ratings where similarity between offers was rated to investigate whether the same dimensions would be obtained when different response modes were used, namely preference and similarity ratings. The similarity data were in study I analysed by a method developed for multidimensional scaling of individual data (Carroll & Chang, 1970). This method called INDSCAL, which is metric, gives the group stimulus space and also the weightings of the different dimensions for each individual.

In studies II and III the similarity data were also analysed by TORSCA, another method for multidimensional scaling. This MDS method is non-metric. The results obtained from the different methods of multi-dimensional scaling were compared.

4.1.3 Method

The stimuli and design were about the same in all the empirical studies on lotteries.

In study I ratings were performed as to perceived favorableness of 16 different offers to buy tickets in lotteries, the stake being constant. These preference ratings were analysed by the functional method of measurement and similarity ratings were analysed by INDSCAL, methods which have been described above. The weightings of different factors obtained by preference ratings and by similarity ratings were compared.

Study II contained a comparison between different rating scales for preference: category judgments, magnitude estimations and graphic ratings. The rating scales for similarity were category judgments, magnitude estimations and paired comparisons. The additive model and the multiplicative model were tested on data obtained by the different rating scales for preference judgments, and the similarity ratings for different rating scales were analysed by INDSCAL for individual multidimensional scaling. The similarity data were in addition analysed using TORSCA to test whether the same dimensions would emerge with the two different methods for multidimensional scaling.

In study III the effect of contextual factors was investigated. The contextual factors were ranges of the probabilites of the lotteries and instructions given for the ratings. The fit of an additive model and a multiplicative model was tested on the preference data to test the effect of different ranges of variation. The effects of range of variation and instructions were tested on similarity data.

Study IV gave a comparison between three different age groups as regards delay behavior. The three age groups were: five to six, nine to ten, and grown-ups. The subjects performed preference ratings and the fit of an additive model and a multiplicative model were tested on data.

In study V ratings with respect to perceived favorableness were performed of gambles varying only in the two variables of probability and value of outcome. After the ratings the subjects were asked to state what time of outcome they had thought of for every offer to gamble.

4.1.4 Results

The tests of the models in Study I showed a better fit to the data for the multiplicative model. The additive model could be excluded as a description of the judgment process for these subjects. The improvement tests for introducing parameters for value and probability in testing the SEU model

versus the SEV model, SEU versus EU, and SEU versus the SEU_t model yielded significant improvement for the probability and value parameters. The exponents of time, value and probability based on the multiplicative model in log form exhibited considerable interindividual variation.

The multidimensional scaling analysis using INDSCAL yielded about the same dimensions as the preference ratings, while the weightings of the factors seemed to vary with the two response modes.

In Study II the results obtained by different methods of ratings were compared. The plot of the scale values obtained by the different methods of rating yielded a curvilinear trend for the graphic ratings when compared to the other two methods of preference ratings. The goodness of fit tests of the additive and the multiplicative model gave about the same results for the three methods of rating. Some support was obtained for the multiplicative model and somewhat more differentiating results in this respect were obtained with the magnitude estimation data and graphic ratings compared with the category judgments.

Improvement tests gave the same result as in Study I, in which a significant improvement was brought about when utility and subjective probability were substituted for objective value and objective probability.

The scale values for different stimuli using similarity judgments were approximately linearly related to each other. In the multidimensional scaling analysis probability and value could be interpreted as two factors in the fitted solutions, and almost the same was found for category judgments and magnitude estimations, while the results for paired comparisons data yielded somewhat deviant results. Another feature of the data was that the TORSCA analysis yielded about the same results as the INDSCAL analysis.

In Study III, in which context effects were examined, bad fit was obtained both for the additive and the multiplicative model. The bad fit applied when assuming power functions relating the subjective and objective variables.

In some earlier studies (for a review see Lee, 1971) another function had obtained support. This function implies an overestimation of low, and underestimation of high probabilities. This relation could be denoted by means of a sine function for the probability variable. This function can also describe an underestimation of high and overestimation of low probabilites, which, however, was less probable on the basis of the results found in earlier studies. When this sine function was used for the probability variable, however, it also produced bad fit to the data for the multiplicative model.

The similarity ratings gave in one part of the study the expected result in which the ratings were adjusted to the ranges of variation. In another part of the study the multidimensional analysis did not yield a result that was clear enough to permit conclusions about the effect of the different ranges. No marked effect of the instructions could be noticed. The INDSCAL and

TORSCA analyses yielded about the same results with probability, value and time as interpretable dimensions.

The developmental Study (IV) produced unexpected results. No difference was found between the age groups as regards the time factor. The multiplicative model showed somewhat better fit for all age groups compared to the additive model. Large inter-individual variations were found in the exponents of time, probability and value.

In Study V the multiplicative model and the additive model were tested on preference data based on gambles varying only in probability and value of outcome. The multiplicative model showed good fit to the data, while the additive model had to be ruled out as an explanation as it produced significant lack of fit for all cases. For those subjects who did not follow a multiplying rule, interactions were found where combinations with extreme skewness, that is, with a low probability and a high value, or the reverse, were overestimated.

Positive product moment correlations were obtained between the expected delay periods and the ratings of perceived favorableness of the offers to gamble, and also for the prizes. Lower positive correlations were found between the expected delay periods and the probability factor.

4.2 Conclusions of Studies I-V

The studies showed that a multiplicative model gave a better fit (expect in Study III) when describing delay processes. Behavior following this rule could be taken to indicate a rational judgment. All the studies gave evidence that the stronger models EV, EU and SEV did not give a good description of the judgment process.

Moreover, the exponents of time, probability and value based on the multiplicative model in log form generally exhibited large inter-individual variation. The variation found was larger than that found in earlier studies. The conclusion was, that adding time to judgments gave a larger variability.

The developmental study (V) gave an unexpected result as the negative exponents were somewhat smaller in the younger group compared to grown-ups. A tentative explanation presented is the use of different strategies in different age groups.

The approach of functional measurement in studies of delay processes seemed useful in descriptions of judgments and decisions based on time.

4.3 Studies VI and VII

Previous research has, like studies I -V, to a large extent focused on time discounting and monetary values. The relationship between health and time effects has, however, attracted an increasing interest.

The time effect and its impact on health behavior has to a limited extent been investigated earlier. Therefore, two additional studies VI and VII were performed, where the relationship between time and the addictive behavior of smoking was investigated during an attempt of quitting smoking.

Data were collected in Bulgaria in October - December, 1994. Young women were selected as they belong to a group that today to a large extent starts smoking. Moreover, smoking while pregnant implies a risk for detrimental effects on the fetus.

Four different groups were included:

A. Smoking pregnant women, did not try to quit smoking.
B. Smoking pregnant women, tried to quit smoking.
C. Smoking non-pregnant women, did not try to quit.
D. Smoking non-pregnant women, tried to quit smoking.

Twenty in each group, in all 80 subjects, were included. They were matched in age and education. Mean age for the group was 25.1 years, age range 20-31 years. They had smoked for 6.5 years on an average.

The subjects participated in the study for 14 days, and they responded to a questionnaire during the first 7 days and on day no 14. Out of the forty subjects twelve subjects failed in their attempt to quit and were replaced by new subjects.

4.3.1 Study VI

The purpose of Study VI was to investigate the addictive behavior of smoking during a period of 14 days. The focus was on the perception of the three variables of value, probability and time of outcome during an attempt to quit smoking. Of special interest were the changes of perception in these three variables, as failures in quitting have been attributed to a shortened time perspective.

The validity of two different models, the Value Model and the Action Model in describing time aspects in addictive behavior was tested.

The Value Model formulated by Ainslie (e.g. 1975) describes addictive behavior by a discounting of values following a hyperbolic function. This will

give a crossing over of curves describing the motivating effect of behavioral consequences. With a time delay and a decrease in reward value a reversal of choice could occur, hence a relapse.

The Action Model postulates that inability to reach a goal is caused by emotional arousal, positive or negative. Arousal costs mental energy, thereby bringing about twisted reasoning and a shortened time perspective. A shortened time perspective allows temporal exceptions from the decision to quit. This reasoning could be applied to health behavior.

Ratings of states and events were performed as to

-the value, if it was good or bad, if the event should occur
-how likely the events were, if they went on smoking
-how likely the events were, if they quit smoking
-when the events would happen, if they went on smoking
-when the events would happen, if they quit smoking

The ratings were analyzed by means of factor analysis, which showed that, like in the study by Sjöberg, (1983) two factors could be extracted and given a meaningful interpretation. These two factors were related to bodily functions (named Soma) and moods and social relations (named Rel). For pregnant women a third factor related to the condition of pregnancy was obtained (Grav).

Ratings of the states and events related to value gave the least negative judgment for the Rel variables. For both pregnant and non-pregnant women the negative effects of smoking were rated as less likely to occur if quitting smoking. The difference between estimations, given continuing and quitting, was largest for the quitting women. If quitting smoking, the negative states and events were in general rated as less likely to occur. If continuing smoking the negative effects first affected the Rel variable, but if quitting, the negative effects for all the variabes of Soma, Rel and Grav were rated to occur somewhat later.

For pregnant women the Rel variable was estimated to occur in approximately 3-4 weeks, if continuing smoking, and approximately 2-6 months, if quitting smoking. For the Soma variable the time periods were 13 months or later if quitting, and 13 months or later up till never, if quitting.

For non-pregnant women the negative effects of the Rel variable was estimated to occur approximately in 2-6 months, if continuing smoking, and 2-6 months to 7-12 months if quitting smoking. For the Soma variable the figures were 7-12 months, if continuing, and 13 months or later, if quitting. To sum up, the negative effects of smoking for all the variables of Rel, Soma and Grav were estimated to occur later if quitting.

For both conditions of time, that is, if I go on smoking and if I quit smoking, small changes over time were obtained. The estimations of the point of time for the events and states to occur were not influenced by the time passing during the period of two weeks, but remained fairly constant. This indicated a function independent of passing time. One possible explanation of the results is, that the time period for the study was limited to 14 days, whereas the judgments of time for events and states encompassed 13 months or later, or even never.

Differences in estimations between women, trying to quit and not trying to quit, were most pronounced for the Grav variable. A tentative explanation is, that the factor of smoking or not smoking probably is more important when being pregnant.

As a basis for another analysis calculations were performed of the expected utility for smoking, both given continued smoking (AB) and given quitting smoking (AC). No main difference was obtained between the two alternatives AB (smoking) and AC (Not Smoking).

Like the result obtained by Sjöberg (1983) both the alternative of Smoke and Not Smoke were negative for all conditions. As expected the alternative of Smoke was more negative compared to Not Smoke. One explanation presented by Sjöberg (1983) to these results is, that smokers experience both alternatives as negative but for different reasons. The explanation presented is based on the constellation of two negative options creating an avoidance-avoidance conflict (Lewin, 1946).

The difference between Smoke and Not Smoke was for the Rel variable. The impact of smoking might be expected to be smallest for that condition; thus, an expected result.

As a third analysis mean utility differences were computed between Not Smoke and Smoke as a function of the time elapsing. Like all the other analyses this was performed separately for the variables of Soma, Rel and Grav.

For all the groups there was a decline in the difference starting on day 3. This decline had recovered on day 6. Sjöberg (1983) found an increasing difference between smoking and not smoking over time. This result was, however, not obtained in the present study. The decline in difference is tentatively explained by short-term withdrawal symptoms caused by nicotine as a chemical substance (Goldstein & Kalant, 1990).

A slight tendency to short-term transitory effects could also be noted in the study by Sjöberg (1983). The alternatives of Smoke and Not Smoke exhibited an increasing divergency up to day 3, and after that day the difference between the two alternatives levelled off. The result indicatates critical periods

during attempts to quit smoking. Support in different forms, chemical and psychological, is called for during critical periods identified.

Finally, belief value correlations were computed given continuing smoking (AB) and given quitting smoking (AC). The coefficients were computed for each day and subject separately. Mean correlation coefficients were analyzed. For both the alternatives of Smoke and Not Smoke no tendency was obtained for belief value correlations to change over time. However, large differences between the alternatives Smoke and Not Smoke was obtained for the two subgroups (pregnant and non-pregnant) trying to quit. The pregnant and non-pregnant women exhibited approximately the same pattern. Quitting/non-quitting seemed to be the variable of importance.

The importance of the quitting/non-quitting variable was supported by the results obtained in analyses of variances performed with days as repeated measure. For all the three variables of Soma, Rel and Grav quitting/non-quitting had an impact on estimated difference between expected utility for alternatives Smoke and Not Smoke.

Another result obtained was that correlations between value and probability of events tended to become more negative in the time interval day 3 to 4. This could be interpreted as an increase in twisted reasoning during these days, tentatively also explained by these transitory short-term withdrawal effects.

In testing the two different models, the Value Model and the Action Model I found some support for the Action Model, whereas the support for the Value Model was weaker. Both the alternatives of Smoke and Not Smoke were negative for all conditions. However, an increasing difference between Smoke and Not Smoke as a function of time, as postulated by the Action Model was not obtained.

The relevant variable for belief value correlations seemed to be the commitment to quit smoking, whether pregnant or non-pregnant. The validity of the Action Model needs further testing in different contexts.

4.3.2 Study VII

The problem of maintenance of behavior change is an important challenge to the fields dealing with health-related behaviors. This applies particularly to addictive disorders, e.g. smoking, as most cessation programs generally are effective only temporarily in helping people to stop smoking. However, maintenance of abstinence in addictive behaviors such as smoking, alcoholism and other substance abuse has been a neglected area (Annis, 1991).

When trying to quit smoking different coping techniques could be used. The purpose of study VII was to investigate the use of these techniques and relate

them to different aspects of changes over time. The subjects were the same as in study VI, and the design, method and procedure were identical to study VI.

For pregnant women it is especially important to avoid relapse using different coping techniques. As is evident from earlier studies (e.g. Fingerhut, Kleinman & Kendrick, 1990; Mullen, Quinn & Ershoff, 1990) relapse is common during attempts to quit smoking. Therefore, relapse prevention is an important part in quitting programs.

The analysis was mostly performed on the different subgroups to examine if there were any differences between pregnant/non-pregnant and quitting/non-quitting. Analysis showed that those trying to quit smoking had tried to quit more often compared to those not trying to quit. Pregnant women trying to quit had the most negative attitude, and non-pregnant not trying to quit had the least negative attitude towards smoking. Data showed that the most powerful variable for difference in attitude towards smoking was trying to quit smoking and not trying to quit smoking. The variable of pregnant/non-pregnant did not have the same impact on the attitude.

The group as a whole, also those not trying to quit, changed their attitude to become more negative towards smoking during the period. The pregnant and non-pregnant did not differ in relation to the smoking attitude. Analysis of variance with repeated measures for days showed that there was a difference between quitters and non-quitters and between different days, but that the difference was not depending on days, indicating a constant difference between quitters and non-quitters over time.

The pregnant women were on day 1 somewhat more resolute and judged it as more certain that they would succeed in their attempt to quit smoking. This was probably caused by their pregnancy.

Smoking was somewhat more common on days 2,3 and 14 among quitters. The higher number on day 14 could be explained by the longer time period. The higher number on day 2 and 3 could tentatively be explained by transitory short-term abstinence symptoms.

Copings techniques most used were:
'Diverting attention from smoke tempting thoughts.'
'Pursuing some other activity in smoking tempting situations.'
'Proceeding slowly with quitting smoking allowing myself occasional relapses.'
whereas the least used was:
'Using substitutes for smoking such as food, drugs or alcohol.'

For the following coping mechanisms there was a difference in use between groups:
'Breaking habits connected with smoking.'
'Obtaining social support and reinforcement for quitting.'

'Trying to get insight into why I wish to smoke.'
'Running away (physically) from a temptation to smoke.'

Pregnant women trying to quit used these strategies more often than non-pregnant not trying to quit. The former group was also those that disliked smoking the most, and the latter group disliked it the least. Coping mechanism used, thus, seems to be related to smoking attitude.

Two techniques showed an evenly distributed use among the different groups:
'Setting up partial and realistic goals in my attempt to quit smoking.'
'Using substitutes for smoking such as food, drugs or alcohol.'

Correlations between use of different coping techniques were found to be quite low. Moreover, correlations between use of different coping techniques and various independent variables, like quitting, were also low.

The results of study VII showed that important changes take place in an attempt to quit. A main result was that the attitude towards smoking became more negative during those 14 days. The change was most pronounced for those trying to quit, with a significant difference between quitters/non-quitters. As in study VI short-term transitory effects could be noticed on day 2 and 3.

Sjöberg (1993) has earlier found two groups of different techniques being used, attention diversion and goal actualization. In the present study mostly diverting techniques were used. In addition, coping mechanisms used seemed related to smoking attitude, that is whether smoking was disliked or not.

However, there was a low correlation between coping technique used and different aspects of quitting behavior, indicating an intricate relationship between coping mechanisms used and other variables. Complicated mental phenomena evidently take place during an attempt to quit.

5 DISCUSSION

5.1 The effect of time on results

The aim of this thesis was to study delay processes and the effect of time discounting on behavior. Studies I-V introduced the time factor as a determinant for judgments and decisions. These studies were focused on delay behavior related to gambling situations.

In the five delay studies on gambling behavior two models, one multiplicative and one additive, were tested on preference data. A multiplicative model fitted data (except in study III) fairly well. All studies showed that the stronger models EV, EU and SEV could be ruled out as explanations of the judgment

process. Moreover, the impact of the time factor was described by two different models; in the more basic model it was assumed to describe a power relation between subjective and objective variables. In the other model it was expressed as a percentage of the payoff discounted per hour. The same rank-order correlations for the time factor were obtained. In addition the studies showed that the exponents of time derived from the basic multiplicative model generally were negative.

One study related delay behavior to age. Contrary to earlier studies in this field no large difference between the groups was obtained. A tentative explanation of the unexpected result was based on different judgment strategies used.

The model tests performed in the studies indicated that the judgment process in a gambling situation based on time might be considered as rational, as the studies tended to support a multiplicative combination of the factors of time, probability and value of outcome.

Discounting of monetary values has earlier been in the focus of interest, but in recent years the relationship between health and changes over time has to a larger extent been investigated. A comparison between money and health as it comes to time discounting effects has exhibited discrepant results and could not easily be generalized between the two fields. The present studies, therefore, encompassed discounting effects on monetary values as well as health.

In pursuing an addictive behavior there is no evidence of lacking knowledge. Although informed about the damage caused by addiction, a decision is made to quit and then there is often a relapse. This could be the case even though patients have asthma, emphysema or heart myocardial infarct waiting for a coronary heart by pass operation. Indeed, addictions seem to be a mental and a volitional problem of conflicts between desires.

There is an indication that addiction is a complex behavior that could not be described by a simple model. It involves questions such as, at what individual level there is a consciousness about these problems. How much is governed by heritage and how much by surrounding factors?

Delay behavior has been regarded as a self-control problem. Ainslie (e.g. 1975) has described self-control problems and addictive behavior and an assumption has been made that results could be generalized from simple experimental paradigms to more complex phenomena like addictive behavior and other health-related behaviors.

Study VI indicated that there are intricate relationships between the three variables of value, probability and time of outcome in the area of health-related behavior. Like in the study by Sjöberg (1983) the expected utility of

both Smoke and Non Smoke was estimated as negative, with the Smoking alternative being the most negative.

The Action Model predicts an increasing difference in expected utility between the two alternatives Smoke and Not Smoke. This prediction was not supported in the present study (VI). Furthermore, for both the alternatives of Smoke and Not Smoke no tendency was obtained for belief value correlations to change over time. Large differences, however, were obtained between the alternatives Smoke and Not Smoke for the two subgroups who tried to quit. No such difference was obtained between pregnant and non-pregnant women. Thus, commitment to quit seemed to be an important variable rather than values, assuming pregnant women to value quitting more important than non-pregnant women.

Other results might, however, have been obtained for more extended time periods. The results obtained in the present study are tentatively explained by transitory effects such as short-term withdrawal symptoms caused by nicotine as a chemical substance (Goldstein & Kalant, 1990). Supposedly pharmacological aids like Nicorette might be useful in the beginning where withdrawal symptoms are potent.

The Action Model was to some extent supported by other data, which exhibited quite a complex pattern of judgments. One example were correlations obtained between value and probability of events to become somewhat more negative during the period day 3 to 4. This might be interpreted as an indication of increasingly twisted reasoning.

The result of all seven studies reported above indicate that delay behavior and time discounting processes are variable. They vary with individuals and also with different contexts.

Simplified single functions could, therefore, hardly be expected to give a good description. A more diversified description is needed where consideration is taken to include short-term transitory effects and long-term effects. A variation with different context factors, individual factors and addictive behaviors must also be accounted for.

Many fundamental studies have been performed by Sjöberg and co-workers (e.g. Sjöberg, 1980, Sjöberg, 1983; Sjöberg & Olsson, 1981) where addictive behavior has been found to be governed by complex psychological mechanisms. Twisted reasoning causes a break-down of will. This reasoning might be affected by many different psychological factors influencing the judgment bias. When it comes to explaining complex behavior patterns a well-developed and broad basis like this one is demanded. The approach of treating all three factors of value, probability and time at the same time is, therefore, preferable. No single model such as Ainslie´s Value Model could be

expected to describe this process as discounting behavior is complex, encompassing different anomalies.

5.2 Anomalies in intertemporal choice

Earlier research on decision making under uncertainty has documented numerous anomalies of expected utility. Time preference has been extensively studied by Loewenstein and Prelec (1991, 1993), and it is pointed out that the corresponding topic related to intertemporal choice and discounted utility (DU) lacks this analysis. Research on decision making under uncertainty has to a large extent focused on expected utility (EU) and behaviors that violate this axiom. Intertemporal choices have to a less extent been investigated from this point of view. Discounted utility (DU) is, however, also in need of a model that takes into account anomalies and framing factors in discounted utility behavior. An integrated critique of Discounted Utility has been presented, enumerating a series of intertemporal choice anomalies which run counter to the predictions of DU. Different aspects of intertemporal choice takes choice framing effects into account. These effects are a challenge to normative theory.

Contrary to normative discounted utility theory, decision makers might use different temporal discount rates for health and money. In the present study time was related both to money and health. The question was raised by Chapman (1994) whether the discount rates for health and money will still differ when expressed on a common utility scale, and it was found that correcting for exchange rates did not reduce domain independence. With exchange rates is meant the utility for health relative to money.

She found that the result of domain independence persisted despite three manipulations designed to remove the effect of different utility functions for health and money. Thus, it was concluded, domain independence is not an artifact of differing utility functions for health and money but rather a fundamental characteristic of intertemporal choice. Despite a difference between money and health decisions, both domains consistently revealed three discounting biases; a magnitude effect, dynamic inconsistency and a sign effect. These biases will now be discussed in some detail.

5.3 Framing factors

- The magnitude effect

By magnitude effect is meant, that discount rates are lower for large magnitude outcomes. If the magnitude effect also occurs in health decisions, it would suggest that the value of future health outcomes would increase if these outcomes were seen as important or large. In the study by Chapman (1994) a magnitude by domain interaction indicated a larger magnitude effect on health than for money. It could be concluded, that the range of health outcomes (1 to

8 years of full health) had more of an effect on discount rates than the range of monetary outcomes. Chapman and Elstein (1995) had found, that the discrepancy between money and health discount rates was most extreme for the smaller magnitude and shorter delays.

- *The dynamic inconsistency effect*
Chapman (1994) also found, that the discount rates were smaller for time intervals that were relatively more distant, challenging the assumption that discount rates are constant over time. There was an interaction between domain and delay in that the difference between health and money decreased with delay. With long delays (e.g. 12 years) discount rates for health and money are equivalent. The pattern of dynamic inconsistency implies that people will reverse their preference over time.

- *The sign effect*
By sign effect is meant, that discount rates for losses are lower than discount rates for gains. Lower discount rate are predicted for choice between losses. Consequently, research on the sign effect in the health area would suggest that discount rates for negative health states would be lower than those for positive health states. Preventive behaviors could therefore be encouraged by framing decisions as losses e.g. fat foods can be given up now, or a good health could be given up later.

Moreover, discount rates have been found to vary between different health settings. Discount rates for temporary blindness have been found to be smaller than for colostomy or depression (Redelmeier & Heller,1993). The assumption of identical discounting in all settings is, thus, violated. This finding might also be related to whether the health state is presented as a gain or a loss.

Chapman (1994) found an interaction between sign and domain indicating a larger sign effect for health than for money. Health discount rates were lower than rates for money for both gains and losses, but the difference was greater for losses. The sign effect was larger for health decisions.

- *Loss aversion*
Judgments and decisions should be characterized by invariance of preference over response modes (Tversky & Kahneman, 1986). Only the attributes and features should determine preferences towards objects.

Another issue to be tested is whether the time dimension influences trade-off to make a reversal occur. There is a bias in trade-off depending on whether x is traded off against y, or y is traded off against x. Preference reversals could be choice-choice reversals or judgments reversals. The framing effects are choice-choice reversals due to whether alternatives are presented as gains or losses compared to a reference. Judgment reversals imply that with the same expected value there is a preference for a safe bet to a long-shot, but people appreciate the long-shot better. This lack of invariance causes a problem

when prescribing procedures for decision analysis, as confirmed by Delquié (1993).

The sign effect is related to loss aversion. Important work within decision theory by Benzion et al. (1989) and Tversky and Kahneman (1991) have concluded that potential losses have a greater impact than gains on preferences. This loss aversion has implications for decisions and economic behavior. It may also have implications for health behavior, but that remains to be further tested.

Tversky and Kahneman also discuss a diminishing sensitivity, as the marginal value of both gains and losses decreased with their size. Moreover, the marginal value decreased with the distance from the reference point, see Figure 1.

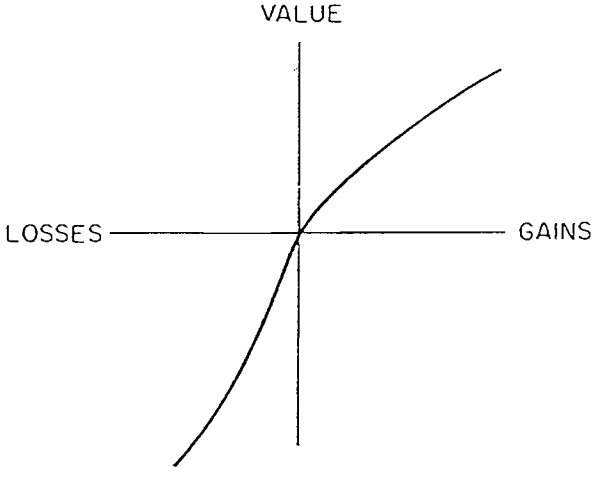

Figure 1. A value function for gains and losses.

Reversals of preference might occur due to a shift of frame of reference if gains turn into losses. Responses to changes are supposed to be more intense for unfavorable situations like losses than for changes leading to improvements. Therefore, when making decisions it is advisable to give greater weight to negative than to positive consequences.

Reference levels are adopted in a context. Their impact on decisions might according to Tversky and Kahneman be dubious when it comes to setting the norm for decisions with long-term consequences. Moreover, it is pointed out that the initial response to these consequences might be of relatively small importance if adaptation induces a shift of reference. These changes in adaptation level and the shift of reference could preferably be further investigated in a study with time sequences.

Loss aversion has earlier been found by Viscusi, Magat and Huber (1987) to be more pronounced for safety than for money, and more for income than for leisure (cf. Chapman, 1994).

-Rating scale used
Rating scale properties have been found to be dependent on other alternatives in the task (Bleichrodt & Johannesson, 1996a). If there is a tendency to spread health states over the whole scale continuum the attractivity of other health states may have an impact on the judgment of a health state. Context effects were obtained when evaluating health states, as the rating scale valuations of a health state depended on the number of health states that were preferred and less preferred to it. This dependency on other health states included questions of the validity of the rating scale method.

- Instant endowment and status quo bias
Two other concepts discussed by Tversky and Kahneman are instant endowment and status quo bias. By instant endowment is meant, that the loss of utility associated with giving up a valued good is greater than the utility gain associated with receiving it. This is in accordance with results by Cohen and Knetsch (1990) on court decisions where compensation was found to be more likely for out-of-pocket costs than for unrealized profits.

Status quo bias means a preference for no changes in decision making. Loss aversion also implies a status quo bias.

Samuelson and Zeckhauser (1988) have earlier found that new medical plans are more often chosen by the new employees than by employees that have started that work before the plan was introduced. Moreover, small changes were preferred to large ones.

- The sequence effect
As is evident from above, most analyses of judgments and decisions are based on single period models or models which assume time-separable utility.

Becker, Grossman and Murphy (1994) introduced a model of addictive behavior with interaction between past and current consumption. Past consumption of addictive goods, like for example cigarettes, influences current consumption through an increase in marginal utility of current consumption. This utility is larger than the present value of marginal harm for future consumption. Addiction means linked consumption over time. This assumption of separability has to be relaxed through allowing utility in each period to depend on consumption in that period and the previous period.

In many situations it seems reasonable to assume the consumption in one period of time to influence the marginal utility of consumption at another point of time. Intertemporal additivity, then, has to be considered. This is also in accordance with previous findings by Constantinides (1990), where the model

of habit formation assumes instantaneous utility to depend negatively on past consumption

As regards health behavior or addictive behavor, it is by now evident that it is not the result of one single action but a long series of actions. In a way it could be said that addictive behavior is a reflection of temporal preference and in this behavior there is really a time discounting effect. Some people prefer the proximity of the addictive reward; then there is often a period of regret. It could also be the other way around, that the addictions give a short-sighted relief from unhappiness rather than obtaining happiness.

Intertemporal models generally assume that people are impatient, and that a delayed outcome generally is preferred less than a more immediate one. Research on time preference has generally obtained positive discounting rates. Based upon this we would expect people to prefer a deteriorating rather than improving health, holding lifetime health constant. If outcomes in the future are discounted, unpleasant actions would be postponed as far as possible to the remote future.

Recent research has documented negative discounting rates for judgments of outcome sequences. This seems to be in accordance with the dynamic inconsis-tency effect related above. A sequence effect has been concluded to exist as implicit discount rates are lower for outcomes embedded in a series. This is in accordance with research findings on work - study programs by Stevenson (1993) where discounted values were obtained for single outcomes in the future, whereas discounting was eliminated when outcomes were presented in a series.

Loewenstein and Prelec (1993) found that, when presented with a sequence, subjects actually demonstrated a negative discount rate, preferring to postpone the more attractive event. This could be related to an earlier finding by Loewenstein and Sicherman (1991), that workers preferred to receive their salary in a moderately increasing series. Decision makers adapt to their current level of consumption and are averse to decreases in level of consumption. In addition, they lack self control and thus cannot separate their consumption stream from their income stream. People are impulsive enough to spend the money when they receive it, but are also prudent enough to desire the self control scheme that is implied in the increasing income stream.

Loewenstein and Prelec found two different motives for time preferences. The motive for single outcomes might be impatience, whereas, for sequential outcomes the motive might be preference for improvement.

It is emphasized that this is a violation of additivity due to a wish for spreading utility levels evenly over time, and is not attributable to a diminishing utility within periods.

The explanation of preference for improvement is related to:
1. anticipatory savoring and dread (Loewenstein, 1987)
2. adaptation and loss aversion (Kahneman & Tversky, 1979; Tversky & Kahneman, 1991)
3. recency effects (Miller & Campbell, 1959).

1. For gains, preference for improvement means to save the best till the end of the sequence. For losses, getting over with the worst outcomes minimizes dread. Economic theory predicts, that temporal preference for gains and losses are parallell. However, empirical results indicate that this is not always the case.

2. People tend to assimilate and evaluate new stimuli relative an assimilation level. Relative values or changes are more important than absolute levels. A series with positive changes or gains from the adaptation level provides improving sequences, whereas a declining series gives a series of relative losses. This would be unfavorable as loss aversion implies that people are more sensitive to a loss than to a gain. This condition is related to a contrast effect described by Elster and Loewenstein (1992), where comparing the present with the past or the future has effect upon the evaluation of the present.

Sequences are influenced by both savoring and dread, and assimilation and loss aversion. For single outcomes only savoring and dread apply. There are two factors favorable to deferring desirable outcomes for sequences and the tendency to postpone desirable outcomes is stronger for them.

3. A recency effect occurs when the final outcome in a sequence is the most important for the judgments made. With a retroperspective perspective the late periods will be relatively overweighted compared to periods in the middle. In addition to this preference for improvement, some 'gestalt' properties, related to the total time interval have been discussed.

In two studies by Loewenstein and Prelec (1993) it was found that more than 75 percent of the subjects preferred improving sequences, that end with a gain. In addition there was a small preference for a good start and global uniformness, with a desire to spread consumption over time. How events are distributed over an interval depends on the length of that interval.

In models of coping capacity it might be postulated that a separation of losses over time replenishes coping resources. This is an advantage as subjects generally have a limited psychological capacity to absorb losses.

5.4 Practical implications

Thus, framing of preventive health messages may be important. Due to the limited tradeability of health, when eliciting its time preference rate, it has been

concluded (Olsen, 1993) that intertemporal choices must be framed in such a way as to resemble as closely as possible those choices facing health planners and decision makers. The desire for behavioral change in preventive health programs would, therefore, benefit from considering the usefulness of psychological factors in the models.

Chapman (1994), emphasizing the relationship between implicit discount rates and health behavior, suggests a method for encouraging future-oriented health behavior by exploiting biases in discounting.

According to results obtained on discounting biases, they appear to be somewhat more prevalent in health than economic decisions, even when health and monetary outcomes are matched for utility. Research has indicated, that framing health decisions in terms of large, important outcomes or long delays should induce lower implicit discount rates. Framing health decisions as losses, rather than gains, or as involving a series of outcomes, rather than individual outcomes, might similarly lower the implicit discount rate used.

In summing up, time is only connected to the ordering of events in the model presented by Loewenstein and Prelec (1993), also independently tested by Chapman (1994). This introduces a completely new perspective on time discounting and intertemporal choice with large possiblities for future research.

A relevant point to the results presented above is an asymmetry in risk aversion found by Kahneman and Tversky (1979). Certain to uncertain gains are preferred, but for losses uncertainty to certainty is preferred.

Such asymmetry, if applied to health behavior, might be important, as discussed by Fuchs (1982). In health, generally, the immediate action gives a loss with a high degree of certainty. However, for the individual the gain in the future is uncertain, in spite of being predictable for the population on a whole. A strong asymmetry between gains and losses will give a low willingness to undertake actions to improve health.

This highlights a very important aspect of health-related behavior. A variation in an individual's risk aversion may influence results when studying time preferences or when effects of time preference on health are analyzed.

Moreover, intertemporal behavior is often embedded in a context of other factors where the psychological perspective or frame could shift. Different frames, discussed above, are the sequence of outcomes, and the sign of the outcome, the length of time and the size of the outcome. Previously, usually gains have been studied. Quitting addictive behavior might by the addicted person be experienced as a loss, so future studies should take this into consideration.

Regarding behavior as sequences of outcomes evidently has important implications for behavior change. Specifying the relevant interval and notifying the end of the sequence has relevance. The best strategy for a sequence may vary across different addictions and different contexts.

The model for presenting information as sequences of outcomes may introduce a new method for educational methods and preventive campaigns. A change in time prespective is introduced with a model, where time establishes the ordering of sequences, giving a within-sequence discounting. Period position implies relativity of time, and the judgment may be more dependent on the relative than the absolute sense of time. Loewenstein and Prelec (1993) speculate that moving the sequence more close in time, where the assumed hyperbolic discount function is steeper, changes the discount rate function.

Many studies on intertemporal choices have in recent years been performed with an interdisciplinary approach. Baumeister (1994) discusses addiction as a series of short-term choices. Each one seems to be a good optimal choice but together they give an undesirable result.

An example presented by Baumeister is whether preferring 100 $ six years from now or 200 $ eight years from now. Most people would choose 200 $ eight years from now. If there is a choice between 100 $ now or 200 $ two years from now, the preference would mostly be 100 $ now. This represents a preference reversal and is a contradiction and challenge to rational models of decision-making.

Applied to health-related behavior (Cropper, Aydede & Portney, 1994) for a life saved at T = 100 the discount factor to T = 50 is the same factor when T = 50 is to be discounted to T = 0.

An equality of these discount factors has repeatedly been proved to be false (e.g. Loewenstein & Thaler, 1989). They found the discount rate from T = 50 to T = 0 to be larger than T = 100 to T = 50 . This implies that the discount factor decreases over time and is not constant, which an exponential discount curve presumes. Thus, framing factors causing different preference switches have an impact on the descriptive discount function. Large discount rates for small delays and small discount rates for large delays implies that the descriptive function does not follow an exponential form which previously has been the norm.

As is pointed out by Redelmeier and Heller (1993), the exponential model makes strong claims as the rates are assumed to be small positive numbers, constant over time and invariant for different settings.

Future costs and future health benefits have been supposed to be devalued at a constant rate. This discount rate is estimated to be approximately 5 percent for a present net value of both costs and health (Krahn & Gafni, 1993).

However the assumption of a common proportional rate is also refuted by the very low discount rates found by Svenson and Karlsson (1989) where 30 percent did not at all discount future nuclear waste leakage. The mean discount rate was 0.0086 percent, which shows the invalidity of a constant proportional devaluation of approximately 5 percent for social values related to preservation of life.

Thus, the exponential model suggested as a description of discounting behavior has repeatedly been refuted. It could be concluded, that the exponential model does not well describe preferences towards negative and aversive health outcomes.
Other possibilities to describe the discount rate are that they are
- declining linearly with time, or
- following a rectangular hyperbola (Cropper et al., 1994).

A piecewise linear discount rate function has been found to be better for the time span of 0 - 25 years, and for more than 25 years a hyperbolic function was proved to give a better description (Cropper et al., 1994).

The validity of a constant rate discounted utility mode has been doubted. Individual intertemporal preferences for health have been described by Bleichrodt and Johannesson (1996b), and they have obtained support for a common difference effect. This implies that remoteness in time gives a smaller discount rate, which is in accordance with the dynamic inconsistency effect discussed by Chapman (1994). Bleichrodt and Johannesson (1996b) also speculate about different discount functions for quantity and quality of life.

It could further be speculated about a difference in discount functions for physical and mental health states, and more specifically different rates for different health states like osteoporosis, diabetes, cancer and myocardial infarct. The differing discount functions might potentially affect the treatment recommended by the physician. It might also affect the way in which the patient perceives and complies to the treatment, which may open a new field of research.

Procedures and interventions taken within a medical setting might give different outcomes in different time periods. An example is that investigations with mammografi could give an early detection of cancer mammae. This is a gain for the patient. However, the same procedure could cause cancer at a later period of time. A conclusion is, that prevention could give a gain or a loss depending on time perspective.

The variable outcome of gain or loss depending on time might also be applicable to osteoporosis, where different interventions, like for example oestrogen intake could give varying effects with time (e.g. Fries, 1996).

Another point to be made is that time of an outcome to occur varies, and also the time span for that outcome. A theoretical point should also be made about

the possible relevance of the time sequence of interventions for results obtained.

There is not always a knowledge of what we have been exposed to, in the first place. Moreover, the outcome in the future is a non-event, that is, a negative outcome that will not occur. For this negative outcome not to occur we have to refrain from immediate satisfactions of various kinds (Allander, 1996). As is easily understandable this is not always an easy task.

All these context factors supposedly are of relevance for health-related judgments and decisions. Therefore, they need to be investigated in future studies on time and health perspectives, as they might have a great impact on the efficiency of health information and campaigns.

5.5 The relationship between the factors of time and risk

In the models described above, time and value of outcome are fundamental variables. Most previous work on intertemporal choice has been based on a trade-off between two outcomes of different values and different periods of time. The risk factor has not been focused to the same extent, although this factor generally has a large impact on judgments and decisions. In addition, risk is connected to framing factors. There are different reactions to risk in gains and in losses.

Continuing the research tradition initiated by Mischel (e.g. 1966; 1986) self-control behavior was investigated in the five studies (I-V) where time preference was assumed to be related to the three different variables of time of outcome, value of outcome and risk of outcome.

Gafni and Torrance (1984) have earlier proposed the concept of risk attitude to describe intertemporal choices of health. According to them risk attitude embodies three effects:

-A time preference effect that represents a preference structure in which the individual prefers his health gains earlier as opposed to later. Olson and Bailey (1981) have called it pure time preference.

-A quantity effect, referring to a diminishing marginal utility of consumption. This effect has by Sutherland et al. (1982) been explained as follows. When an individual, who is offered various durations of life extension in a chronic dysfunctional health state, gives each succeeding year less value simply because he is growing weary or satiated with the situation, there is a quantity effect.

-The third effect, a gambling effect, depends on one's attitude to risk and seems to have a parallel in what Olson and Bailey (1981) called uncertainty. By uncertainty, they mean the possibility that one will not be able to benefit

from the promised future pleasure. The relationship between the factors of time and risk is, therefore, important for the decisions that are made either by the individual or by society.

The problem of treating death and other health effects as monetary equivalents is illustrated by Viscusi and Evans (1990). They discuss the concept of deferred risk reduction in the health area and especially the value of risk reduction to future generations. The expected benefits are reductions in the probability of morbidity and mortality from diseases in the future.

An additional factor that might influence judgments on future health is how inferences generally are made. Most clinical inference is characterized by backward reasoning in that diagnosticians often attempt to link observed effects to prior causes (Kleinmuntz, 1990). Compared to this post hoc explanation, statistical prediction entails forward reasoning because it is concerned with forecasting future outcomes, given observed information. Clinical inference utilizes information from time passed to make a statement about today. Prediction is trying to use data to make a forward reasoning about the future. Thus, the former is backward and the latter is forward in time, leading to different problems in judgments and decision making. The time factor may, thus, have influence on future health in different aspects. Moreover, the clinical side considers error as a nuisance variable. The statistical approach, per contra, accepts error as inevitable, and in so doing makes less error in prediction in the long run (Einhorn, 1986).

Slovic, Fischhoff and Lichtenstein (1985) viewed the concept of risk as a bundle of characteristics. This notion has been developed by Horowitz and Carson (1990) who regard discount rate for a particular risk as one of its characteristics. Discount rates have been found to differ for different types of risks (Horowitz & Carson, 1990), and the varying results obtained for the discount rate might partly be explained by a difference in the value of risk reduction. As is pointed out, empirical work on risk reduction has mostly studied risk in the present time or has used atemporal models.

However, when it comes to risks, Erlich and Chuma (1987) proposed time discounting utility-based theories of the value of life, that included both atemporal models and inter-temporal, life-cycle models in which the timing of risks could be considered.

Some studies on risk have used exposure to carcinogens as the risk factor (Smith & Desvousges, 1987). This implies a very long latency period. However, the time dimension was not varied, and therefore the discounting rate could not be estimated. Moreover, Hellinger (1989) found, that people were more risk aversive with respect to choices involving years of life than they were to those involving monetary outcomes.

Risk perception has also been found to be related to addictive behavior. Wright and Weitz (1977) found that when the outcome of a choice was in the

near future, subjects were more risk averse than when the outcomes were in the remote future. A high level of perceived risk has been found to decline over time for all those who failed at their quit attempt (Gibbons, McGovern & Lando, 1991). They examined smoker's perception of health risks associated with smoking versus not smoking. The measurements were performed at three different times during an attempt to quit smoking at a cessation clinic treatment. A measurement was also performed after the cessation clinic. The subjects were asked to judge personal risks to develop different diseases, such as lung cancer. The first alternative was conditioned continuing smoking, and the other alternative conditioned quitting smoking.

The conclusion is, that effort should be made to counteract the tendency among relapsers for risk perception to decline. This may help relapsers to maintain cessation motivation.

Björkman (1984) argued that willingness to take risks increased with time distance to obtaining the outcome. Risk-willingness increased with disengagement, and a smaller value of the consequences. He also found that learning experience to a very small extent improved decision making. Bayesian studies have shown conservatism in judgments to increase for rare events (cf. Slovic & Lichtenstein, 1971). Conservatism in judgments is in accordance with an increased tendency to take risks with delayed outcomes of the decisions. A common finding is discussed: the salience of both negative and positive consequences diminishes with distance to the goal, but faster for negative outcomes.

In a study of large scale hazardous technologies are studied (Svenson & Karlsson, 1989), there was a main difference in discount rates between groups. It was found that some groups, engineers, students of engineering and retired people, discounted risks of spent nuclear fuel faster than younger people with another education. They also found that some persons would not discount at all when the valuation was about large values with moral dimensions.

The relation between perception of risk and health behavior has extensively been investigated also by Sjöberg (e.g. 1995). Sjöberg (1993) has reported that personal risks are judged as smaller than the same risks for people in general, and that the difference between personal and general risk is related to perceived control. When people are of the opinion that they have control over a risk they also judge personal risk as smaller than general risk. The conclusion drawn by Sjöberg is, that they do not consider others as equally capable or willing to protect themselves from risk.

Van den Berg, Hendrickx and Vlek (1993) found that all subjects, regardless of whether they exhibited value discounting or not, used probability discounting if the risk was perceived as controllable. For perceived controllable risks probability discounting would then be a more general mechanism than value discounting. People's tendency to discount future

consequences may then be suppressed by lowering the amount of perceived control. If factors are stressed that oppose the idea that temporal delay will result in increased control the discount rate might be lowered. Applied to the area of smoking it could be emphasized to smokers that the possibilities for future corrective actions are limited due to physical limitations. Some effects of smoking might even be irreversible.

Thus, the relationship between risk perception and time horizons seems to be relevant. It might be expected that risk averse persons would tend toward positive time preferences and risk prone persons towards a negative time preference. However, this area has to a very limited extent been investigated.

The time dimension is of importance and, moreover, a factor over which govern-mental institutions have jurisdiction (Horowitz & Carson, 1990). A decision will often have to be made as to when to undertake a risk-reducing project rather than whether to undertake this project.The judgment also gives some guidance to when a technology should be adopted.

A second situation where time is a key aspect is when risks with different time profiles compete. A trade-off in timing of risk will be obtained rather than, as earlier seen as the regular case, a trade-off of risk for money.

Horowitz and Carson (1990) have speculated about the present value of risk reduction that occurs in the future. According to their viewpoint, when it comes to programs that reduce long-term health risks, the market view implies that less emphasis is placed on reducing long-term health risks in favor of a greater emphasis on programs that can achieve very quick reductions in health risks. This conclusion is valid even if those programs may save fewer statistical lives in the long run than an alternative program that produces less immediate results.

Their work suggests that for some risks median discount rate may be close to the real market discount rate, while for other risks it may not, and consequently that we can reject the hypothesis that the discount rates for all risks are equal. Risk has been studied in many other settings and evidence has also been provided that risk-risk trade-offs might be more stable than responses to risk-income choices (Krupnick & Cropper, 1992).

It seems to be a fairly well-established fact that individuals are risk averse. The certainty equivalent value will then be less than the expected value. It is of importance to health outcomes, for example years of life gained, and especially, if benefits are not transferable. In the judgment process the nontradable risk must be accounted for in some way. Benzion and Gafni (1983) argue that, therefore, discount rates for health outcomes should incorporate the evaluation of risk.

For outcomes calculated without risk reduction (e.g. life of years gained) the preventive programs will be overvalued in an absolute sense. Compared to

the more risky alternative they might, however, be undervalued. As some programs may be undervalued because of a net risk reduction, this should be taken into consideration when evaluating preventive projects. Johannesson, Pliskin and Weinstein (1993) have discussed different measures of health, incorporating risk aversion or risk preference with respect to remaining life years.

Lindberg and Sjöberg (1994) have performed interesting studies on risk perception and insurance policies. Risk is generally supposed to be composed by the two concepts of probability and consequence, more specifically combined with an additive procedure.

Risk = constant + probability + consequence.

An additive combination of these two factors implies, as is pointed out, that they do not interact, and that every component could be studied separately as regards its influence on risk perception.

A distinction is generally made between personal and public risks. Personal risks are almost exclusively determined by the probability factor, whereas the judgment of consequences only slightly influences the perception of risk (e.g. Lindberg & Sjöberg, 1994). It could be speculated that the time concept should be more important for the judgment of consequences rather than the judgment of risk.

A distinction is, moreover, made by Lindberg and Sjöberg between judging the value of insurance and the importance of preventive actions. According to the opinion of the present author, the time aspect should be more salient for preventive procedures, as it implies more of a planning over time. In the study by Lindberg and Sjöberg (1994) it was found that the value of insurance was determined by personal consequences and perceived competence to prevent the damage. The importance of preventing damages was determined by personal consequences and by perceived worry. In addition, it was shown, that the importance of prevention was connected to perceived competence.

These are all intricate relationships, and hypothetically they could be related to a dimension of risk aversiveness and risk seeking behavior, and to a preference for gains compared to losses (cf. Tversky & Kahneman, 1991).

It could be speculated that the time variable should have a larger impact on personal risks compared to public risks. This is, however, somewhat in opposition to the fact of both public and personal risks being determined mainly by probability and to a lesser extent by judgments of consequences.

Sjöberg (1994) has, moreover, found that demand for risk reduction was only weakly related to perceived level of risk. The perceived consequences seemed to be much more important. Risk level had less influence on insurance value and prevention importance than consequences. In the studies

risks were defined as level, but could also be defined as seriousness of risk. The choice of definition has implications for risk communication and preventive programs.

The time aspects have been studied and related to life saving interventions (Sjöberg & Ogander; 1994). It is pointed out by Ramsberg and Sjöberg (1996), that when comparing different interventions they can be implemented to various degrees, and that some of the interventions will be implemented in the future, while others will not.

A very interesting hypothesis introduced by Ramsberg and Sjöberg (1996) is, that the size of the investment in absolute numbers has an impact on the decision to invest. This implies that a large investment has to be more cost effective compared to a smaller investment. This has possible implications for future life-saving strategies.

How resources are allocated over time has an impact on mortality and morbidity. Fries (e.g. 1980; 1996) has developed a compression of morbidity paradigm with an attempt to reduce lifetime illness and morbidity, where fractures associated with osteoporosis are a major cause of this morbidity. Preventive interventions aimed at age-specific incidence of fracture are important to reduce morbidity resulting from these fractures. The effect of interventions is due to age factors such as age of onset of morbidity. Another time-risk interaction in this context is the optimum timing of different preventive actions.

Jönsson, Hedbrant and Johnell (1993) computer simulated a model to analyse the cost-effectiveness of fracture prevention of osteoporosis. A calculation was performed of life years and quality adjusted life years and discounting of the effects of the intervention. Discounting was calculated on each life year and then added over time.

Johannesson and Jönsson (1993) have discussed the problem of reliable data to base cost-effectiveness analyses on. This makes it difficult to draw conclusions about the cost-effectiveness of osteoporosis prevention. Different methods were discussed when discounting life-years gained. The difference in methods leads to problems in comparing studies. Tosteson, Rosenthal, Melton and Weinstein (1990) stress that the results of the cost-effectiveness analyses are sensitive to subjective side-effects of treatment and discount rate. These two effects could be incorporated into the contingent valuation (CV) method, which is used to measure willingness to pay.

Risk equations have to be determined and a function predicting rate of bone loss is necessary to make predictions about future fracture risk.

Risk neutrality with respect to discounted life years is important for the theoretical model (Johannesson et al., 1994) of QALY (quality-adjusted life years). Jönsson et al. (1995) calculated cost-effectiveness and cost-utility of

treating patients with established osteoporosis to reduce the risk of fracture. Johannesson and Johansson (1995) have measured the value adults charge to an increased survival probability at high ages.

There is evidence that the majority of deaths among Americans under age 65 are preventable, including premature deaths, many injuries and other types of morbidity (Fisher, 1989). Mapping has been performed of 'avoidable deaths' to investigate the impact of preventive procedures (Holland, 1991). Causes of death have been listed (Westerling & Smedby, 1992), that in certain age groups were defined as indicators of the outcome of medical care intervention.

In summing up the discussion above, there evidently is an intriguing relationship between the time dimension and risk dimension. This clearly is an interesting field of research for the future, also with applications to the health area and preventive medicine.

5.6 Individual - societal intertemporal choices

Time discount rates may depend on who is making the judgment. A difference between the values of society and the individual has been reported (Krahn & Gafni,1993).

In the 1930s and 1940s individual preferences were studied. Positive time discounting was then regarded as an unfortunate mistake of human common sense and potentially harmful to social welfare. Rational man was assumed to take no consideration of the time factor in decision making.

Societal choices encompass the values on which judgments are based. The relative value of proximate versus later consumption is then usually defined on a social, as opposed to an individual basis. Another important distinction when it comes to long-term issues is whether the consequences are reversible or irreversible.

With a social frame of reference, judgments are made concerning the proportion of the present resources that should be spent on programs with long-term pay-offs. As reported earlier, very low discount rates have been found with the policy of nuclear waste energy, where Svenson and Karlsson (1989) found that approximately 30 percent did not discount at all, and the mean discount rate was 0.0086 percent.

For future costs and benefits within the health area a discount rate of 5 percent is sometimes assumed. This makes it possible to calculate cost-benefit and cost-effectiveness ratios. In sensitivity analysis of the discount rates the range is usually 0-10 percent. Strangely, as is pointed out by Krahn and Gafni (1993), many cost-effectiveness analyses of health care programs are often insensitive to these discount rates. One explanation presented is that health care programs have a short time perspective compared to other

social programs e.g. within the fields of energy and resource policy. However, an exception to this is that of preventive programs, like for example programs for preventing hyper-tension or hypercholesterolemia. These programs have a time perspective of generations.

The issue whether intertemporal choices for individuals may differ from societal intertemporal choices made by health planners has been discussed by Ganiaths (1994). He considered it as a misconception if policies are not differentiated, but considered as the same. As is pointed out one type of policy is general, population-based, perhaps even legislated. This kind of policy might be based on societal judgments and political opinions. The other type of policy is one developed to assist the clinician with the individual patient. Included in these preferences should be an assessment of the individual's discount rate. Discounting performed by patients, for example when it comes to addictive behavior, also belongs to individual discounting.

The normative rationale for using the same discount rate for health and money are that they are fungible. Chapman (1994) speculates that this condition may be less easily met for individual decisions than for societal decision, suggesting that health and monetary discount rates may be similar for social choices.

Chapman (1994) has also estimated discount rates for the vacation area, and performed comparisons between areas. The analysis indicated domain indepen-dence. Discount rates were largely independent across domains, relative to the reliability within domains. Different discount rates of money and health decisions have earlier been found. The largest between-domain correlation was between health and vacations suggesting that those two temporal domains are more closely related than other possible pairs. The vacation domain was more similar to the health domain than to the monetary domain. A possible explanation presented by Chapman (1994) of this similarity is that good health and vacations both occur at particular points in time and must be 'consumed' when they occur.

5.7 Other theoretical constructs related to health behavior

Additional theoretical constructs related to health behavior are Need for achievement, which has been found to be weakly positively correlated to self-control behavior and delay ability (Atkinson & Feather, 1966; Mischel & Gilligan, 1964). Raynor (1969) postulated that the tendency to achieve success was somewhat related to need for achievement multiplied by all immediate and distant goals added together. This might also be related to type A personality.

Addictive behaviors could also be regarded as bad habits. A Type A behavioral pattern might be considered to be an example of addictive behavior. Type A behavior has been extensively investigated and found to be

slightly related to the incidence of and recovery from coronary artery disease (Friedman & Rosenman, 1974).

Another explanation of health behavior has relied on the concept of lifestyle. An important point made by the Weinstein (1990) is that prevention is most cost-effective when managed as personal lifestyle changes rather than a clinical intervention. Intensive areas for counseling are weight reduction, smoking cessation, prenatal care and prevention of HIV-infection. For these areas an aggressive strategy of behavior change makes sense economically and psychologically.

The problem of changes in behavior has been studied by Sjöberg (e.g. 1993) who gave a summary of the efficiency of different behavior predictors. From this it is evident, that life styles only contribute 0- 5 percent to explained variance of behavior. Also personality variables fail to predict behavior. According to review by Sjöberg explained variance for personality variables varies between 5 and 10 percent (Mischel, 1968) or sometimes slightly more than 10 percent (Tett, Jackson & Rothstein, 1991). It is also clear, that affective or volitional variables are the best predictors of behavior, where risk perception contributes with 10-20 percent, specific attitudes about 50 percent and specific intentions with more than 50 percent.

5.8 Relapse prevention and coping mechanisms

To achieve good results in clinical interventions the prevention of relapse is important. Research has given attention to two aspects of relapse (Logue, 1995):

-relapse prevention
-the effects of relapse on subsequent abstinence.
As most abusers relapse most treatment programs must include methods for coping with relapse.

According to the matching law (Herrnstein, 1974) and the principle of melioration (Herrnstein, 1982, 1990) animals and also humans should be brought to a more rational behavior and given the opportunity to use better alternatives and longer time perspectives. This would induce an improvement in judgment and a behavioral change. Choices are followed by rule-making and different impulse controlling mechanisms. The use of different coping mechanisms to avoid temptation is stressed (e.g. Schelling, 1980); clinicians have described mechanisms used by psychiatric patients (Ainslie, 1986).

Ainslie and Haslam (1992) developed this approach implying that choices are organized into categories yielding information to be used in similar situations. The choice is based upon successive motivational states. These states have some interests in common yielding the long range interests. Short range interests are special interests. Applied to the situation of smoking a long range

interest would be a smoke free life and a good economy, while the short term interest would be the pleasure of smoking.

The processes of self-control are complicated, and do not always lead to rational behavior as people are often guided by short-sighted interests. To be able to neglect the smaller rewards and achieve impulse control Ainslie & Haslam (1992) proposed the use of private side bets. In this way information could be obtained and cues in behavior used to predict future behavior. If this does not give result as a second possibility categories of gratification delaying behavior could be created to be avoided or pursued.

In the study on coping mechanisms (VII) it was found that those trying to quit smoking had tried to quit more often compared to those not trying. This is accordant with results obtained by DiClemente and Prochaska (1982) where those trying to quit had made many attempts before success. The theory behind implies that quitting smoking is a continuous process with frequent relapses.

All the groups became more negative towards smoking especially after day 3. Magneberg (1995) has earlier found that the basic mood of quitters was very low around day 8 and 9. After that they slowly improved in mood. Quitting smoking is, thus, a large problem. The drinkers trying to quit did not sink that low in melancholy.

Pregnant women trying to quit as expected disliked smoking most and the important variable for changing was not trying to quit/trying to quit. Pregnant women being more resolute and certain to succeed was expected, considering their pregnancy.

The two most often used coping strategies implied a diverting strategy, whereas cognitive strategies were less used. Earlier studies (e.g. Sjöberg & Persson, 1979) stressed the importance of proceeding at a slow rate. Loss of control due to extraneous factors might induce relapses.

It is a well-established fact (e.g. Sjöberg, 1980) that groups with varying addictive disorders exhibit somewhat different relapse patterns. For example, one single relapse has a more devastating effect for smokers than for alcoholists. This fact has relevance as to the most efficient use of coping techniques. Therefore, different techniques could be recommended for the different groups.

Another point to be further investigated is the best use of coping techniques at different periods of a an attempt to quit. The impact of the techniques as expected varies with stage of quitting behavior.

Marlatt and Gordon (1985) have stressed the importance of anticipating and developing strategies for coping with temptations to slip or relapse so that a high level of self-efficacy can be maintained for warding off such temptations

in the future. The ex-smoker who has overcome the temptation to smoke feels more confident about such efforts. Therefore, continued abstinence is more likely.

Two important concepts in Shiffman's and Marlatt's cognitive-behavioral approaches to relapse prevention are self-management and self-efficacy expectation. Self-management implies self-regulation and self-control training in which the smokers are taught how to regulate their own behavior and lifestyles to prevent relapse. Self-efficacy expectation is a central construct in Bandura's (1989) social cognitive theory. Self-efficacy is often construed and measured as if it were a stable personal characteristic, but might be dynamic and changing.

Recent research has given evidence that self-efficacy is a powerful determinant of behavioral intentions and of actual behavior. Self-efficacy determines the evaluation of one's personal resources in stressful situations and contributes to behavioral intentions. With strong self-efficacy beliefs people set high goals for themselves and their commitments to engage in the intended behavior becomes firmer.

Most research on the change of detrimental behaviors has been conducted on smoking cessation (Baer & Lichtenstein, 1988). Various authors have found relationships between relapse occurrence, time of relapse and self-efficacy (Condiotti & Lichtenstein, 1981; Colletti, Supnick & Payne, 1985; Wilson, Wallston & King, 1990). Several studies on self-efficacy and non-smoking intentions and behaviors have been conducted within a smoking prevention program with adolescents (Mudde, Kok & Strecher, 1995). The effect of self-efficacy on health behaviors has also been demonstrated in postcoronary patients where recovery of cardiovascular function was enhanced by self-perception of coping resources (Ewart et al., 1983). Self-efficacy also appears to influence health behaviors that contribute to the prevention of AIDS (Mudde, Kok & Strecher, 1995).

Carmody (1992) has stressed the importance of greater emphasis on intervention methods, that have the greatest public health impact, including primary care settings, mass media and with neglected populations, e.g. women, minorities, heavy smokers.

Relapse prevention procedures also need to be tested with women workers, high-risk medical patients and blue-collar workers because the prevalence of smoking is declining at a lower rate in these groups (Pierce et al., 1989). Clinical research in this area has suffered from the underrepresentation of smokers from these segments of the population of smokers. Future research with these groups also needs to focus on identifying modifiable variables associated with long-term abstinence, including self-efficacy and level of commitment.

Summing up, direct and indirect effects, it can be stated that the total effect of self-efficacy on health behaviors probably exceeds the effects of any other single variable.

Finally, a recent new theoretical approach is introduced by Gerkovich et al. (1993) with the concept of telic-paratelic metamotivational states. According to this theory people are mostly in the telic state when they begin their cessation attempt, i.e. oriented towards the goal of being a non-smoker, serious about accomplishing this goal and aware of the possible long-term consequences of continued smoking. If tempted to smoke while in the telic state, people are likely to remember the importance of their long-term goal and be able to resist the temptation. In the paratelic state people are unlikely to think of the long-term consequences of having a cigarette and are, in fact, likely to downplay the significance if smoking.

According to this theory successful identification of consistencies in relapse crises would aid relapse prevention by alerting the ex-smoker to unique vulnerabilities, thereby strengthening his or her ability to institute effective, specific coping strategies. States which appear in pair of opposites are identified. Within each pair, an individual is in one or the other state at all times but never in both at the same time. Ex-smokers should be taught to identify which of the metamotivational pairs is placing them at risk at a given relapse crisis.

The review by Gerkovich et al. (1993) shows that the great majority of the suggested strategies are relevant only to the telic state. Long-term strategies have a seriousness and goal-directedness about them that make them appropriate for the telic state, but they are unlikely to be used or even considered by people in the paratelic state, who simply are not oriented towards the long-term consequences of their behavior.

5.9 Final comments

The present studies (VI-VII) encompassed a time period of 14 days and during that period changes were noted with regard to attitude towards smoking and judgments of events and states as regards value, probability and time. The effect of the time for the events and states to occur seemed, surprisingly, to have the least effect on the judgments.

The time dimension has, however, to an increasing extent been a basic explanation of health-related behavior. The length of the time period has, as discussed above, an impact on time discounting. Longer time periods should preferably be encompassed by a future study. One reason is that within one year most quitters have relapsed. In addition, during that time period different context effects would be considered. Context effects have also been shown to have an impact on time-based judgments with monetary values in studies I-V.

Earlier research (Prochaska & DiClemente, 1986) has described a smoking cessation model related to relapse. Coping mechanisms were related to time and stages. In the present study, a period of two weeks, diverting strategies were more extensively used compared to cognitive strategies.

In clinical work and health education coping mechanisms used could be made to vary with stage of the attempt to quit. This seems to be a promising approach to addictive behavior like smoking, which is very resistent to change.

As is also stressed by Magneberg (1995), risk perception might be a new profitable approach to addiction studies. The present author considers it as especially valuable to continue the studies on addictive behavior with special reference to the relationship between perceived risk and time discounting. This has been a neglected area and probably many of the problems of addictive behavior could be explained by the relationship between these two factors.

In summing up, extensive research remains to be performed on health-related behavior, where the approach of time discounting effects is very promising.

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II

DELAY OF OUTCOME AND PREFERENCE FOR DIFFERENT COURSES OF ACTION

Monica Örtendahl and Lennart Sjöberg

Summary.-In this study the effects of expected delay of reward on preferences for gambling offers were studied. Time, probability and value entered approximately in a multiplicative manner into the final judgment of preference. However, the effects of time were weaker than the effects of probability and value. The effect of time was most often negatively accelerated as a function of physical time. In a developmental study various age groups were compared. There was no difference indicating a preference for smaller and more immediate rewards among the younger children. This was suggested to depend on the use of different judgment strategies in the different age groups. Multidimensional scaling analyses of similarity data for gambling offers resulted in the same dimensions as those functional in the preference data but with different weights.

1 INTRODUCTION

Contents

Extensive research has been carried out on the effects of the value of the outcomes on judgments and decisions. Other characteristics of the decision outcomes which may be important for the decisions have been investigated to a lesser extent. To these belong the time of the outcome. This aspect is of interest in the case of several practical decisions. The choice of a profession is one example, where length of education probably is an important determinant for decision making.

This article deals with the question of how the three factors, delay period, probability, and value, influence choice behavior, with an emphasis on delay period. Delay period is here defined as the time elapsing from the decision to the occurrence of the decision consequences.

The factors of time, probability, and value have been discussed within different fields of research. The fields mainly covered here are those of social learning and decision-making. Social learning is given a rather detailed coverage as investigations emanating from this area of research more explicitly than other fields of research have been based on all the three factors of time, probability, and value as they affect preference for different courses of action.

In social learning research time intervals of up to one month have as a rule been investigated. The task of the subjects has been to choose between a small reward immediately available and a large reward available after some time. In work on decision-making the probability component and the value component have been extensively treated, whereas the time factor seems to have been relatively neglected. Usually the components have been varied in a gambling situation. The responses have been choice preference, rating, and bidding (see Sjöberg, 1968).

Traditional work on learning and also psychoanalysis have also treated the impact of delay periods on delay behavior. These fields of research are, however, only of marginal interest for the purpose of the present study as the interest here is focused on other time intervals than those investigated within these fields of research. (Traditional research in learning has investigated the shortest time intervals,from one or a few seconds and upwards, while psychoanalytic theory deals with the effect of longer time intervals, up to years).

The purpose of this introduction is, thus, to review work on delay behavior carried out under the heading of social learning; methodological comments will be derived from work on decision-making and, in particular, integration of information (e.g. Anderson, 1974). As we shall see, workers in the field of social learning have collected much useful empirical information on delay behavior. However, it will be shown that an improved understanding of this field can be brought about by conceiving of it within the general framework of Anderson's information-integration theory, much in the same spirit as Anderson's penetrating analyses of attitude change (Anderson, 1971) and attribution theory (Anderson, 1974).

2 BACKGROUND

2.1 SOCIAL LEARNING WORK ON DELAY BEHAVIOR

Work on self-imposed delay of reward was inspired by Rotter's theory of social learning (Rotter, 1954). The work has been pursued by Mischel (Mischel, 1958, 1961a, 1961b, 1961c; Mischel & Metzner, 1962; Mischel & Gilligan, 1964; Bandura & Mischel, 1965; Mischel & Staub, 1965; Mischel, 1966; Mischel & Grusec, 1967) and others such as Hunt (1955), Mahrer (1956), Melikian (1959), Grusec (1968), and Klineberg (1968) belong to the tradition which has evolved from Rotter's theory of social learning.

2.1.1 Interaction of Time, Probability, and Value

In this section the importance of a variation in time, probability, and value to judgments and decisions as well as the interactions between these three factors will be treated. It has generally been assumed that the tendency to choose a delayed but greater reward would increase with a shorter time interval,with greater probability that the reward will materialize and with increased value of the reward.

The influence of the time factor on expectancy has been pointed out by Cohen (1970), implying that a longer time interval yields an experienced, lower probability for the occurrence of the outcome. Cohen has also taken an interest in how probabilities of multi-stage situations are estimated. In a couple of investigations, Cohen (1971) and Cohen, Chesnick and Haran (1972) found compound probabilities overestimated. The degree of overestimation increased with the number of stages. Hence, the overestimation was greater in later stages. Cohen consequently implied that the probabilities for separate events will be underestimated whenever they occur on a later occasion, whereas the probability of events occurring in a sequence would be overestimated, especially when events occurring later are concerned. This would imply that different bases of explanation will have to be employed for probability estimation of separate events and sequential events.

A theoretical frame of reference which might suggest a preliminary starting-point could therefore be illustrated as follows. An important problem in connection with the evaluation of this starting-point is whether the time factor can have a direct effect on the decisions or whether the effect comes about via the two factors probability and value. Some investigations have primarily concentrated on the value of the reward (Grusec, 1968) and the length of the delay period (Mischel & Metzner, 1962; Mischel & Grusec, 1967). Others emphasize expectancy as the important factor (Hunt, 1955; Mahrer, 1956; Mischel, 1961a, 1961c; Mischel & Staub, 1965). Effects in the expected directions were usually found in these studies.

TIME

PROBABILITY

VALUE

JUDGMENTS
and
DECISIONS

Figure 1. Interacting factors accounting for judgments and decisions

The theory which Rotter outlined distinguished only between expectancy of reward and the value of the particular reward. Rotter (1954, p. 107) defined these two terms in the following way:" The reinforcement value of any external reinforcement may be ideally defined as the degree of preference for any reinforcement to occur if the possibilities of their occurring were all equal." Expectancy may be defined as the probability held by the individual that a particular reinforcement will occur as a function of a specific behavior on his part in a specific situation or situations.

Perhaps due to this theoretical preconception, results which indicate the significance of the length of the time interval have tentatively been explained by referring to other factors, notably expectancy. The time interval thus is assumed to exert indirect influence via expectancy and value. For example, the correlation which Mischel and Metzner (1962) found between time interval and choice preference was explained by such other factors which were assumed to be more important to choice behavior.

Objections against stress on time interval as having a direct effect have come from other sources as well (Mischel & Staub, 1965). The objection of Mischel and Staub to investigations that claim to have established a certain importance of time interval was that the conditions for obtaining greater rewards usually imply more than just a period of waiting. This is why they consider instrumental activity in the delay period as an important variable. This is especially true of situations where the waiting is unpleasant or where one has little trust in the person who has promised the reward (Mischel, 1958).

Further support for the objections raised against the direct importance of time interval can be found in a thesis by Brackbill and Kappy (1962) mentioned in a survey by Renner (1964). Brackbill and Kappy argued that the time interval itself will have no effects. An effect will be produced by presenting certain cues during the interval. Examples of cues which may have this linking function are verbalization (Brackbill & Kappy, 1962) and goal orientation (Erickson & Lipsitt, 1960). Renner (1964), however, criticized cues as a basis for explanation, as cues may have other effects and may even produce competing responses.

Mahrer (1956) probably is the one who has laid most stress on the expectancy factor. In his investigation he developed different levels of expectancy for the occurrence of delayed rewards to determine whether corresponding changes in preference would be obtained. He found a change of preference as a function of expectancy. Mahrer drew the conclusion that one can increase the efficiency of rewards and punishments rather by increasing expectancy that the delayed rewards will materialize than by reducing the time interval. This will have to be considered rather a loose assumption, as units like time, expectancy, and value are not transformable. The consequence is that one cannot determine which factor is the most decisive with regard to preference.

The investigations accounted for above, have all treated the question of whether the time factor affects the decisions directly or indirectly via a change in the probability factor or in the value factor. Throughout these investigations, the importance of the time factor has been explained via a change in the two other factors.

However, there are also indications that different types of choice situations are affected in different ways by the time factor. A few investigations have tried to clarify such differences as an effect of the time factor. Mischel and Grusec (1967) obtained results which indicated a difference between the effect of time interval on punishment choices and reward choices. More immediate rewards were chosen with an increased time interval, while the time interval had no effect on the punishment choices. This was in opposition to Grusec's results (1968), showing that the time interval had a similar effect on reward choices and punishment choices. It has, furthermore, been found that there is no correlation (over individuals) between choices of reward and punishment (Mischel & Grusec, 1967; Grusec, 1968), which has been taken as support for the opinion that the ability to delay is not a unitary trait and that choices of reward and punishment may be affected by different experiences of learning.

Some previous investigations have also tried to explain individual variations in the ability to delay rewards. One factor that may be bound to expectancy is the individual's time notion. The length of future time perspective (Mischel & Metzner, 1962), the reality connections in notions about personal future events (Klineberg, 1968), accuracy in the recall of the time of a past event (Mischel, 1961c), and the degree of one's involvement with future events rather than with present events (Klineberg, 1968), are all included within the notion of time. Correct time notions in these investigations have been positively correlated with ability to choose greater, delayed rewards as opposed to smaller, immediately obtainable rewards. Mischel (1966) suggested that individuals who might, on account of previous experiences, expect that delayed rewards are difficult to obtain, will react differently than those who expect them to be easy to obtain. Those who have learned that delayed rewards will very likely be obtained will react on the delay

with greater hopefulness. Those individuals who from previous experiences have low trust, on the other hand, consider the probability of rewards really occurring as small.

We now turn to the possible influence of the value factor on delay behavior. The theoretical explanations, stressing value as the important factor in choice, are based on the fact that the value of the reward decreases with a time delay. The efficiency of learning will become less with a lower reward value, and this would give a preference for immediate rewards (Mahrer, 1956). What else can achieve a change in the value of the reward? The number of reinforcements following a choice of a certain goal object would, according to results obtained by Hunt (1955), be a factor capable of achieving a change in the value of the reward. According to this explanation, a change in the reward value would come about with a variation in the number of reinforcements. Whether reinforcement at all occurs or not has, on the other hand, been considered to produce an effect on expectancy in a similar succeeding situation (Jessor, 1954). Reversing the causal direction, a longer time interval could decrease expectancy and thereby value.

Interest has in many investigations focused on relations between value and probability. These studies fall somewhat outside research on delay of outcome, but some of them have nevertheless been included here as usually an indirect effect of time via probability and value has been supposed. A more complete account is given by Lee (1971).

Correlations between expectancy and value have thus been found. Feather (1959) found that unattainability, i.e., experienced low probability of obtaining a positive outcome in certain situations, increased the desirability for the outcome, i.e., its value. This correlation was true only for such situations which were not ego-related, i.e., a situation in which success or failure cannot be connected with the efforts and the skill in the individual. Furthermore, these situations were not achievement-oriented. There was no pressure to do things well. In the situations which were ego-related and achievement-oriented the opposite result was obtained, i.e., unobtainability decreased the value of the reward.

An unobtainable, positive goal may be experienced as being still more attractive on account of its very unobtainability. However, after having for some time experienced this unobtainability, processes may appear which have the effect of one's tending to depreciate the value of the unobtainable reward (Mischel,1966).

Hence, it appears that an experienced low probability for the occurrence of the reward in situations that are not ego-related and not achievement-oriented yields an increased value of the reward. In ego-related and achievement-oriented situations experienced low probability yields decreased value. It would therefore be feasible to suppose that

low trust would yield experienced increased value of the reward in the first situation. In the second situation low trust would yield an experienced decreased value of the reward.

It is possible not only to vary the value of the reward depending on a variation in expectancy of obtaining the reward but an opposite effect has also been found: the desirability of the outcome influenced the subjective probability of obtaining the goal (Marks, 1951; Worell, 1956). A highly valued goal would, thus, have a low expectancy of attainment. Worell (1956), however, found also that the introduction of punishments for incorrect judgments achieved a somewhat more realistic notion of the probability of obtaining a reward.

2.1.2 An Information Integration Approach to Delay Behavior

Some of the social learning hypotheses yield to an information integration approach; other hypotheses do not. We now introduce a preliminary interpretation of information integration of delay behavior.

A choice option can be specified by a certain subjective value (U_i), subjective probability of attainment (Ψ_j), and subjective delay period (τ_k). The utility of the option may be designated as U_{ijk} and it is suggested that

$$U_{ijkm} = f(U_i \Psi_j \tau_k) + e_{ijkm} \qquad (1)$$

where the index m refers to replications over time, carrying a random response error. Now it is of great advantage to assume context invariance (Sjöberg,1966), thus specifying that, say, a given objective value always gives rise to the same U_i regardless of probability of attainment and delay period. Likewise, we assume context invariance of subjective probability (Ψ_j) and subjective time (τ_k). The U's, Ψ's, and τ's are subjective scale values, that may or may not be linearly related to their objective counterparts. They may, under certain conditions, be estimated from choice data.

We need also specify the combination rule. Linear averaging and multiplicative (log linear) models are common. If a hypothesized model fits (it may be tested against estimates of random error), it may be used to estimate scale values.

Let us return to the social learning studies. First, we shall be concerned only with effects of time as expected before the delay actually occurs. That is, expected "cues" are of interest here but not actual ones. Several notions are easily absorbed then within the information-integration framework. The scale value of time may well be affected by such

factors as expected events in the delay period, punishment vs reward, time concepts (which may, e.g. affect the over-all weight given to time), and previous experience of positive outcome following long delays. These effects, thus, in no way speak against a direct effect of time scale values, but the properties of those scale values may need further analysis (of no immediate interest here).

Other hypothesized phenomena are harder to deal with because they involve a rejection of context invariance. This is true of suggested effects on value of time (directly or via expectancy) and, of course, of value-expectancy interactions generally. We submit however, that the existence of such interaction should be subjected to empirical tests with the approach of information integration. If they exist and are strong enough to be of importance revised models will be called for.

Typical social learning studies are too little informative to allow a clear-cut decision to be made on the question of context invariance (not to speak of scale values and the combination rule). True, suggestive information as to the bases of subjective time, expectancy, and value has been obtained. However, pairwise choices among immediate small rewards and delayed longer rewards are simply insufficient to decide the issue of context invariance. Several values, probabilities, and delay periods should be combined and preference data should then be obtained for all those combinations. Such data, then, allow for adequate tests of context invariance and rule of combination as well as estimates of scale values.

Consider a choice between obtaining $1 today or $10 next week. If a person chooses $1 today this may be explained in many ways. The following subjective entities are useful:

U($1) and U($10): utilities ,
Ψ($1) and Ψ($10): subjective probabilities,
τ (1 day) and τ(7 days): subjective times.

For simplicity, assume that the utility of a choice option is

over-all utility = utility of outcome
+ subjective probability - subjective time.

Choices are assumed to reflect the difference:

$$U(\$1) + p(\$1) - \tau(1\text{ day}) - U(\$10) - p(\$10) + \tau(7\text{ days}).$$

Now, perhaps,

τ(1 day) = τ(7 days) = 0

but

$\Psi = f(\tau)$ so that

$\Psi(\$1) > \Psi(\$10)$

and

$\Psi(\$1) - \Psi(\$10) > U(\$10) - U(\$1)$.

This is the major social learning explanation of the effect of the time factor. But the data do not allow for differentiating it from the quite common-sensical idea that

$\Psi(\$1) = \Psi(\$10) = 1$

and

Ψ (1 day) > Ψ (7 days)

(it is nice not to have to wait, but promises are believed).

In similar ways, it may be shown that social learning designs in general are not informative enough to allow for the rejection of alternative hypotheses. An approach richer in information both on the data and the analysis sides is therefore called for. Information integration theory and functional measure-ment provide such a framework.

2.1.3 Correlates of Delay Behavior

So far we have been following the outlines of the relations between the variables of time, probability, and value. Another important question is the effect of a variation in time, probability, and value, compared to the effect of a variation in other more indirect factors. Some indirect factors treated briefly in this review are influence of social models, situation factors, and personality characteristics. Our objective has been to describe the relation as shown in Fig. 2. The discussion is based on this frame of reference. From the figure can be deduced that social models, situation factors, and personality characteristics are supposed to work out their effect via a change in the factors of time, probability, and value.

SOCIAL MODELS	TIME	JUDGMENTS
SITUATION FACTORS	PROBABILITY	and
PERSONALITY CHARACTERISTICS	VALUE	DECISIONS

Figure 2. Correlates to delay behavior: an outline of a frame of reference

The influence of social models.- One factor which has been investigated in connection with delay behavior is the influence of social models. In studies by Bandura and Kupers (1964), Bandura and Mischel (1965), Bandura and Whalen (1966), and Mischel and Lichert (1966), the delay by self-control of rewards was not only obtained by direct reinforcement but also by exhibited delay behavior in social models.

The investigations on social influence have probably been based on the two-stage influence described above. This is not, however, explicitly mentioned in these studies.

General or specific behavior. - Another problem which has been given a tentative focus in connection with the appropriation of delay behavior is whether this behavior is a stable, general, and uncomplicated kind of behavior or whether it is an easily influenced one and varies with different situations. Some workers have considered choice to be a function of specific situation factors (Mischel & Staub, 1965). Others, however, have tried giving an explanation of choice on the basis of more stable personality characteristics (Block & Martin, 1955).

Variation along a continuum or extremes of a continuum. - Another problem is whether delay behavior varies along a continuum or solely constitutes the extremes of the scale. From the point of view of social learning theory the distinction between delayed and immediate behavior is considered as an "either-or" phenomenon. This may be due to the fact that in the investigations based on social learning theory, the experimental situation has frequently been planned as a choice between two alternatives, those of greater, delayed reward and smaller, immediate reward. Consequently the choice will be considered a function of two different behavior clusters, where one type of behavior is characterized by different properties as for instance, a sense of responsibility, ability to distinguish correct time notions and ego strength, while the other behavior is characterized by the opposite personality traits.

In these investigations where the individual has been placed in a situation of two alternatives of choice, preference found for any one alternative action has sometimes been explained on the basis of variation in some of the personality traits mentioned. Results obtained from investigations of risk taking have previously (Wallach & Kogan, 1965) been tentatively explained on the basis of different personality characteristics, which in the same way as the above-mentioned traits are indirectly correlated with the actual process of judgment and decision. Sjöberg (1978), however, yields an explanation of previously obtained results in investigations on risk taking to the effect that the willingness in individuals to take risks may be explained on the basis of a more fundamental variation in the factors of value, subjective loss, and subjective probability. It seems also possible to explain, in a similar way, the results obtained from investigations on preference for different alternative actions, varying in time, probability, and value more directly due to variation in these factors.

Mischel seems to have based his investigations on the tacit assumption of two different behavior patterns. One example of this is given in his test of the difference in delay behavior between children whose fathers were at home and children whose fathers were not (Mischel, 1961b).

It seems highly likely that delay behavior depends on value, probability, and time. Even a subject very prone to prefer the most immediate reward can, probably, be made to exhibit "ability to delay" if the delayed reward is made large enough and the time period small enough. Investigating the rule of combination and the relative dynamic ranges of the three kinds of scale value is more informative than using a necessarily arbitrary operational definition of ability to delay.

2.1.4 Recent Research in Social Learning

The most recent social learning research is based on an assumed two-stage delay process in which the choice of a course of action constitutes the first stage and the second stage the very sustenance of the delay. This second stage where the conditions for a successful maintenance of delay periods are investigated seems to attract an increasing interest and a review of this research was given by Mischel (1974). In addition, the relationship between cultural factors and delayed gratification has recently been investigated (Gallimore, Weiss & Finney, 1974).

Delay behavior has also been reviewed by Lefcourt (1973) with special reference to the connection between locus of control and delay processes. A distinction is made between internal and external control and a relationship is assumed between internal

control and delayed behavior. The relationship between locus of control and delay behavior has also been investigated by Mischel, Zeiss and Zeiss (1974).

The basic process with the factors probability, value, and time of the outcome has not been treated in the two mentioned reviews. Instead, the main stress is, as was pointed out above, on different correlates to this process and the conditions for effective control of the delay period.

2.1.5 Conclusions of Reviewed Research and Plans for Empirical Work

Social learning research has attempted to determine how the factors of time, probability, and value interact with one another as regards preference for different courses of action. Research has first and foremost focused on probability and value, whereas the time factor often has been supposed to exert indirect influence via the probability factor or the value factor. Also, influence of exhibited behavior from others, so-called social models, in choice of courses of action has been treated. Other problems under consideration are whether choice preference is a stable personality characteristic or a behavior varying with different situations and whether the behavior constitutes the extremes of a continuum or varies along the whole scale.

In order to investigate the influence of time on delay behavior, e.g. exhibited in preference data, there is a need to proceed to the use of more powerful methods, such as those offered by functional measurement. The plan of the present empirical studies was to do so, and to start with basic model testing experiments, followed up by a developmental study.

3 STUDY 1

A principal issue is whether a linear or a non-linear model best describes the way in which information from the components of time, probability, and value is combined. It was hypothesized that time of outcome would influence judgment and decisions and that these processes might be described by a linear model.

This hypothesis may be tested by a research design where individuals rate the favorableness of different combinations of probability and value, and into which time is introduced as a further determinant of the judgment. In the present study lotteries varying in these three factors were rated as to perceived favorableness. This design made it possible to test rules for integration on the basis of these factors and to get information about the psychophysical relations for time, probability, and value.

A suitable method for this analysis is functional measurement (Anderson, 1970). This method works in two steps: (a) testing which model best describes the integration behavior and (b) stimulus scaling on the basis of the established model equation.

3.1 Model Analysis

Two main models were tested, one multiplicative (referred to as Model 1) and one additive (referred to as Model 2).

The testing of Model I was based on the assumption of a power function relating the objective and subjective scales. In some investigations this relation has obtained empirical support for value (Tversky, 1967b). For the probability component the empirical results are somewhat uncertain as to which function best describes the relation. In the present study a power function was assumed. For the relation between objective and subjective time a power function was obtained by Lundberg and Ekman (1973).

Power functions are flexible, analytically attractive to work with, and very well known as psychophysical functions in a great number of continua. Therefore, it seems justifiable to try power functions as a first approximation of possible practical value in the present context; a more explorative approach to the subjective scale values being less powerful for model testing and also of interest mostly when the scale values are in the focus of interest.

The multiplicative model was tested both in log form (Model Ia) and in raw form (Model Ib). In the log form test the least squares were computed on log R est - log R obs., but on R est - R obs for the test on raw data.

A comparison between the multiplicative model in log form and in raw form indicates how the parameters are influenced by minimizing the squared deviances on log data or on raw data. This yields an estimation of the robustness of the multiplicative model.

A comparison between the multiplicative model in raw form (1b) and the additive model in raw form (2) indicates whether the deviance is larger on a multiplicative or an additive model.

In many instances of decision research the multiplicative SEU-model has been found to give a good description of the judgment processes based on the factors of probability and value. One example of another study where a multiplicative combination of

probability and value obtained empirical support is the one by Anderson and Shanteau (1970). In the SEU-model the favorableness of different courses of action is made up of the sum of the utility of the outcome, weighted with the subjective probabilities:

$$U = \Psi_1 U(\$)_1 + \Psi_2 U(\$)_2 + ... + \Psi_n U(\$)_n \quad (2)$$

where U denotes the favorableness of a course of action, Ψ_1 subjective probability and $U(\$)_1$, the utility of an outcome.

A multiplicative integration process based on time of outcome as an additional factor can then he expressed:

$$U = \tau_1 \Psi_1 U(\$)_1 + \tau_2 \Psi_2 U(\$)_2 + ... + \tau_n \Psi_n U(\$)_n \quad (3)$$

where τ_1 = subjective time. The model will be symbolized SEU_t, to distinguish it from the SEU-model which disregards time effects.

This model has a drawback as the exponent of time is somewhat difficult to interpret psychologically. One advantage of the model, however, is that the goodness of fit can readily be tested. Another alternative model which gives an easier interpretation of subjective time but which is disadvantageous from an analytical point of view is:

$$U = \Psi\, U(\$)\, (1 - \gamma)^t \quad (4)$$

where γ is discounting per each hour and t is objective time. This will be referred to as Model 3. In this model γ is a parameter term. Taking logarithms of both sides of the equation would give the following expression for the time factor: t log $(1 - \gamma)$. This means the logarithm of an unknown value, and this model could therefore not be analyzed in the same way as the other models. It will, however, be analyzed parenthetically to test if discrepancies are obtained in the parameter values of time between this model and Model Ia.

In Model 3, if subjective probability is a linear function of objective probability, utility of money is a linear function of the value of money, and the utility of an outcome is not discounted by time, then: the exponent for probability = 1, the exponent for value = 1, and γ = 0. The general model is then reduced to

$$U = p^1 \times v^1 \times (1-0)^t \quad (5)$$

that is,

$$U = p \times v. \quad (6)$$

This is recognized as the common EV-model.

The multiplicative model has substantial empirical support, but in some studies it has been found that an additive model makes good predictions of the integration of information from the factors of value and probability of outcome. Some studies where this additive combination has been found are Sjöberg (1968), Slovic and Lichtenstein (1968), and Shanteau (1970). If the information from the factors of time of outcome, probability of outcome and value of outcome are added the model becomes (referred to as Model 2):

$$U = \tau_1 + \Psi_1 + U(\$)_1 + \tau_2 + \Psi_2 + U(\$)_2 + ... + \tau_n + \Psi_n + U(\$)_n \quad (7)$$

The present experiment thus tests the fit of an additive and a multiplicative model to response data. The additive model can be tested on the original scores. The multiplicative model will be log transformed to be tested in a linear form (1a):

$$\log u \; a \log t_1 + b \log p_1 + c \log v_1 + + a \log t_n + b \log p_n + c \log v_n \quad (8)$$

where a, b, c are the regression coefficients of time, probability, and value, in successive order. The variables t, p, v are objective time, probability, and value.

The multiplicative model will also, for the purposes mentioned above, be tested in raw form (1b).

Both Models Ia and 2 predict no interaction between the components.

This assumption, with some exceptions, generally agrees with the results on value and probability summarized, e.g. in a review by Lee (1971). These models must be considered, however, as preliminary for the combinatory rules for time of outcome with probability and value have not yet been investigated.

A summary of proposed models is given in Table 1.

Table 1

Summary of proposed models for integrating value, probability and time

Model Verbal label	Equation	
1	3	Multiplicative
2	7	Additive
3	4	Discounting

3.2 Model Testing

The models will he tested by the method of functional measurement. The method used for testing the model equation has usually been analysis of variance in functional measurement. The regular use of analysis of variance is based on a factorial design (e.g. Anderson, 1970, 1974). A complete factorial design, however, is disadvantageous because it is impractical in many experimental situations. It would therefore have to be considered of importance if the models could be tested and the subjective values obtained from an incomplete design. In some studies a fractional replication design has been found applicable to an analysis of variance. This sort of incomplete design, however, assumes that the higher-order interactions are of small importance.

Another kind of incomplete design is a Latin square design, that is inappropriate for an analysis of variance because the higher-order and lower-order inter-actions would be confused. If two of the independent variables are held constant the variation in the third variable is lost when using a Latin square design. If this kind of incomplete design is used, a different method of analysis for testing the model equation is required.

A multiple regression analysis is adequate for testing linearity as both analysis of variance and multiple regression analysis are alternatives of the same linear model. Regression analysis in information integration tasks has been commonly used to yield a correlation coefficient as a test of goodness of fit. This has been criticized (Anderson, 1969, 1972; Birnbaum, 1973) as a multiple linear regression can yield a high correlation coefficient between the predictor and the criterion variable although interactions are found with an analysis of variance. Multiple regression could, however, be used to solve problems for which analysis of variance has been traditionally used (Draper & Smith, 1966, pp. 67-69; Cohen, 1968). This approach has been described by Sjöberg (1971). The method is based on the allocation of the residual sum of squares between lack of fit and pure error. The pure error sum of squares is the measure of the

variabilitity within one cell in the Latin square design, in the present analysis the variability across trials for each subject as the models were tested on individual data.

The F tests were used for two purposes. The first was to test goodness of fit of an additive and a multiplicative model. The F ratio for testing of interactions was computed and lack of fit was tested against pure error. The null hypothesis was that there were no interactions. The second purpose was to test improvement of fit when a larger number of parameters was estimated. The multiplicative model EV was first tested and the SEV, EU, and SEU models were tested by successively introducing an increasing number of parameters. In the final test of the SEU model time was assumed to combine with probability and value in a multiplicative way. In this analysis the difference in variance accounted for between two models was tested against the variance due to pure error. The null hypothesis was that there would be no improvement.

A condition for the F tests is normal distribution of the dependent variable and homogeneity of variances. The F test is, however, fairly robust even though these conditions are not fulfilled (Cohen, 1968).

One disadvantage of using multiple regression analysis is that the beta weights are constant within source of information, while the regular use of functional measurement gives information of differential weighting within one stimulus dimension. This drawback, however, was felt to be of minor importance for the purposes of the present study.

3.3 Method

Preference judgments.- Offers to buy tickets in lotteries were rated as to perceived favorableness. The stake was constant: 50 öre (about 10 cents). The lotteries were defined through a specification of the three variables: time of outcome, probability of outcome, and value of outcome.
The times: 1 hr., 1 day, 1 wk., 2 wk.
The probabilities: 0.05, 0.15, 0.50, 0.95.
The prizes: 1:-, 2:-, 4:-, 7:- Sw.Crs.
A Latin square design to combine times, probabilities and values gave the 16 lotteries described in Table 2.

Table 2

Sixteen lotteries of study 1

	Value			
p	1:-	2:-	4:-	7:-
0.05	a*	h	c	d
0.15	d	c	b	a
0.50	b	a	d	c
0.95	c	d	a	h

*a = 1 hr.; b =1 day; c = 1wk.; d = 2 wk.

Magnitude estimation was used as a rating scale in the present study. A further experiment is devoted to a test of the relations among different types of rating scales.

Each subject made 10 X 16 preference ratings. There was a random order of presentation and the positions of the three variables of time, probability, and value were rotated within subjects. The presentation order of the variable and standard stimulus was randomized. The standard was selected from the middle of the range of stimuli (time: 1 hr.; probability: 0.50; value: 2:-).

The standard stimulus was assigned the number 10. The number was written to the right, beside the standard stimulus. The subjects were asked to give a number reflecting the relation between the standard and the variable stimulus. They were free to use any number. The standard was presented with every variable stimulus.

The experiment was performed in a seminar room, with all 10 subjects present at the same time. The offers were presented on sheets of paper, about 18 offers on every sheet. The variables of time, probability, and value were explained. The probability variable was illustrated for each subject by means of four pie diagrams showing the four different probabilities. Information was given about the range of stimulus values.

There was a real lottery situation and the subjects were informed of this. In this experiment the subjects were allowed to buy five lottery tickets selected from 10 lotteries chosen at random. The five lotteries rated most favorable were chosen to be played on. Subjects were also encouraged to express their personal feelings about the offers and to rate them in an absolute manner.

After the instructions ten practice trials were given. The practice trials formed a representative sample of the stimuli used in the experiment.

The subjects were students of educational psychology, aged from 24 to 29 yr. Ten subjects participated on the first occasion with preference ratings, five men and five women. The experiment lasted about 60 min.

3.4 Results

Preference ratings.- The median reliability of the preference ratings was 0.91. The reliability was computed in the same way as in the study by Gabrielsson (1973) on multidimensional scaling of auditory rhythms. See also Winer (1962, p. 124). This means that the reliability =

$$1 - (R + RS)/S$$

where

R is mean square for replications
RS is mean square for replications and stimuli, and
S is mean square for stimuli.

Table 3
F tests resulting from analysis from analysis of multiplicative model in log form

Subject No.	Goodness of fit tests EV SEV EU SEU SEU_t				
1	9.14**	9.69**	7.34**	7.76**	2.96**
2	4.61**	4.82**	1.24	1.21	1.27
3	14.04**	13.08**	12.81**	11.67**	2.07*
4	3.09**	3.30**	3.30**	1.64	1.52
5		2.49**	3.30**	0.34	0.35
6	3.52**	2.27*	3.25**	1.88*	1.91*
7	6.89**	5.03**	4.83**	3.53**	3.72**
8	1.38	1.28	1.40	1.29	0.99
9	22.29**	10.12**	15.47**	1.82	1.88
10	6.00**	6.00**	6.25**	6.25**	6.00**

a Based on 15 and 144df ; b Based on 14 and 144 df; c Based on 14 and 144 df; d Based on 13 and 144 df; e Based on 12 and 144 df
*p = 0.05. **p = 0.01.

When no F ratio is reported the sum of squares of deviation from the regression exceeds the total sum of squares.

All the models were tested on days of 16 hr. The tests of fit of the multiplicative model in log form are summarized in Tables 3 and 4. See Note 2

.

Table 4

F tests resulting from analysis of multiplicative model in log form.

	Improvement tests		
Subject No.	SEU vs SEVa	SEU vs EUb	SEU_t vs SEU c
1	5.44*	0.30	10.24**
2	10.30**	0.36	0.07
3	8.98**	7.91**	36.44**
4	0.08	11.13**	0.14
5	21.99**	30.30**	0.15
6	2.65	7.55**	0.54
7	13.73**	8.37**	0.47
8	0.59	1.57	2.71
9	25.79**	42.08**	0.17
10	0.09	0.12	0.20

a Based on 1 and 144 df; b Based on 1 and 144 df; c Based on 1 and 144 df.
*p = 0.05. **p = 0.01.

As zeros cannot be tested in log form, zero ratings were transformed to 0.001. This applies to all F tests of the preference ratings. As a control the arithmetic mean of the ratings of a stimulus (except zero ratings) was treated as a rating instead of the zero ratings found for Subjects 4-8. For three subjects the analysis of the multiplicative model in log form gave no difference in fit. For two subjects, Nos. 5 and 8, the analysis based on the inserted arithmetic means yielded a result different from the analysis based on the 0.001 transformations. These subjects exhibited significant lack of fit for the analysis based on the inserted arithmetic means, while good fit to the data was obtained when the 0.001 transformations were the numerical base for these two subjects. This throws some doubt on the zero ratings, but as the 0.001 transformations were more close to these zero ratings the report will be based on these results. Table 5 gives the result of the goodness of fit test of the multiplicative model on raw data and the additive model on raw data. The multiplicative model on raw data showed significantly bad fit in 5 of 10 tests and the fit of the additive model on raw data is significantly bad in most cases, 9 of 10.

The exponents in Table 6 are based on the multiplicative model in log form. This model showed better fit than the additive model on raw data and about as good a fit as the multiplicative model in raw form. The exponents of the SEU_t model in log form could also be given some substantive meaning, why these were chosen to be reported. The exponents varied considerably between different subjects, mostly for probability and value, but also for time.

The multiplicative model with time interpreted as a direct discounting factor was tested for each subject on the arithmetic means of the ten ratings for every stimulus. The size of the time values derived from this model had about the same rank order as those above. The Spearman rank-order correlation between the time values derived from the two models was 0.28. The result of two subjects gave a large deviation. Without these two subjects the correlation was 0.64.The testings of this model also gave an idea of which stimulus combinations deviated most from the assumed model. A difference of more than 3.0 points between predicted response and obtained response was noted. This gave notable deviations for three stimuli.

Stimulus No.3	time: 1 day	probability: 0.50	value: 1:-
Stimulus No.12	time: 1 hr.	probability: 0.95	value: 4: -
Stimulus No.16	time: 1 day	probability: 0.95	value: 7:-

Table 5

F tests resulting from analysis of multiplicative model on raw data and additive model on raw data

	Godness of fit tests	
Subject No.	Multiplicative model on raw data c	Additive model on raw data b
1	1.70	8.05**
2	0.79	5.32**
3	0.35	10.65**
4	3.82**	9.45**
5	1.64	1.64
6	0.20**	34.12**
7	0.77	9.74**
8	9.52**	73.43**
9	1.91*	8.61**
10	2.88**	33.24**

a Based on 12 and 144 df; b Based on 12 and 144 df.

*p = 0.05. **p = 0.01.

Table 6

Exponents of time, probability, and value based on SEU_t model in log from and discounting per hour based on model 3

	Exponents			Discounting
Subject No.	Time	Probability	Value	Time(Model 3)
1	-0.16	0.95	0.66	-0.0021
2	-0.01	0.95	0.55	-0.0004
3	-0.56	1.49	0.19	-0.1294
4	-0.04	1.60	1.08	0.0010
5	0.02	0.54	0.40	-0.0001
6	0.07	1.49	1.45	-0.0016
7	0.09	1.73	2.45	-0.0027
8	-0.15	1.22	1.21	-0.0034
9	-0.0	0.60	0.52	-0.0004
10	-0.02	1.03	1.05	-0.0001

3.5 Discussion

The results of the experiment gave some support for a multiplicative combination of probability, value, and time of outcome. Eight of 10 subjects integrated the information according to either the SEU model, the SEU_t model on log data, or the SEU_t model on raw data. For one of these eight subjects the SEUt model showed a significantly bad fit while the SEU model fitted the data. This is due to the fact that the number of degrees of freedom is smaller for the F ratio computed for the SEU_t model. The additive model on raw data yielded a significantly bad fit to data in most cases (9 of 10).

The additive model on raw data could thus be ruled out for this sample of subjects while a multiplicative algebraic rule for processing the information in most cases could be applied to the data.

To the degree that the SEU_t model could describe the judgment process the exponents of the variables could be regarded as valid. Considerable care should be taken when interpreting these exponents. A comparison between exponents of different factors is not adequate (see Darlington, 1968) as the variables have different ranges of variation. In this context criticism could he directed toward the investigation by Slovic and Lichtenstein (1968) which tried to assess the relative importance of value and

probability for decisions. Probability is, in most cases, and in the study by Slovic and Lichtenstein, included with a large range. This gives a large coefficient for probability. In the present study, therefore, the exponents for one variable were only compared between different subjects. The exponents showed large inter-individual differences, especially for probability and value. This result is also in accord with earlier studies (Sjöberg, 1968; Slovic & Lichtenstein, 1968; Anderson & Shanteau, 1970). The exponent for value was for five subjects < 1.00 which agrees with the notion of decreasing marginal utility. For five subjects the exponent was > 1.00. The exponent for probability for some subjects was also < 1.00 and for some > 1.00. The result obtained for the probability exponents should not be stressed too much. The reason is that the probabilities chosen were 0.05, 0.15, 0.50, and 0.95. That makes it difficult to determine the function for the upper half of the continuum, between the two points 0.50 and 0.95. Also, the probability is not restricted to add to 1.

A slight tendency for larger exponents on log data was found, which might indicate that the model is somewhat sensitive to transformations in the scale.

Exponents for time obtained by the multiplicative model SEU_t showed that time for most subjects had a small exponent. The alternative model where the influence of time in a more direct psychological sense could be interpreted as a discounting factor yielded about the same rank order of the sizes of the exponents. That gives a validation of the interpretation of the time effect in the SEU_t model.

The time values of the "discounting model" may be commented upon as they can be expressed as a percentage of the payoff that is discounted per hour. One subject showed a strong discounting effect of 13% per hour. This means for example that after one week the utility of the money is none for this subject. Moderate discounting effects are found for all subjects but one. If this tendency is general also for large sums of money these subjects could not be regarded as ideal bank customers.

The present study also gave information about the improvement of fit when proceeding from a strong to a weak model. One advantage of functional measurement is that the basis is not a normative but a descriptive one. In this study no empirical evidence was found for the parameter free model EV. Neither could any support be found for the weaker models EU or SEV. The improvement of fit was as large for introducing the parameter for value as for probability. The strong evidence for the weakest model SEU is in agreement with earlier studies in decision making (e.g. Coombs, Bezembinder & Goode, 1967; Tversky, 1967a, 1967b).

In summing up, it seems fair to say that the present study gives some support to the usefulness of the regression analysis approach when studying the effect of time on the judgment process. Also, time appeared to affect preference directly, entering in a multiplicative manner. Further analysis of the generality of these findings across different response modes is, however, called for.

4 STUDY 2

There has been extensive research on relations among scales obtained from stimuli varying in one attribute. These attempts to estimate sensory magnitudes have generally found non-linear relations between different methods of judgment. For reviews, see, for example, Ekman and Sjöberg (1965) and Stevens (1971). Relations between different methods in tasks with stimuli varying in several attributes have also been investigated in recent years but to a lesser extent.

One area of research where the scaling problem is fundamental is information integration theory. Different methods of rating have been used in studies on information integration and many of them have relied on category ratings. Earlier studies, however, have shown that these category scales generally are non-linearly related to magnitude estimation scales, and that the relation between these two scales is approximately logarithmic (see Ekman & Sjöberg, 1965).

Later investigations in which scales have been compared have obtained somewhat varying results. Weiss (1972) obtained a non-linear relation between graphic ratings and magnitude estimations, when the task was to rate average greyness. The relation between these scales was linear when average angle was rated (Weiss & Anderson, 1972). Properties of graphic ratings have also been studied in an investigation by Anderson (1972).

Graphic ratings have been used in the study of decision processes (Sjöberg, 1968; Slovic & Lichtenstein, 1968; Anderson & Shanteau, 1970; Shanteau & Anderson, 1972).In the first two of these studies empirical evidence was found for an additive model in decision making (integration of value and probability). In the third study compound adding and multiplying processes were supported by the data. The SEU model, which is multiplicative, is generally used; it describes judgment processes based on probability and value. It is therefore plausible to suggest that the deviant results related above may be due to the rating scale used (cf. Svenson, 1975).

In information integration studies category ratings seem to have been favored, while magnitude estimations are assumed to bias responses, it is suggested, by rating a given difference as smaller higher up on the continuum (Anderson, 1974). One advantage of magnitude estimation, however, is that as it places no upper limit on numbers, ceiling effects may be reduced. This method has been favored by Stevens (1971) among others. The properties of magnitude estimation also seem to be better known.

Curtis (1970) suggested a two-stage process to explain the scale values obtained by magnitude estimation. His approach involved introducing a parameter that relates to number usage. Poulton (1968) exhaustively reviewed the magnitude estimation method. Sjöberg (1971) tested different models used to analyze ratio estimation. This result may also have reference to magnitude estimation as this method is principally the same as ratio estimation. Sjöberg found that the error in responses could he explained in part by response bias which it is possible to describe by a model and also to correct for.

In some studies on the size-weight illusion discrepant results were obtained using magnitude estimation and category judgment. In a study by Sjöberg (1969) a multiplicative model described the judgments of perceived weight based on physical weight and physical size. The rating scale in this study was magnitude estimation. On the other hand, Anderson (1972) with category judgments obtained a linear relation between these two variables. Sarris and Heineken (1976) further demonstrated the intimate relation between choice of response scale and model.

To assess the value of a rating scale a validational base must be provided.In the present study the rating task was the same for different response scales. The results obtained for these scales were tested against the fit of an assumed multiplicative model and also an additive model. The testing of different rating methods against an assumed model may give an empirical validation and the choice of a rating method may be made in the light of this validation.

In studies of integration of information single stimuli have generally been used and the method of studying the integration of information has mostly been functional measurement (e.g. Anderson, 1970, 1971); this method was described earlier and, in short, involved relating both the physical stimulus to the psychological scale and the psychological response value to the observed numerical response. The scaling is based on an established model equation.

The models generally assume that the integration process is algebraically simple such as, for example, adding or multiplying, and that there are no interactions. Interactions, if found, might imply that the model is not valid. The interactions may be devoid of any

psychological meaning, however, and merely reflect properties of the response scale, but knowledge of these properties makes it easier to interpret whether the statistical interactions are meaningful or not.

A monotone transformation of the overt response may be a solution if the response data do not well fit the model. This may save a correct model and may also have the advantage of giving a valid response scale. In the present study the multiplicative model was tested on raw data and on logarithmic data. Rescaling is only considered suitable on the basis of a supported model (see Bogartz & Wackwits, 1971) and was not considered here further.

Tests were also made of the improvements in fit that are introduced by using an increasing number of parameters for the multiplicative model in log form; the procedure for this was described in Study 1 of the present paper.

The purpose of the present study was, thus, to investigate the relations among different scales when stimuli varying in several different attributes were rated. Single objects were studied in a task for which information from several sources was integrated into an over-all judgment. Lotteries were used as stimuli; they varied in probability, value, and time of outcome.

4.1 Method

The subjects rated lotteries as to perceived favorableness. Offers were presented to buy lottery tickets at a constant stake of 50 öre (about 10 cents).
The lotteries were specified in the three variables of time, probability, and value of outcome.
The time: 1 hr., 1 day, 1 wk., 2 wk.
The probabilities: 0.05, 0.15, 0.50, 0.95.
The prizes: 1:-, 2:-, 4:-, 7:- Sw.Crs.

Stimuli. - A Latin square design that combined times, probabilities and prizes gave the 16 lotteries for the preference ratings given in Table 7.

Table 7

Sixteen lotteries of study 2

	Value			
p	1:-	2:-	4:-	7:-
0.05	a*	b	c	d
0.15	b	a	d	c
0.50	c	d	a	b
0.95	d	c	b	a

* a = 1 hr.; b = 1 day; c = 1 wk.; d = 2 wk.

Procedure. - Each subject made three preference ratings. Preference ratings using one judgment task were made on each occasion, and at least 1 wk. elapsed between one rating occasion and the next. The time order was: Occasion 1: category judgments, Occasion 2: magnitude estimates, and Occasion 3: graphic ratings. The order of presentation between stimuli was randomized. If there were two stimuli at one presentation the order of presentation between them was randomized. The position of the presentation of the three variables time, probability, and value was rotated within subjects. The number of presentations was as follows:

category judgments: 3 X 16 = 48
magnitude estimations: 3 X 16 = 48 (including standard)
graphic ratings: 3 X 16 = 48

The category scale had seven categories, and each category was indicated by a numerical label. Higher numbers on the scales indicated offers that were more favorable.

In magnitude estimation the number 10 was assigned to the standard stimulus, and this number was written to the right beside the standard stimulus. The subject was to give a number reflecting the relation between the standard and the variable stimulus and was told to use any number. The standard was shown for every variable stimulus. The standard stimulus was: time: 1 week, probability: 0.50, and value: 1:-.

A graphic scale of 15 cm: s was used. A bar in the middle of the scale denoted the point of indifference; unfavorable offers were to be marked to the left of it, and favorable offers to the right, the distance from the bar denoting the degree of favorableness or unfavorableness.

Stimulus presentation. - Ratings were made in a seminar room with all subjects being present at the same time. The offers to buy lottery tickets were presented on sheets of paper, with 10 offers on every sheet. The concepts of time, probability, and value were explained before the experiment. The probabilities were illustrated by pie diagrams as in Study 1. Spot checks indicated that the subjects seemed to understand these concepts. The range of stimulus values were presented before the ratings were made.

The subjects were informed that after the experiment they were to gamble on three lotteries to be selected from eight lotteries chosen at random according to the same principles for the preference ratings that were used in Study 1. The subjects were instructed to make their ratings in an absolute sense, and they were encouraged to give their personal opinions of the offers to gamble, it being explained that there were no right or wrong answers in the rating task. After being given these instructions the subjects made 10 practice trials: the first of them was to test the instructions and the remainder were to acquaint the subjects with the range of stimulus values.
Subjects. - The subjects were students of educational psychology at Uppsala University and aged from 21 to 30 yr. Six were men, and four women. The ratings lasted between about 25 and 45 min.

4.2 Results

The scale values were obtained directly from the ratings for all rating methods. The scale values obtained from the different rating scales were plotted against each other. The medians over replications and subjects were calculated for all scales.

The relationships between scales for preference ratings can be studied in Figure 3.

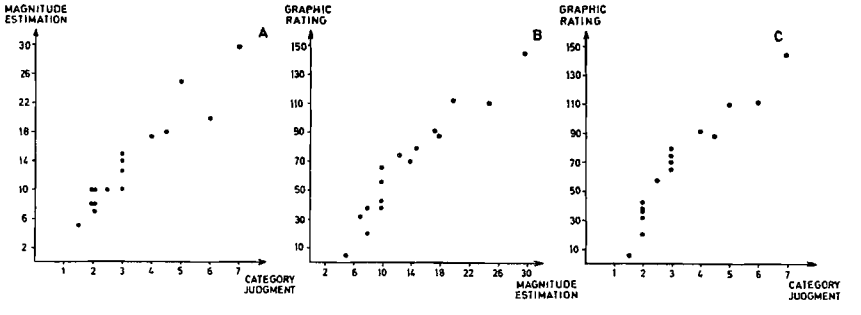

Figure 3. Plots of category judgments, magnitude estimations and graphic ratings against each other (medians); preference ratings

The relationship between category judgments and magnitude estimation was approximately linear, while the relationships between category judgments and graphic ratings and between magnitude estimations and graphic ratings were non-linear.

Homogeneity of variances for different rating methods was also investigated. The total standard deviation, including both intra- and inter-individual variance, was calculated for each stimulus and for each rating scale. The standard deviation divided by the scale mean values (over replications and subjects) indicated the homogeneity of variance. The most homogeneous variance was found for the category judgments (a variation between 0.02-0.40) and magnitude estimations (0.02-0.56). The variance was more heterogeneous for the graphic ratings (0.01-1.04).
The reliability was computed in the same manner as in the previous study.

Table 8
F tests resulting from analysis of multiplicative model in log from

	Godness of fit tests				
Subject No.	EV(Ia) model	SEV(Ib) model	EU(Ic) model	SEU(Id) model	SEU_t(Ie) model
	Category judgments				
1				2.00	1.59
2				1.00	0.71
3				0.88	0.63
4		11.29**	19.14**	2.29*	2.43*
5		14.60**		3.60**	1.80
6				1.50	1.00
7				1.00	1.33
8		19.40**		1.80	1.80
9		4.25**		0.63	0.50
10				1.50	1.00
	Magnitude estimations				
1				0.40	0.20
2		22.67**		2.33*	2.67*
3				1.38	0.75
4	17.13**	13.13**	8.00**	2.63*	2.88*
5		4.18**		2.73*	1.27
6				1.00	0.92

7		11.80**		1.80	1.80
8		15.20**		1.40	1.40
9		4.43**		1.57	0.64
10				5.67**	2.67*
	Graphic ratings				
1				1.25	1.25
2	8.38**	5.54**	7.92**	4.69**	3.38**
3				1.80	1.20
4	9.45**	6.45**	7.25**	3.75**	3.00**
5	7.53**	1.26	8.05**	1.37	1.47
6	5.85**	4.23**	3.63**	1.78	1.88
7	5.35**	4.10**	3.20**	1.75	1.25
8	7.60**	4.80**	7.40**	4.30**	2.90**
9		4.15**		0.13	0.13
10				6.00**	4.00**

Note. - Ia, based on 15 and 32 df; Ib, based on 14 and 32 df; Ic, based on 14 and 32 df; Id, based on 13 and 32 df; Ie, based on 12 and 32 df.
*p = 0.05. **p = 0.01.

Table 9

F tests resulting from analysis of multiplicative model in log form

	Improvement tests		
Subject No.	SEU vs SEV	SEU vs EU	SEU_t vs SEU
	Category judgments		
1			1.50
2			1.13
3			1.28
4	18.75**	34.75**	0.08
5	20.55**		3.37
6			1.56
7			0.00
8	36.82**		0.03
9	14.28**		0.55
10			2.08

	Magnitude estimations		
1			0.26
2	24.46**		0.03
3			3.13
4	15.38**	8.00**	0.00
5	4.57*		4.36*
6			0.63
7	16.64**		0.26
8	27.80**		0.06
9	0.16		0.05
10			0.07
	Graphic ratings		
1			0.00
2	1.94	5.92*	2.34
3			3.92
4	9.27**	11.61**	2.82
5	0.00	17.72**	0.01
6	4.56*	3.49	0.05
7	6.78*	4.33*	14.62**
8	0.94	3.96	1.71
9	26.64**		0.00
10			0.55

a Based on 1 and 32 df; b Based on 1 and 32 df; c Based on 1 and 32 df.
*p = 0.05. **p = 0.01.

The median value of reliabilities was for preference category judgments 0.90, magnitude estimations 0.87, and graphic ratings 0.93.

The tests of goodness of fit are presented in Tables 8, 9, and 10. When no F ratio is reported the sums of squares of deviation from the regression exceed the total sum of squares. This means that the fit of these models is very bad. This result could be obtained as the Models EV, SEV, and EU assume the exponent to be 1 for the variables of value and probability. For the category judgments all three models with time included produced good fit: Model I (multiplicative in log form) in 9 out of 10 cases, Model II (multiplicative on raw data) in 8 out of 10 cases, and Model III (additive on raw data) in 8 out of 10 cases. The fit of the models was good to a lesser extent for the magnitude estimation data: Model I 7 out of 10 cases, Model II 4 out of 10 cases, and Model III 4 out of 10 cases. The graphic ratings yielded good fit to data in 6 out of 10 cases for Model I, in 1 out of 10 cases for Model II, and 4 out of 10 cases for Model III.

Table 10

F tests from analysis of multiplicative model on raw data and additive model on raw data

	Godness of fit tests	
Subject No.	Multiplicative model on raw data	Additive model on raw data
	Category judgments	
1	0.97	1.60
2	1.00	1.88
3	1.15	0.68
4	1.69	2.00
5	2.48*	6.28**
6	2.76*	0.88
7	1.30	3.45**
8	1.72	1.45
9	0.54	0.98
10	1.22	2.04
	Magnitude estimations	
1	0.42	1.32
2	3.20**	7.33**
3	1.25	0.90
4	2.23*	2.77*
5	0.60	3.26**
6	1.43	1.58
7	2.66*	2.95**
8	21.70**	4.54**
9	6.61**	1.57
10	2.67*	3.63**
	Graphic ratings	
1	12.42**	0.86
2	4.87**	3.54**
3	2.67*	1.12
4	11.53**	3.51**
5	1.19	1.64
6	6.29**	4.97**
7	8.58**	5.57**
8	4.24**	11.22**
9	2.47	1.37

10	58.06**	16.29**

a Based on 12 and 32 df.
*P = 0.05. **p = 0.01.

No support was found for the restrictive models EV, SEV, or EU in this study as in Study 1. This applied to all methods of rating. Another result obtained was that no large improvement of fit was produced when proceeding from the SEU model to the model with time included (SEU_t). Instead, as expected, significant improvement of fit was obtained when parameters for value and probability were introduced.

Exponents obtained for the multiplicative model in log form, which was the model that obtained most support, were plotted against each other for the three methods of rating, and the largest variability was yielded for the time and value exponents. The relationship showed a slightly curvilinear trend when graphic ratings and magnitude estimations were plotted against each other for the value component. For the probability component a non-linear relationship was found between category judgments and magnitude estimations, and between graphic ratings and magnitude estimations.

The importance of the placement of the psychological point of zero for the gambles was also tested. Possible differences in results for the multiplicative model tested in its log linear form between perceived favorable and unfavorable offers to gamble were investigated. The assumption of this testing was that the judgment process might be described in the following way. First, a preliminary decision is made as to whether the offer is favorable or unfavorable. Second, discrimination is done within the subpart of the total continuum chosen.

The procedure for testing implied that the point of indifference obtained by the graphic ratings was used as a point of zero. This point of zero for the graphic ratings was used to derive the zero point for the magnitude estimations and category judgments. The stimulus whose mean rating was most close to the point of indifference for the graphic ratings was given number zero for the magnitude estimations and the category judgments. To the negative ratings a constant was added to give all positive numbers. The unfavorable and favorable offers were then analyzed separately. This applied to all the three methods of rating.

The analysis showed that there were more unfavorable than favorable ratings. As the data for unfavorable and favorable offers included different numbers of observations the exponents of the three variables gave the most reliable information about the effect of the point of zero. The exponents of time and value did not differ to any large extent

between unfavorable and favorable offers while the exponent of probability showed some tendency to be larger for unfavorable offers for magnitude estimations and graphic ratings. For category judgments, however, the exponents for probability were slightly larger for favorable offers. No pervasive tendency was found for differences in the parameter values between unfavorable and favorable offers. This result may indicate that about the same model is followed when unfavorable and favorable offers are rated and that the procedure for estimating the zero point had some validity.

Summing up, non-linear relations among scaling methods were found as expected. In the tests of raw data a multiplicative model fitted better than an additive model for magnitude estimation data; the reverse was true for graphic ratings, all in accordance with expectations. Category judgments fitted equally well both models. We note here, also, the larger heterogeneity of variances for graphic ratings.

4.3 *Discussion*

As pointed out in the introduction, previous investigations have found varying results for the relation between graphic ratings and magnitude estimations. The non-linear relation found in the present study is in agreement with data obtained for averaging greyness (Weiss, 1972), while a linear relationship was obtained when the task was to average angle (Weiss & Anderson, 1972). The homogeneity of variances varied with different methods of rating. Graphic ratings yielded the largest heterogeneity of variances.

The tests of goodness of fit for the category judgments produced no differences between the multiplicative model in log or raw form and the additive model on raw data. This may signify a lack of power for this particular rating method.

More differentiating results were found for magnitude estimations and graphic ratings, where the multiplicative model in log form was given somewhat stronger support. The graphic ratings threw doubt on the validity of the multiplicative model in raw form, while the model could not be ruled out for the magnitude-estimation data.

The outcome of the plots of exponents seemed to indicate that magnitude estimations in some cases yielded exponents related non-linearly to exponents obtained by category judgments and graphic ratings. This may be considered to support the conclusion that magnitude estimations give a biased result. On the other hand, the goodness of fit tests and the explained variance for different models did not give any clear difference compared to the other methods of rating.

The major choice of rating scale is the choice between magnitude estimation and graphic ratings. The former favors multiplicative models, the latter favors additive models. There is no strong empirical support in the present data for either of the two. And there is no clear theoretical advantage to either. Indeed, we favor the idea proposed by Torgerson (1960) that there may be only one subjective relation which is simply expressed differently under the two types of response instruction (as a ratio or as a difference). In this situation we prefer, in future studies, to work with magnitude estimation because of the flexibility in formulating multiplicative models and because of its greater homogeneity of variance. We are well aware that parallel additive models could probably be supported by other rating scales.

The bad fit of data to the stronger models EV, SEV, and EU was in complete agreement with the results found in the previous study. The significant improvement caused by introducing parameters for probability and value was also found in the present study. This study clearly illustrates some of the problems of attempting to describe cognitive processes by using a quantitative framework. If the assumed model for the processes shows lack of fit, the problem is whether or not this should be interpreted as being due to the model or to the response scale. In this study rather the opposite problem came up. No model could definitely be excluded as an explanation. This indicates the importance of knowledge of the properties of a scale when interpreting the results obtained from its use. When algebraic models are tested the findings have limited generalizability. One limiting factor is the characteristics of the rating scale used.

5 STUDY 3

In the present study we investigated the effect of different context factors on preference and similarity ratings of offers to gamble. The invariance of results over different subjects was studied, as were other context factors including the range of the independent variables of stimuli and instructions.

Earlier investigations have generally found that a variation in the range of stimuli affected results. In psychophysics (Engen & Levy,1958) the range of psychological ratios has been found to decrease slower than the range of physical ratios, that is, the exponent of the function relating the physical and psychological scales became larger when the range of physical stimuli diminished, a result that was also reported by Poulton (1968) in his review of magnitude estimation.

Similar results have been obtained from rating the similarity between pairs of objects varying in several different attributes. Torgerson (1965) varied the range of physical

stimuli in a two-to-one ratio. His subjects seemed to adapt their ratings to the changed range of variation in that they gave a higher relative weighting to the restricted dimension. This agrees with the results found for single stimuli (see Poulton, 1968).

The range of probability in the present study also varied in a two-to-one ratio, being at first 0.05-0.95, afterwards being changed to 0.30-0.75. The effect of this restricted range of variation was investigated for single objects and pairs of objects, the single objects being rated as to perceived favorableness and the pairs as to similarity.

The preference ratings were analyzed for individuals by means of multiple regression analysis. The model developed by Carroll and Chang (1970) to obtain individual weights in multidimensional scaling was used to analyze the similarity data.

5.1 EXPERIMENT 1

5.1.1 Method

General design and choice of stimuli. - The experimental plan is given in Table II. The method was mainly the same as that used in Studies 1 and 2. The experimental plan was the same, there being the same three independent variables of time, probability and value of outcome. The experiment was performed in two parts, and in the first part the values of the independent variables were: Times: 1 hr., 1 day, 1 wk., 2 wk.; Probabilities: 0.05, 0.15,

Table 11
General design of exp. 1, study 3

Part I	Part II		
Week 1	Week 2	Week 3	Week 4
preference ratings original range 0.05-0.95	similarity ratings original range 0.05-0.95	similarity ratings restricted range 0.30-0.75	preference ratings restricted range 0.30-0.75

0.50, 0.95; Prizes: 1:-, 2:-, 4:-, 7:- Sw. Kr.; the stake was fixed at 50 öre (about 10 cents). In Part II the range of the probabilities was restricted to 0.30, 0.40, 0.55, and 0.75, while the other stimuli were the same as in Part I.

Preference ratings. - The experimental procedure was the same as in the previous studies and the same 16 stimuli were obtained by using a Latin square design. Magnitude estimations were used and the standards were: Part I-time: 1 hr., probability:

0.50, value: 2:-; Part II-time: 1 hr., probability: 0.55, value 2:-. Each lottery was rated 10 times by each subject. The experiments took place in a lecture room and entailed actual gambling, the subjects being informed that after they had made their ratings they would be allowed to buy five lottery tickets; they were informed about the ranges of times, probabilities, and prizes and had ten practice trials.

The eight subjects (two males, six females) were pupils at a residential college for adults outside Uppsala, aged from 18 to 37 yr. Average time to complete the task was about one hour.

Similarity ratings. - The three independent variables were the same as those for preference ratings and had the same values. Subjects had to rate the similarity between two lotteries. Seven stimuli were chosen from the 16 used for preference ratings and could be combined to form 21 different pairs, each of which was rated 10 times by each subject. Magnitude estimations were used
for the similarity ratings, the standards being:

Part I-	time: 2 wk.	probability: 0.05	value: 7:-
	time: 1 hr.	probability: 0.50	value: 2: -
Part II-	time: 2 wk.	probability: 0.30	value: 7:-
	time: 1 hr.	probability: 0.55	value: 2:-

The similarity ratings were connected with an actual gambling situation. After making their ratings, subjects were asked to say if they preferred playing lotteries that were similar or the reverse to some other lottery. One lottery was then chosen at random and the subjects then played the five lotteries that the earlier ratings had shown to be most or least similar to the lottery chosen at random.

The same subjects made both similarity and preference ratings, taking on average about one and a half hours to make the similarity ratings. In all other aspects the similarity ratings were performed in the same way as the preference ratings.

5.1.2 Results and Discussion

Preference ratings. - Median values of the reliabilities, which were computed as in the earlier studies, were 0.98 and 0.95.

One additive and one multiplicative model were tested, the former being tested in its raw form and the latter in raw and log form; all the models fitted the data badly. The result when the range of probability was 0.05-0.95 will first be reported. The multiplicative model SEU_t in log form could fit the data in one test out of eight, while in raw form this

model fitted the data well in two out of eight tests. In all other tests the fit of the models was significandy bad at least at the 0.05 level. Fit improved significantly when SEU was used instead of SEV, SEU instead of EU, and SEU_t instead of SEU in 7, 6, and 2 tests, respectively.

The test of the models gave about the same results when the range of probability was restricted to 0.30-0.75. The multiplicative model SEU_t in log form fitted significantly badly for the same seven tests out of eight. In no case did the stronger models EV, SEV, and EU fit the data well. SEU fitted the data significantly better than SEV in all cases; SEU fitted significantly better than EU in five cases out of eight: and SEU_t fitted significantly better than SEU in three cases. The fit of the multiplicative and the additive models on raw data was significantly bad in all cases.

The present results showed bad fit of all the three models in almost all tests. The multiplicative model in log form was somewhat more encouraging than either the multiplicative model or the additive model on raw data. The stronger models EV, SEU, and EU could all be excluded as descriptions of the process of judgment.

These tests of models were based on an assumed power function. This assumption of a power function is perhaps most inadequate for the probability variable. Some previous studies (for a review see Lee, 1971) showed that probabilities are overestimated when low and underestimated when high. Another reason for testing a further function is that subjective probabilities of complementary events do not add to one if the power function is assumed. One possible function with the properties of (a) taking care of overestimation of low probabilities and underestimation of high probabilities and (b) making the subjective probabilities of complementary events add to one is

$$\Psi = -p + \Gamma\gamma \sin(2\Gamma p) \qquad (9)$$

where 2 is chosen to let the probability continuum 0-1 correspond to the 0-2 Γ angular continuum.

$\gamma > 0$ implies overestimation of low and underestimation of high probabilities and $\gamma < 0$ yields underestimation of low and overestimation of high probabilities. $\gamma = 0$ implies that subjective and objective probabilities are the same. We would then expect that γ : s giving the best fit to the data would be larger than zero.

$$U = U(\$)\ \tau\{p + \gamma\ \sin(2\ \Gamma\ p)\} \qquad (10)$$

where U is the favorableness of a course of action, $U(\$)$ the utility of an outcome and τ subjective time, was tested in raw form since it could not be tested in its log linear form as the raw new function is not expressed as a simple power function.

This model was tested both for the study with the probability range of 0.05-0.95 and the study with the range of 0.30-0.75, and the results yielded no better fit when this function was assumed for the probability variable. Significant lack of fit occurred in all eight cases on the 0.01 level for the 0.05-0.95 range. For the range 0.30-0.75 significantly bad fit was also obtained in all cases, on the 0.01 level in seven out of eight cases.

The exponents of time and value remained almost the same in the two tests that incorporated the different probability functions.

The tests of the models thus did not yield good fit to the data when either a power function or a sine function was assumed for the probability variable. Of course, other less restrictive models could be tested, but in the present study testing was restricted to the stronger models already described.

Simplifying strategies were also sought by computing the product-moment correlations between the responses and the objective values of the three independent variables. The median value of the product-moment correlations in the probability range 0.05-0.95 and 0.30-0.75 were, for time -0.04 and -0.02; for value 0.39 and 0.63; and for probability 0.84 and 0.62, respectively.

The median correlation for time was slightly negative for both ranges, nor were any large differences obtained. In the probability range of 0.05-0.95, they were somewhat lower for value than for probability, perhaps because the latter could have a larger range of variation than the former. That the correlation for the probability variable was less in the range of 0.30-0.75 than in that of 0.05-0.95 was probably due to the restricted range of variation of the probability variable.

Although these correlations cannot supply any simple answer to the questions about simplifying strategies, they may indicate that at least the variables of value and probability of outcome to some extent were the basis for the judgments.

The effects of varying range of the stimuli are discussed after the results of the similarity ratings.

Similarity ratings. - The medians of the reliabilities were 0.79 in the first part of the study and 0.85 in the second. The similarity data were treated by a method for multidimensional scaling of individual data developed by Carroll and Chang (1970). Input was one half of a similarity matrix for each individual and the arithmetic mean of the 10 replications was the basis for the INDSCAL analysis.

The similarity data in this experiment gave somewhat unclear results. To account for all three factors a five-dimensional solution had to be chosen that accounted for 86% of the variance. The first factor was not related to any of the expected factors. It might be interpreted as related to the evenness of the values of the independent variable. Lotteries with values in the middle of the range were highly loaded in this factor, while those with a high value in some factors and a low value in others had lower loadings. Lottery 5 is highly loaded in this factor with a time of 2 weeks, a probability of 0.50 and a value of 4:-. Number 2 has a low loading with a time of 1 week, a probability of 0.95 and a value of 1:-. The second dimension could be related to time of outcome and the third dimension to probability of outcome. Dimension IV was unclear. It might be interpreted as a factor related to both value and probability, while dimension V could be related only to value. The individual weights of the five dimensions showed that the weighting of the dimensions was very similar for the different individuals.

In the second part of the experiment the range of the probability factor was restricted and the same results were obtained. Dimensions I and II are not quite clear. Dimension II might be related to the evenness of values, while Dimension I cannot be related to any single factor, although perhaps to a combination of the factors of probability and value. Time of outcome appeared as Dimension III and probability as Dimension IV. Dimension V might be interpreted as related to value. The individual weights show once again no large difference between subjects. The five-dimensional solution in this part of the study accounted for 92% of the variance.

TORSCA solutions that are based on a nonmetric approach were computed as a control. These group stimulus spaces which were rotated according to a varimax criterion yielded about the same results as the INDSCAL solutions. The same dimensions were obtained, but the order of emergence differed somewhat as between the INDSCAL and TORSCA solutions.

This study did not lead to the stimulus configuration that had been expected, the evenness factor being unexpected, nor did the five dimensions that were required to

take account of the variables of time, probability, and value emerge as clearly as had been expected. The results might have been influenced by extraneous factors. The findings prompted the thought that the subjects might have felt unsure about the ratings and may therefore have tried to simplify them, thus responding to the evenness of the values of the independent variables, so giving the somewhat unexpected results. As extraneous factors may have influenced the results, study of the effect of the different ranges of the probability factor will be carried out later.

5.2 EXPERIMENT 2

The results of Exp. 1 on similarity ratings aroused the suspicion that the instructions might have adversely affected them, so the instructions were varied in the second experiment. While subjects in the first experiment had been instructed to make their ratings "with reference to perceived similarity," in the second they were told to rate "similarity with reference to perceived favorableness" of the offers. The two different ranges of probabilities were used in both Parts I and II.

5.2.1 Method

General design and choice of stimuli. - The design is given in Table 12. The standards and the number of ratings were the same as in Exp. 1, and indeed the only differences between Parts I and II were that the subjects were not allowed to gamble on any lotteries in Part II.

Table 12
General design of exp. 2, study 3

Part I		Part II	
General similarity Range of probabilities		Similarity specified to perceived favorableness Range of probabilities	
0.05-0.95 A	0.30-0.75 B	0.05-0.95 C	0.30-0.75 D

Four male and five female students of educational psychology participated in the experiment, and, as in the previous experiment, they needed about 1 1/2 hr. to complete it.

5.2.2 Results

The median values of reliabilities were 0.76, 0.86, 0.84, and 0.90.The configurations of the lotteries in three-dimensional solutions accounted for 89%, 86%, 82%, and 79% of the variance in successive order. In Part A (general instructions and full range of the probabilities) only the value of outcome emerged as an expected factor, and it was related to the evenness factor of the stimuli. The inclusion of Dimensions IV and V did not yield the factors of probability or time of outcome. In Part B of the experiment (general instructions and restricted range of probability) the three hypothesized factors did emerge interpreted as related to Dimensions I (probability of outcome), II (value of outcome), and III (time of outcome). The evenness of the offers emerged as Dimensions IV and V. Also, in Part C (specified instructions and full range) the three hypothesized factors might be interpreted as emerging dimensions with value of outcome as related to Dimension I, probability of outcome to Dimension II, and time of outcome to Dimension III. In Part D value of outcome could be related to Dimension I and time of outcome to Dimension II. Five dimensions would have to be included to take account of probability of outcome.

Also, in this experiment about the same result as when using INDSCAL was obtained using TORSCA analysis. In Part A a discrepancy between the two solutions may be noted as value but probability also emerged as dimensions in a three-dimensional TORSCA solution. Of the three factors only value emerged from the INDSCAL solution; in Parts B, C, and D the three factors of time, value, and probability of outcome all emerged as dimensions from both the INDSCAL and the TORSCA solutions when these had been extended to include five dimensions.

Another feature of the INDSCAL data was that, taken together, subjects' weightings of the different dimensions were seemingly stable in different experimental conditions. Probability emerged as a rather distinct factor in this study in both parts when the range of values was restricted. When the instructions were general, probability emerged as a factor only when the range was restricted; when they were specified the range of weighting was 0.01 to 0.73, for the full range, and -0.01 to 0.59 for the restricted range, giving a relationship of 1: 1.2.

5.2.3 Discussion

The INDSCAL solutions in this experiment mostly yielded all the three expected factors of value, time, and probability; and, in addition, a factor related to the evenness of combinations was found, mostly in Part A.

One purpose of this study was to investigate the effects of the range of stimuli as another contextual factor. Dimensions II and V, in Parts C and D, respectively, could be related distinctly to probability of outcome, so that the relationship between the objective and the subjective ratios could then be studied for this variable, giving results that were as hypothesized. The ratings were adapted to the restricted range of stimuli and this agrees with previous results mentioned in the introduction.

5.3 GENERAL DISCUSSION

The results of Exp. 1 were unexpected. The hypothesized multiplicative model did not fit the data, nor did an additive model describe the judgment process well. The multiplicative model in raw form that assumed a function other than a power function to relate the objective and subjective probabilities also failed significantly to fit the data. This function assumed that probabilities would be variously over- or underestimated when they were high or low.

The multidimensional scaling in Exp. 1 did not produce the dimensions that had been expected. In Exp. 2, however, on similarity ratings, the results came up to expectation. The experimental conditions for the preference ratings were exactly the same in the earlier and in the present study.

When tests reveal models to fit the data well the cognitive algebra approach (Anderson, 1974) is straightforward, but if, on the other hand, they do not, as in this study, the problem is how to interpret the results.

The first such interpretation is that a linear model cannot adequately describe the integration process, because of interactions between the variables. This would accord with the results obtained in those investigations in which interactions have been found to occur between the components of value and probability of outcome. Such investigations are surveyed in the introduction. An exhaustive review of decision research by Lee (1971) treats the problem of interactions; it is also discussed by Cohen and Christensen (1970) among others.

One disadvantage using a Latin square design to reduce the number of combinations is that the data cannot be tested for interactions. An experimental design that permits study of the effects of the time variable on decisions and still leaves open the possibility of studying interactions is to reduce the number of combinations of value and probability and to use the full range of the time variable.

The possibilities of using a linear model to describe the process of judgment in different contexts should, in our opinion, be further explored before more complicated nonlinear models are tested.

The second, alternative interpretation is to attempt to describe the judgment process by means of multilinear models that might require compound adding and multiplying rules to describe the information integration into an over-all judgment. Models of this sort have been applied mostly to decision making (e.g. Shanteau & Anderson, 1972), as Anderson (1974) pointed out in his review of integration of information.

A third alternative interpretation is that for these subjects a linear model does not describe the judgment process for the ranges chosen for the independent variables. With other, probably higher values on the independent variables a linear model might prove appropriate.

A fourth alternative interpretation is that subjects simplify the stimulus configuration by focusing on some aspect of the information. One simplifying rule is to add the information but the data did not support that rule. Simplifying strategies are mentioned by Slovic and Lichtenstein (1968) in their study of decision making, in which they hypothesized that these strategies could be used by untrained subjects for complex stimulus configurations. The subjects in the present study had received less formal education than those in the earlier studies (university students of educational psychology). Those in the present study were adults studying at an advanced secondary level. The use of simplifying strategies has been found especially when subjects are unmotivated and bored with their tasks (Slovic, Lichtenstein & Edwards, 1965).

Slovic and Lichtenstein (1968) further assumed that simplifying strategies yield consistent ratings, and the reliabilities of the preference ratings of the present study support this, for they were extraordinarily high. This high reliability also makes it more difficult to show that any model fits for any deviation from the regression line may more justifiably be defined as lack of fit of the model than it could be were the reliability of the ratings low.

The similarity ratings in Exp.1 could also have been made by means of some simplifying strategy, for the expected dimensions did emerge to some extent in this study, but not so clearly as in Exp. 2.

To sum up, it may be said that against the background of the findings of the present study, context seems to produce an effect and, further, that it appears to influence both

the similarity and the preference ratings. The usefulness of linear models to preference ratings seems to be limited, and it therefore remains to be seen under what conditions it is possible to describe delay behavior by means of a linear model.

6 STUDY 4

In the earlier studies ratings were made of perceived favorableness of offers to buy lottery tickets in lotteries where outcome was delayed, and it was found that time of outcome was sometimes a determinant of the judgments and decisions. It was also found that these judgments could tentatively be described by a multiplicative process.

The purpose of the present study was to investigate what time of outcome can be expected for courses of action defined only by means of probability of outcome and value of outcome. Another parenthetical purpose of the study was to test which model best describes the integration of information from the two factors of probability and value. The design and method were principally the same as the ones used in previous studies.

6.1 Method

Offers to buy lottery tickets in lotteries were to be rated with respect to their perceived favorableness. The lotteries were specified in two variables, probability and value of outcome. The stimulus values for probability of outcome were: 0.05, 0.15, 0.50, 0.95 and for value of outcome: 1:-, 2:-, 4:-, 7:- Sw.Crs. The stake was fixed at 50 öre (about 10 cents). There were in all 16 possible combinations of a probability and a prize. Every lottery was rated 10 times.

Magnitude estimations were used. The lottery with the probability 0.50 and the prize 2:- was chosen as standard. This lottery was assigned the number 10. With the favorableness of this lottery being given as 10, the subjects were asked to give numbers to the other lotteries that would reflect their perceived favorableness.

The subjects were encouraged to express their personal feelings about the lotteries and to make the ratings in an absolute manner. The subjects were told that after having made their ratings they would play on five lotteries, determined in part by the ratings that had been given to them. From 10 consecutive lotteries chosen at random the five lotteries rated most favorable were to be played on.

After the ratings were completed the subjects were asked to state which time of outcome they had thought of for every offer when the ratings were performed. Finally, they were allowed to play on the five lotteries chosen. When asked after the experiment the subjects said that they were not acquainted with the expected value rule (EV-rule).

The experiment was performed with all subjects together at the same time in a lecture room. The subjects, 5 males and 7 females, were students of educational psychology, aged from 19 to 37 yr. The average time for completion was about 1 hr.

6.2 Results

The median reliability of the ratings was 0.90. (The reliability was estimated in the same way as in the previous studies). Three subjects, two males and one female, were excluded from the analysis because of an excessive number of negative and zero ratings. Such ratings were very few in number for the other subjects and were transformed to the value of 0.001 for the model testing.

The model testing was performed in the same way as in previous studies. The multiplicative model showed good fit to the data in six of the nine cases. All the cases of bad fit were significant at the 0.01 level. The additive model on raw data yielded bad fit to data that was significant in all nine cases. The results are given in Table 13.

For the Subjects, 1, 8, and 9, whose data could not be described by a multiplicative model the exponents showed a marked deviation from a linear relationship between objective and subjective values. This applies both to the probability exponents and to the value exponents.

For those subjects who did not follow any of the two models, interactions between probability and value were significant and for all those subjects the same pattern of interactions was found. Lotteries with small values and small probabilities and also large values and large probabilities were underestimated. Overestimation was found for combinations of large values and small probabilities and also for small values and large probabilities.

The mean values of ratings for expected time of outcome for the 16 stimuli are presented in Table 13. The time was counted in minutes. The ratings exhibited large interindividual variations. One subject expected to obtain the outcomes immediately. This applies to all combinations of a prize and a probability. Other subjects' ratings of expected delay periods were varying. The individual mean values of expected delay periods indicated a rather short expected delay period for the outcome of the lotteries.

For the lotteries with a low expected outcome the median value was mostly zero, the outcome being expected to occur immediately. For Stimuli 9, 12, 13, 14, and 15 the expected time was about 1 hr. and for the lottery with the highest expected value the median expected delay period was the longest.

Table 13

Mean value of ratings of expected time of outcome for sixteen stimuli (in minutes)

Lott-ery	1	2	3	4	5	6	7	8
Value	1:-	1:-	1:-	1:-	2:-	2:-	2:-	2:-
p	0.05	.15	.50	.95	.05	.15	.50	.95
Subject								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	6
4	72	60	60	60	72	60	60	60
5	5202	2478	30	0	6210	2202	0	1008
6	4368	54	48	0	54	48	6	0
7	6	24	4332	6	60	60	60	60
8	0	0	0	0	0	0	0	6
9	0	0	0	0	0	0	0	0
Mdn	0	0	0	0	0	0	0	6
Lottery	9	10	11	12	13	14	15	16
Value	4:-	4:-	4:-	4:-	7:-	7:-	7:-	7:-
p	.05	.15	.50	.95	0.05	.15	.50	.95
Subject								
1	54	66	60	60	60	60	60	60
2	0	0	0	0	0	0	0	0
3	6	0	54	34572	12	42	34572	43200
4	60	72	60	60	38886	38892	43200	38886
5	1200	2184	6	0	2058	3066	0	0
6	192	12	0	0	18	0	0	0
7	25944	25944	30258	30258	47520	30258	30258	30258
8	6	0	6	6	4362	12996	8676	8676
9	0	0	0	1008	0	0	0	38880
Mdn	54	12	6	60	60	60	60	8676

Product-moment correlation coefficients were computed between the mean value of preference ratings for each stimulus and the length of the expected delay period (see Table 14). For most subjects there was a positive correlation between stated preference and expected length of the delay period. Two subjects exhibited a negative correlation for these variables. High positive correlation coefficients were obtained between objective value and expected time of outcome (six of nine subjects). Some negative correlations were obtained for three of nine subjects between objective probability and length of the delay period. The positive correlations obtained were relatively low. In addition there was a slight tendency for the probability factor for low exponents to yield negative correlations between objective probability and the expected delay period. This tendency was not found for the value factor.

Table 14

Product-moment correlation coefficients between mean values of preference ratings, prizes and probabilities of lotteries - expected time of outcome

Subjects	M preference ratings	Prizes	p
1	0.48	0.87	0.00
2	Immediately for all stimuli		
3	0.92	0.54	0.54
4	0.43	0.88	0.00
5	-0.61	-0.20	-0.70
6	-0.31	-0.29	-0.29
7	0.43	0.90	-0.04
8	0.56	0.82	0.02
9	0.42	0.40	0.40

6.3 Discussion

The results of the model analysis must be interpreted with some care since it only included nine subjects. The multiplicative model obtained some support from the data, while the additive model could be ruled out as an explanation of the judgment process based on probability and value.

In the study by Sjöberg (1968) for example, where support for an additive model was found, graphic ratings were used with endpoints of the scale in the same manner as for category scales. Therefore, this additive combination obtained might be due to the rating scale used. In the present study magnitude estimations were used and support was obtained for a multiplicative combination of probability and value. This is in accord with a logarithmic relation between magnitude estimations and category judgments.

The exponents of probability and value showed a marked variation between subjects. One exponent of probability, -0.50, was quite unsatisfactory and might indicate a preference for low probabilities on the part of the subject concerned. The concept of probability was thoroughly explained to the subjects, but the possibility still exists, of course, that this subject confused the probability of winning and probability of losing. This exponent will, therefore, be excluded from further interpretations because of its extreme value.

The probability exponent for those subjects who followed a multiplying rule otherwise varied between 0.63 and 1.24. For the value exponent this variation was 0.44-1.89. The result of the present study thus displays a considerable variation in exponents.

Neither a multiplicative nor an additive model could be applied as a description of the judgment process of three of the subjects. Their ratings were influenced by context effects where the expected outcome of combinations of extreme values in the same direction for both value and probability were given low loadings. On the other hand, combinations with a high and a low value in the two variables were overestimated.

The interactions found for these subjects might tentatively be explained as a preference for extreme skewness. Long shots, or bets with a small probability to win but with a large prize if it comes off and betting on the "almost sure thing" with large probabilities and small wins were preferred. The preference was lower for gambles that fell in the middle of the skewness scale, a result that agrees with the results of Coombs and Pruitt (1960). In other studies (Lichtenstein, 1965; Slovic & Lichtenstein, 1968) no preference for skewness was found, however. In a review by Lee (1971) it is pointed out that skewness preferences sometimes obtain, or do not, for no clear reasons.

The analysis of expected time of outcome showed that most subjects had expected a delayed outcome of the lotteries. Only one subject had expected an immediate outcome for all lotteries. Rather short delays were expected and the delay periods varied between subjects. The short delays might be due to the restricted experimental situation and in another situation the expected delay periods would perhaps have been longer. It was also noted that the expected delay periods were generally shorter than the range of

delays (1 hr. to 2 wk.) used in other investigations on delay periods by the present authors.

A tendency was observed for positive correlations between stated preference for the lotteries and the expected time for obtaining the prizes. There was also a tendency for positive correlations between value and expected time, while there were relatively more negative correlations between the probability factor and the delay period.

The positive correlations indicated a compensatory behavior in which a positive outcome is assumed to be compensated for by a long delay period before the outcome occurs. This result might be explained by a positive value in one aspect balancing a negative value in another aspect which, in this case, is a longer delay period.

The result can also be explained by a self-control behavior where the subjects have learned that larger rewards generally occur after a delay period. In the present study this connection is relevant only for supposedly empty delay periods. This means that the prize was won only by waiting, and one may perhaps speculate that the correlations would have been higher if some effort was actually required.

In the present study a relationship tended to exist between expected time of the outcome and the perceived properties of the outcome; this implied that the expected delays were longer for preferable outcomes. The results of this study cannot be validated against other investigations, for no other investigations having the same purpose have been found by the authors.

7 STUDY 5

Research on delay behavior has generally been focused on different correlates of this behavior, e.g. age, sex, and the subject's time concepts. Delay processes among children have recently attracted a great deal of interest and Mischel (1974) has extensively reviewed research in this field. Lefcourt's research (for a review see Lefcourt, 1973) in which the locus of control is assumed to be related to delay behvior is one example, and another is Strickland's investigation (1973) relating internal locus of control to delay behavior among children. The experimental plan of these studies has generally put subjects in a situation where they have to choose between an immediate, smaller reward and a larger, later one; a choice of the delayed reward has been taken to indicate delay ability.

This experimental design has been criticized in the introduction for failing to provide a possibility of analyzing the process of judgment and an experimental plan that allows a detailed analysis of this process has been described and used in some of the previous studies on delay behavior. The processing of information from probability, value and time of outcome was, in this study, related to age. The use of simplifying strategies was looked for, since it was hypothesized that children in the youngest age group would simplify the processing of information. Earlier investigations have found that ability to tolerate delay increases with age. It was hypothesized that the youngest age group would attach the greatest and the adult group the least importance to the time factor. Another more tentative hypothesis was that the probability factor would be more important for the adult group than for any of the younger age groups, because this factor is a relatively abstract one.

A problem in developmental studies is that different age groups understand and value independent variables differently, so a pilot study was made to try to determine the extent of these differences for the variable of value.

7.1 Method

Ratings were made of offers to buy lottery tickets that varied as to time, probability, and value of outcome. The times were 1 hr., 1 day, 1 wk., 2 wk.; and the probabilities were 0.05, 0.15, 0.50, 0.95. The times were chosen as being about the same as in earlier developmental studies, and the probabilities were to cover a large range of probabilities.

In a pilot study prizes were estimated by people in three age groups: 5 to 6, 9 to 10, and adults. The first group comprised 34 boys and 36 girls (younger children), the second 34 boys and 40 girls (older children), and grown-ups 18 males and 55 females. The children in the first group were from nursery schools in Uppsala, those in the second were from primary schools in Sala; and the grown-ups were students of educational psychology at the teacher's training college and the University of Uppsala.

The children in the youngest group were tested separately while people in the other groups worked in groups 7 or 8. The younger children needed about 40 min., the older children about 20 min., and the grown-ups 15 min.

The instructions were as follows: 'Suppose that a grown-up has a certain amount of money. A grown-up person is here supposed to own 16 different sums. For evey sum he owns it must be said (in crowns and öre) how much money a child of 9 or 10 yr., and a child of 5 or 6 yr. must own in order to perceive his sum of money as large as the grown-up perceives his sum of money.' The same instruction was given to the different

age groups, but the instructions for the 5-to 6-yr.old children were adapted for them, and in some cases the sums of money were illustrated by means of circles of different sizes.

The arithmetical means of the estimations were calculated over the different age groups. The sums were rounded to give about the same kind of figures for different groups.

The average values chosen on the basis of the pilot study for the different age groups were:

5-6 yr.: 75 öre (about 15 cents), 1:25, 2:00 and 3:00 Sw.Crs.
9-10 yr.: 1:00, 1:50, 2:50 and 4:00.
grown-ups:1:25, 2:00, 3:50 and 5:50.

The stake was 25 öre for the younger children, 45 öre for the older children, and 50 öre for the grown-ups.

In the main experiment a Latin square design was used to combine the values of the independent variables. This generated the 16 lotteries of Table 15. Each lottery was rated three times, the order of presentation being random, and the position of the independent variables being rotated within subjects. Graphic ratings were used, because different age groups, including children of five and six, were taking part. The graphic rating scale was 15 cm. Unfavorable ratings were marked to the left, an favorable ones to the right, and the distance from the center denoted the extent.

Table 15
Sixteen lotteries used as stimuli in study 5

	Value				
	-:75	1:25	2:00	3:00	5-6 yr. old
	1:00	1:50	2:50	4:00	9-10 yr. old
p	1:25	2:00	3:50	5:50	grown-ups
0.05	a*	b	c	d	
0.15	d	c	b	a	
0.50	b	a	d	c	
0.95	c	d	a	b	

*a = 1 hr.; b = 1 day; c = 1 wk.; d = 2 wk.

The pilot study had found that a sum of money was rather too abstract for some children in the youngest age group, so in the main study the prizes and the stake were therefore expressed as marbles, the number of which equalled the numbers of monetary units.

For the grown-ups and the older children the concept of probability was illustrated by means of pie diagrams, and chances of winning or not were symbolized by slices of pie of different sizes. The chances were illustrated in the same way for the younger children who seemed to understand an explanation of the number of times that could be won or not; the different times were illustrated for them by lines of lengths proportionate to the times concerned.

Instructions were in writing and were also read aloud to the adults and the older children; the younger children heard the instructions and had them explained. The instructions stressed that responses were not right or wrong, but should express the subject's personal opinion of the offers; each offer would cost one ticket. Subjects were told not to think about ratings they had already done. They were also told that after making their ratings they would play the three lotteries rated by themselves as the most favorable of eight lotteries chosen at random. The subjects were also told the range of the times, the probabilities, and the prizes. Ten practice trials were performed to make sure the subjects had understood the instructions and the range of values. The younger children always made their ratings one at a time, while everyone else made theirs in groups of seven or eight. The subjects in the main study were 77 children (30 boys, 47 girls) aged 5 to 6 from nursery schools in Uppsala; 74 children (35 boys, 39 girls) from primary schools in Sala and 79 adults (25 males, 54 females) from two adults' residential colleges outside Uppsala; two grown-ups, out of the 81 asked, refused to participate. The younger children took about 45 min. to do the test, the older children about 30 min., and the adults about 20 min.

7.2 Results

The responses were scored by measuring the distance in mms. from the left endpoint of the scale. In Study 2 it was shown that about the same result was obtained when comparing unfavorable and favorable ratings as regards the exponents obtained for the three variables of time, probability, and value. This gave some support for measuring in positive numbers from the left endpoint for the graphic ratings used in the present study.

Individual data were analyzed to give a more detailed description of delay processes. For the F tests, moreover, the error variance would have been overestimated if pooled over subjects. The result of the F tests are reported in Table 16. As the non-significant

ratios might indicate lack of power of the test a relative comparison was made between the fit of the additive model and the multiplicative model.

Table 16

Number of non-significant and significant F rtatios for different age groups

Groups	n	Additive model in raw form			Multiplicative model in raw form		
		n.s.	p0.05	p0.01	n.s.	p0.05	p0.01
Boys 5-6 yr.	30	26	2	2	28	2	
Girls 5-6 yr.	47	33	5	9	40	3	4
Boys 9-10 yr.	35	28	2	5	31	2	2
Girls 9-10 yr.	39	31	3	5	31	4	4
Adults							
Men	25	9	4	12	18	5	2
Women	54	33	9	12	41	6	7

For all the groups there was a tendency for the multiplicative model to fit better, the evidence for this being strongest for the grown-up group and also relatively strong for younger girls, i.e., group 5 to 6.

The exponents of time, probability, and value are reported in Table 17. The median value of time was about the same for the different age groups, with a slight tendency for somewhat lower negative exponents for the younger children.

Table 17

Median value and range of exponents for different age groups

	Median value of exponents			Ranges of exponents		
	time	p	value	time	p	value
Boys 5-6 yr.	-0.03	0.17	0.52	-1.04-0.53	-0.79-2.58	-0.95-5.66
Girls 5-6 yr.	-0.01	0.28	0.49	-0.44-0.31	-0.41-3.50	-0.22-5.24
Boys 9-10 yr.	-0.06	0.36	0.53	-0.86-0.11	-0.86-2.28	-0.10-5.64
Girls 9-12 yr.	-0.04	0.14	0.34	-0.75-0.39	-0.36-2.10	0.33-2.46
Adults						
Men	-0.06	0.63	0.37	-0.51-0.13	-0.21-3.84	-0.37-1.79
Women	-0.04	0.50	0.37	-1.05-0.42	0.91-3.05	-0.84-4.87

The probability exponent showed a tendency to be higher for the grown-ups. The probability exponents were especially low, 0.17 and 0.14, respectively, for younger boys and older girls. The median exponent for value exhibited no larger variation between the different age groups, 0.34 to 0.53. The range of the time and probability exponents displayed no larger tendency to vary with age groups. On the other hand, a smaller range of the value exponents was found for older girls and adult males.

Product-moment correlations were computed for all subjects between the values of the independent variables and the preference ratings. In those cases where no model fitted individual data, simplifying strategies were examined in the light of the product-moment correlations; these were generally highest for the probability factor. This applied to all age groups. The adult group tended to produce slightly higher correlation coefficients for probability than did either of the other two groups.

7.3 Discussion

The tests showed that a multiplicative model fitted better than an additive model, particularly with the adult group and with the group of younger girls.

In the present study which employed a larger number of subjects the tendency was in favor of a multiplicative model which might indicate that it better describes delay processes. Behavior that follows a multiplicative rule may be taken to indicate more rational judgment and, as had been expected, however, that younger girls should show a slight predominance for the multiplying rule.

As the data from the two children's groups were probably variable, it was difficult to explain the behavior of these groups by the use of one or the other of the two models.

The value and time exponents were about the same for the three groups, and while it had been expected that the value exponents would be similar because the prizes were made equivalent in the pilot study, the similarity of the time exponents were unexpected. The time exponent was sometimes positive, being mostly so with the younger children (7 boys, 1 girls); there were positive exponents for the older children (4 boys, 9 girls) and for the adults (1 male, 4 females).

Earlier studies had found that younger children have less self-control than older children, something that is evident in their inability to wait for what they want. The results obtained in the present study were not only unexpected but also in disagreement with those of an earlier study (Örtendahl & Elwin, 1968) in which children 6- to 7- yr.-old preferred immediate smaller rewards to larger later ones.

The results for the time exponent for different age groups may be explained in part by a two-stage process (cf. Mischel, 1974) in which the subject first makes a choice of action and then experiences the delay consequent upon it. In the present study preference for different courses of action varying in time was about the same for different age groups as regards the time factor, but this should not be taken to imply, however, that the next stage, the delay period, was experienced in the same way by the different groups. The results of the present study thus apply only to the initial stage of preference for a particular course of action.

Another possible explanation of the unexpected results could be that the exponent of time varies with different ranges of values, if the values had not been made equivalent for the different age groups.

Earlier investigations have obtained varying exponents of value, and some, using grown-ups as subjects, have obtained exponents near 1, or close agreement between objective and subjective values (Tversky, 1967a, 1967b). Other investigations (see Lee, 1971, for a review) have obtained exponents smaller than this but still larger than the median exponent obtained for grown-ups in the present study; this was 0.37 for both males and females. The median value exponent for older girls was also small, 0.34, indicating a strongly decreasing marginal utility, while the exponents were somewhat larger, 0.52, 0.49, and 0.53, for younger boys and older boys. The exponents obtained for the younger age groups thus agreed with those in earlier investigations that had grown-ups as subjects.

The median probability exponent was, however, larger for the grown-ups than for the children groups, being 0.63 for adult males and 0.50 for adult females. It was especially small for yonger boys and older girls, being 0.17 and 0.14 respectively, implying a very small degree of differentiating at the subjective level between the different objective probabilities. If this is due to the abstraction of the concept of probability, it accords with the hypothesis presented in the introduction.

Earlier developmental studies that have found younger children to be unable to wait to get something they want have generally been designed to force a choice between two alternatives. The present study, however, asked for estimates of preference for different lotteries.

Some earlier investigations by Slovic and Lichtenstein (1968) and Lichtenstein and Slovic (1971) obtained results that indicated that preference for different bets could be explained by the type of response. Bidding indicated a preference for the values of the outcome, while choice and different scales made significant probabilities of the

outcomes. These results were explained by claiming that different strategies were used when determining preferences for the bets, and both choice and rating scales thus yielded about the same result of drawing attention to the probability variable.

Adults in the present study gave more attention to probability while the children gave more to value, when the exponents were compared between age groups. The response used in the present study was ratings. A tentative hypothesis to explain the results for the time factor might be that different strategies were used by different age groups to evaluate the favorableness of offers and also, to some extent, the time factor, when ratings were used as the response mode.

The results of earlier investigations of choice behavior which found that children could not accept delays might also be explained, tentatively, by saying that they derive from the use of different strategies. These heuristic rules applied to the time factor might then also be supposed to vary with different age groups but with the opposite effect when the response is choice behavior, an assumption that would account for the results of earlier developmental studies of delay behavior.

Simplifying strategies were looked for when no model could fit individual data and it was apparent, for all age groups, that the probability variable yielded the highest correlations with responses; that correlations in this factor tended to be slightly higher for grown-ups than for children accords with the larger exponents of probability for the adult group.

The variations of the value exponents were especially large for the younger children and for older boys, the exponents being in a few extreme cases up to about 5, meaning an extraordinary high utility of large objective values.

There were a few paradoxical negative exponents. A closer inspection of the data for the value and the probability factor indicated that subjects who had negative coefficients concentrated them in one of these factors and had positive coefficients in the other. This indicates that subjects who had negative coefficients used a simplifying strategy and concentrated on a single factor, generally value, for negative coefficients were mostly on probability.

To sum up, then, the authors used in the present study the same design as in some previous studies. The aim of all these studies was to describe the processes of judgment of a delay of gratification. The experimental design of the earlier studies was applicable to the investigations of the judgment behavior of different age groups, thus supporting the use of this design in further studies of the relationship between delay behavior and different personality characteristics of the subjects.

8 GENERAL DISCUSSION

Two models, one multiplicative and one additive, were tested on preference data in all studies. When the judgment process based on the factors time, probability, and value of the outcomes was investigated, the multiplicative model described it fairly well; this was so in all studies except in Study 3. An additive model showed in some cases good fit to the data, but had more often than not to be excluded as a basis for explanation of the judgment process when time was included as a factor.

In Study 3 neither a multiplicative nor an additive model could be well fitted to the data. This was so when power functions relating the subjective and objective variables were assumed. Bad fit was also obtained when a function assuming overestimation and underestimation of low and high probabilities, respectively, was tested for the multiplicative model. Simplifying strategies were investigated for the subjects in this study, and it is to be concluded that their judgments were based to some extent on at least the variables of probability and value.

All the studies produced evidence that the stronger models EV, EU, and SEV can be ruled out as explanations of the process. This is in accord with earlier studies that have found support for the SEU model (Coombs, Bezembinder & Goode, 1967; Tversky, 1967a, 1967b).

Studies in which improvement tests were performed (1,2 and 3) showed that, in general, an improvement was brought about that was as large for the introduction of a parameter for value as for one of probability. Testing the SEU_t model versus the SEU model mostly produced significant improvement in some cases only.

The exponents of time, probability, and value based on the multiplicative model in log form exhibited in most cases large inter-individual variation. The variation was larger than that generally found in other studies in which judgment has been based on value and probability. The addition of the time factor to the judgments apparently gave rise to the larger variability.

As the impact of the time factor on the judgments had not before been investigated similarly, the results of the time component may be considered as the most interesting.

The impact of the time factor was described by two different models; in the basic model it was assumed to describe a power relation between the subjective and objective variables. In the other it was expressed as a percentage of the payoff discounted per

hour. Rank-order correlations of size of the time coefficients obtained by the two models showed that about the same rank order for this factor was obtained.

Studies 1,2,3 and 5 in which the judgments were based on time as an included factor showed that the exponent of time derived from the basic multiplicative model generally received negative exponents.

Earlier studies on delay behavior have often related this behavior to age, showing that younger children often exhibit deficient delay behavior that indicates their preference for a smaller, immediate reward to a larger, later one (see introduction).

In the present developmental study no difference in the expected direction was obtained. Negative exponents were somewhat smaller in the younger groups than among the grown-ups. Different tentative explanations of this unexpected result were given in Study 5. One of them, perhaps the most interesting one, was based on assumed differences in strategies in determining preferences; they have been shown to vary with different response modes (Slovic & Lichtenstein, 1968; Lichtenstein & Slovic, 1971). Explanations of the present results are in part tentatively based on a use of strategies that differs between different age groups. This variation is also related to the response mode, in that it would explain the result of earlier developmental studies that have relied on choice behavior.

The main result of Study 4 was that positive correlations obtained between expected time of delay and, variously, ratings of favorableness, prizes of outcomes and, to a lesser extent, probability of outcome. The expected delay periods were not long, however, being shorter than delay periods of up to two weeks used in other studies.

The multidimensional scaling analyses were mainly intended to supplement the model analyses. The similarity data showed that the same factors generally obtained as for the model analyses on preference data, with probability, value, and time of the outcome as emerging factors. This indicates the same cognitive structure for the factors included but not for their weighting in the two different modes of response. The INDSCAL and TORSCA analyses yielded about the same result from similarity data. In some case, however, the interpretation was somewhat unclear, and one reason for this was probably the small number of stimuli (six or seven) included.

The method of analysis of preference data showed multiple regression analysis as capable of application to the incomplete design that had been chosen to reduce the working load of the subjects.

The model testings indicated that the judgment process based on time might be considered as rational for the studies tended to support a multiplicative combination of the factors of time, probability, and value of outcome. The present studies were based on a design used in earlier decision research in which judgments of probability and value have been studied and in which empirical support has generally been found for a log linear model; our design thus further supports it.

In some previous studies (see Study 2) an additive model has been supported by category data while a multiplicative model has been supported by magnitude estimation data. The same tendency was found here.

In summing up, the investigations involved an attempt to use functional measurement, which has been found useful within other areas of research (see e.g. Anderson, 1974), to the study of delay process. This approach also proved applicable in describing the impact of time on judgments and decisions, and its validity was tested to some extent by investigating the judgment process under varying conditions.

The studies performed introduced the time factor as a determinant for judgments and decisions. However, the decisions were restricted to a situation of gambling offers. Previous research has mostly focused on time discounting and monetary values. This applied to the present study, too,

Decisions where the timing of costs and benefits are spread over time, are common and important in every-day living. The ultimate value of this approach for studies on delay processes has, however, to be validated in further studies, and among those that might prove profitable are for example the processes of deciding in medicine. Decisions with the time factor are, to a very large extent, applicable to health behavior.

Health problems, like addictive behavior and the difficulties of preventive measures, have become increasingly important, and in recent years the problems of behavorial change have to a larger extent been explained through a time discounting effect.

Addictive behavior can be regarded as a temporal preference, where the immediate satisfaction of smoking a cigarette is preferred to a more remote goal of a smoke-free healthy life and a nonaddictive behavior. Addictive behavior could also be regarded as a time sequence where several decisions are made.

Thus, health and addictive behavior is a problem and a focus of interest, but the strategy may preferably be changed to interdisciplinary projects which focus on the individual and behavior. An advantageous approach would be to more extensively

investigate the impact of time on health related judgments and decisions, and the design in this study could then be used as a basis.

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III

STUDY VI

ADDICTIVE BEHAVIOR AS A DECISION WITH FUTURE CONSEQUENCES.

A STUDY OF QUITTING SMOKING BY PREGNANT WOMEN

Monica Örtendahl

1 INTRODUCTION

1.1 Health and time preference

Intertemporal choices, decisions where the timing of costs and benefits are spread over time, are common and important. Most decisions involve consequences that will show up to a full extent only in a remote future.

When it comes to decisions with future consequences very little research has been carried out. Examples of intertemporal choices are how much schooling and how long education to choose or how to invest money. The importance of time to the value of remote outcomes should also to a larger extent be taken into consideration in the attempts to explain addictive behavior, as it is evident that such behavior is not the result of one single action but a long series of actions.

In a way addictive behavior could be construed as a temporal preference, where the immediate pleasure of the addictive behavior is preferred to the distant far-fetched non-addictive behavior. In this behavior there is a time discounting effect as the value of the non-addictive behavior diminishes as a function of the time distance. The situation could be described as a choice between the immediate pleasure of having a cigarette and good health, or avoiding illness, in the remote future.

If a deferred gratification pattern is followed, eventually in the future a sound health and an improved economy could be gained, among other things. In many intertemporal situations involving self-control, humans are uncertain whether they could manage this rational long-term choice. Some people prefer the proximal addictive reward, then there is often a period of regret. It could also be the other way round, that the addictions give a short-sighted relief from unhappiness rather than obtaining happiness.

Many medical preventive situations involve exchange of costs today for benefits in the future. The preventive programs are intended to change behavior and to save for the future instead of consuming and living today. This implies a relative evaluation of immediate and delayed outcome.

Studies on time preference for health have either dealt with life saving (Moore & Viscusi, 1990; Horowitz & Carson, 1990) or health change (Lipscomb, 1989; Cairns, 1992). However, Olsen (1993) has pointed out that different methods have been used within the two areas to find out individuals' time preference rate. This complicates a comparison between these two areas.

When it comes to preventive health programs the difficulty of improving future health status is a well-established fact and time discounting can be found in health promotion and disease prevention. The value of for example non-smoking is very small because the benefits are obtained in the remote future. The low value of a far-fetched distant goal of a good health is explained by large discount rates within the area of health.

A positive discount rate for health outcomes would imply that a healthy state many years ahead has such a small value that it will be very hard to get people engaged in preventive behaviors. With a high discount rate this effect would increase and would explain the demonstrated deficient effects of preventive programs.

Other examples from the field of health behavior with a time effect are whether skin is exposed to excessive sunshine with a risk of later skin cancer. An example applied to children's health education is that with a regular brushing of teeth, decay will not occur later. Another example, especially for the health of women, is that drinking milk today to get the necessary calcium supply gives a reduced risk to develop osteoporosis in the future (U.S. Public Health Service, 1992).

Children and youth are to a large extent assumed to focus on the immediate (Humphrey, 1994). Recent research (Gardner, 1991) has pointed out that a deficient delay of gratification pattern is one of the best predictors of indulging in risky behavior in late childhood and adolescence. In this group, whose future is uncertain, large discounting and high risk-taking may be fairly rational. The general finding by Gardner (1991) that risk behaviors such as cigarette and alcohol use increase with age motivates an increased focus on children's and adolescent's health behavior in the future.

1.2 Previous research on time preference

The research tradition initiated by Mischel has related delay and time discounting to the factors of probability and value. Mischel and Staub (1965) proposed that delayed positive consequences are avoided due to an inability to conceive future events realistically. Mischel and Metzner (1962) assumed that waiting might be aversive. Also, the affective value of an outcome could be reduced by delay (Mischel & Grusec, 1967).

Self-control behavior, or waiting for the delayed larger reward and refraining from a small but immediate reward has been related to different antecedents, and it has been found that age, intelligence and social responsibility are positively correlated with delay behavior (Melikian, 1959; Mischel, 1966). In later work (Mischel, Shoda &

Peake, 1988) there was a slightly different opinion arguing that relatively stable personality traits interact with situations to produce behavior. Support for the interactionist perspective was obtained through data showing temporal consistency in some situations but not in others.

In recent work Mischel (1986) has proposed a two-stage theory. The first stage is the decision to postpone; it is a fairly neutral stage. During the second stage abstinence must be endured. Mischel's theory, thus, seems somewhat disjointed and changeable over time.

Örtendahl and Sjöberg (1979) and Stevenson (1986, 1992, 1993) have continued these studies on the time impact and the delay of gratification pattern where magnitude, probability and immediacy of outcome have been varied. Two models, one subtractive model and one ratio discounting model, were tested to describe the change in value as a function of temporal distance. Anderson and Shanteau (1970) and Lynch (1979) had earlier found the ratio operation to be more appropriate for describing the discounting function if future outcomes are considered to be risky. Stevenson (1986) obtained support for a ratio discounting function for time. However, Stevenson (1993) found that for events presented in a series, discounting was eliminated. This indicates that temporal discounting is a complex process. It does not always occur, and when found, it is found to vary over situations.

1.3 Economic theories

So far the psychology of human decision making has not paid much attention to the factor of time. This area of research has focused on the importance of probability and utility in decisions. Economists have argued that human beings usually make rational choices disregarding time preferences and seemingly, at times, viewed research on the psychology of decision making almost as a nuisance. Little is known from experimental psychology about the time perspective and, when investigated, rather short time perspectives have been employed.

However, Ainslie (1975) has initiated a tradition of research on self-regulation and self-control behavior from a consumer's point of view. Impulsiveness or maladaptive behavior implies preferring immediate to more remote outcomes. The value of these remote outcomes diminishes with time, that is, the value of the future is discounted. A rational discounting is generally considered to follow a fixed rate per unit of time. This gives an exponential curve for the discount function.

However, these discount curves do not give a crossing over of curves as a function of time. Other discount functions are needed to explain conflicts between immediate and delayed consumption of the same value and some empirical support has been found for hyperbolic time discounting (e.g. Ainslie, 1975; Mazur, 1987; Kahneman, Slovic & Tversky, 1982; Herrnstein, 1990). A crossing over of curves could occur with hyperbolic functions as they are more concave than an exponential function (see Figure 1).

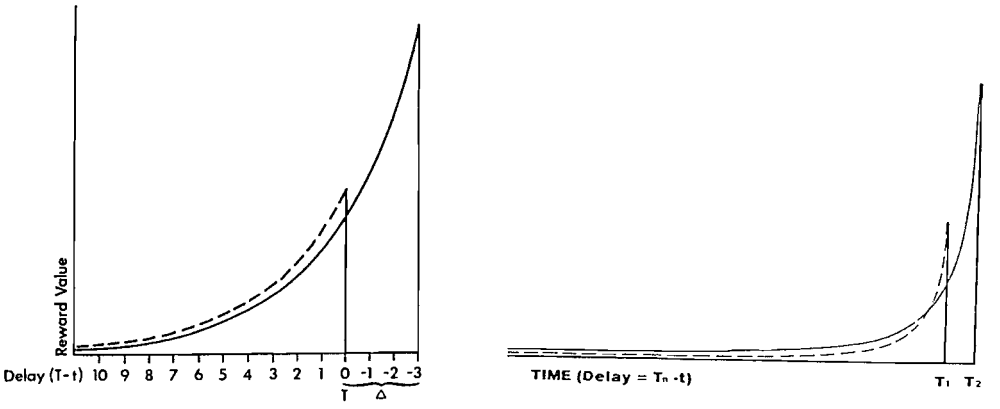


Figure 1. Exponential and hyperbolic curves of the value of a reward.

With this function a crossing of curves is obtained, describing the motivating effect of behavioral consequences. A reversal of choice could thus occur as a function of delay time, accompaning a fast decrease in reward value (Vaughan & Herrnstein, 1985).

Reversal of preference with time elapse has been found with animals (Navarick & Fantino, 1976; Ainslie & Herrnstein, 1981; Boehme et al., 1986) and human beings (Solnick et al., 1980; Ainslie & Haendel, 1983). Both animals and humans have been demonstrated to be disproportionately sensitive to short compared to long time delays. This implies time inconsistent behavior (cf. Strotz, 1955). The larger reward could, however, be obtained by changing the discounting functions. It has been demonstrated by Fantino (1966) and Mazur and Logue (1978) that animals reject a smaller immediate reward in favor of a larger later reward with increasing experience of the choice situation.

Loewenstein and Thaler (1989) and Loewenstein (1992) have also studied decision-making and self-control behavior from the point of view of economics. High discounting rates have been found (e.g. Gately, 1980) with figures varying around 45-130 percent for refrigerators differing in energy consumption. Ruderman, Levine and McMahan (1986) found discount rates up to 243 percent for electric water heaters. In a study by Benzion, Rapoport and Yagil (1989) discount rates were found to decline with time, and to be high for small amounts (less than 100 dollars), and higher for gains than for losses.

Consumers have been found to prefer an increasing income stream over time. This could according to Loewenstein and Thaler (1989) be explained by loss aversion implying a preference for an increasing consumption profile. Lack of self-control gives a desire for an increasing income profile as consumers think they lack the self-control to be able to save enough from the present income. Loewenstein and Thaler proposed different methods to handle impulses, of which personal rules are the most important.

The hyperbolic discounting model proposed by Herrnstein (1974) and Ainslie (1975) has been applied to addictive behavior (Ainslie, 1980; Ainslie & Schaeffer, 1980). According to the theory, there will be an increase of value with time both for quitting the habit and for taking up the habit and a relapse would occur when the two curves cross. The crossing will occur when the value of relapse exceeds the abstinence value. For example, in smoking the immediate pleasure of smoking surpasses the value of the late and larger reward of a smoke free life.

Hyperbolic discounting curves have also been found when investigating values of a mother during childbirth (Christensen - Szalanski, 1984). Before and after childbirth the mothers considered delivering the child without anesthesia was more important than avoiding the pain associated with hard labor. However, during active labor their preference shifted to the inverse preference. This pattern of preference change might also be applied to other health-related choice situations.

The processes of self-control are complicated and interact with one another, but do not lead to rational behavior as people are often guided by short-sighted interests. To be able to neglect the smaller rewards and obtain impulse control Ainslie (1992) proposed the use of private side bets. In this way information could be obtained and cues in behavior would be used to predict future behavior. If this does not give the desired result a second possibility is, according to Ainslie, to create categories of gratification in order to delay behavior to be avoided or pursued.

1.4 The Value Model and the Action Model

Will, principles to control impulsiveness, has been described by early psychologists such as Bain (1886) and James (1890). After that, the concept of will power practically disappeared to be revived in the research of Sjöberg. In a recent review (1993) he has related will to decision, motivation and cognition, and he has defined will (p. 3) 'as a collective term denoting processes of the regulation of action'. Motivation is connected to the generation of goals. The inability to reach the goal of nonaddictive behavior is caused by emotional arousal; either a positive or a negative one. The emotional arousal costs mental energy and this brings about twisted reasoning and a shortened time perspective. A shortened perspective implies that temporary exceptions are allowed from the main decision to quit. Less mental energy will remain to consider long term consequences. This reasoning could also be applied to interests and pursuing an education (Sjöberg, 1994).

Ainslie's model has been criticized by Sjöberg (e.g. 1983) for not taking into consideration that emotional stress usually is an antecedent to irrational and short-sighted behavior.

Another point of criticism is that Ainslie makes no difference in opinion as regards anticipated time of the outcome and time elapsing after a decision is made. But as is pointed out (e.g. Sjöberg & Olsson, 1981; Sjöberg, 1983) time elapsing may have its own effect. Ainslie (e.g. 1975) based data only on anticipated waiting time, but as is

pointed out by Sjöberg (e.g.1983) the most aversive experience could be the actual time of waiting.

Moreover, as pointed out by Sjöberg, Ainslie's model is based on animal data and the anticipated waiting times are short (less than one hour) which hardly could be applied to addictive behavior. To reach a smoke free life more than one hour of waiting is necessary; it is a question of months or even years.

Another critical point, also by Sjöberg, is that in quitting addictive behavior the reward is gained along a continuum, not momentarily once in the future. Addictive behavior furthermore implies multidimensional values; values pointed out by Sjöberg (1993) are health, economy, social relations and mood states. To get a complete description of addiction all these aspects must be considered.

Finally, decision research in the field of addictive behavior should be based on both the value and the probability of outcome. The last factor, probability, has not been taken into account in Ainslie's model, by Sjöberg called the Value Model.

Instead, Sjöberg has proposed a model, called the Action Model, which is based on both factors of values and beliefs. This model has been investigated by Sjöberg and co-workers (Sjöberg & Samsonowitz, 1978; Sjöberg & Johnson, 1978; Sjöberg & Persson, 1979; Sjöberg, 1980; Samsonowitz & Sjöberg, 1981; Sjöberg & Olsson,1981; Sjöberg, 1983; Sjöberg, Samsonowitz & Olson, 1983; Sjöberg & Samsonowitz, 1985). Support was obtained for biased thinking from increased belief-value correlations; a negative correlation between beliefs and values for smoking and a positive one for non-smoking. According to this model twisted reasoning is supposed to cause volitional breakdowns.

1.5 Purpose of the study

The purpose of the present study was to investigate the validity of the two models, the Value Model and the Action Model, described above, to explain addictive behavior.

To summarize, the two models differ in how action is supposed to change under the influence of changing values. The Value Model predicts that action follows from values in a straightforward manner; the dynamics are provided by internally generated value change over time. The Value Model predicts values of both abstaining and of taking up the habit again to increase, but at different rates. In the Action Model action is supported by biased thinking; optimistic bias improves mood and strengthens action. Wishful thinking or optimistic bias is reflected in a high positive correlation between beliefs and values; the alternative of not smoking should obtain a sizeable positive correlation between beliefs and values and that of smoking a negative one.

The general strategy of the study was to follow a number of smokers after the initiation of an attempt to quit. Their values related to smoking and not smoking were studied over time. The variables of value, probability and time of outcome have earlier been investigated (studies I-V) in five different studies. Therefore, in the present study

applied to a health-related domain, addictive behavior, the relationship between these three variables was further investigated from different aspects.

In addition, most analyses were performed separately on four different subgroups formed by the variables of pregnant/non-pregnant and quitting/non-quitting, as the subgroups were expected to be influenced by their personal health situation.

The design has earlier been tested in a study by Sjöberg (1983) and found to be favorable for exploring the field of quitting smoking. It generates a wealth of information and allows for testing of the two models.

2 METHOD

2.1 Subjects

Data were collected in Bulgaria. Women, half of the group pregnant, were selected as subjects as it is an important group as regards health behavior. Younger women are a group that to a large extent starts smoking.

The respondents were 80 women smokers, 40 of them pregnant, 40 non-pregnant.

More specifically, four different groups were included:
A. Smoking pregnant women, did not try to quit smoking.
B. Smoking pregnant women, tried to quit smoking.
C. Smoking non-pregnant women, did not try to quit.
D. Smoking non-pregnant women, tried to quit smoking.

20 in each of the groups A-D, in all 80 subjects, were included. They were matched in age and education.

The mean age of the total group was 25.1 years, SD= 3.86 years. Age range:
20 - 31. All of the subjects had had high school. They had been smokers an average of 6.4 years (SD=3.71). The years of smoking varied from 1 to 16. They smoked an average of 10.5 cigarettes per day (SD=3.86); minimum=2 and maximum=20.

All of them were recruited after informal contact. They (group B and D) decided to quit smoking during their participation in the study.

2.2 Specifications of the sample

Table 1 *Specification of the sample based on age, months of pregnancy, number of years of smoking and number or earlier attempts to quit*

Age	**A**	**B**	**C**	**D**
M	24.1	25.15	24.50	26.65
SD	3.28	3.96	4.10	3.86
Min	20	20	20	20
Max	30	31	31	31

Number of years of smoking	**A**	**B**	**C**	**D**
M	5.50	5.75	6.0	8.65
SD	3.15	2.51	4.07	4.22
Min	1	3	1	2
Max	11	13	15	16

Number of earlier attempts	**A**	**B**	**C**	**D**
M	1.80	2.37	1.70	4.0
SD	2.63	2.22	2.18	2.96
Min	0	0	0	0
Max	10	10	9	12

Number of cigarettes per day	**A**	**B**	**C**	**D**
M	9.35	11.20	11.35	10.20
SD	4.57	4.66	5.04	3.86
Min	4	4	4	4
Max	20	20	20	20

Months of pregnancy	**A**	**B**
M	4.80	4,85
SD	1.54	1.93
Min	2	2
Max	8	9

2.3 Procedure

The subjects were given eight questionnaires, one for each day of the first week and one for day 14 following the start of their attempt to stop or reduce smoking. They were instructed to respond to each questionnaire at approximately 6 pm each day and not to check previous questionnaires at any one day, but to answer as they felt today, right then. If they gave up the attempt, the questionnaire for that day was to be their last. Respondents who gave up were not included in data analysis. The exception was if they smoked only one cigarette during the two week period of the study. Twelve subjects failed in their attempt to quit and they stopped to participate in the study from the day of their relapse. Other subjects were invited in order to attain the number of 20 subjects for each group.

Three sets of questionnaires were not useful for analysis due to a lot of missing data, and three other respondents were recruited to participate.

The data were collected in October - December, 1994. The pregnant women were met in district policlinics in Sofia when under medical observation during pregnancy.

2.4 Questionnaires

There were three versions of questionnaires, intended for day 1, days 2-7 and day 14, respectively. These versions differed for each group of respondents, because the factors 'pregnant/non-pregnant', and 'try to quit/not try to quit' defined the design of the questionnaires for each group.

The question concerning pregnancy was only included in the questionnaires for pregnant women groups (A and B).

There were three versions of the questionnaire.

Version 1. Subjects were asked about their background data and their evaluation of smoking at the moment (for or against). They also made evaluations of their health motivation and health consciousness (see Table 2 in appendix). The quitters were asked about how resolute they were in their attempt and how likely they were to succeed in their attempt (group B and D).

All subjects then made ratings of 35 events and states. The events and states had been used in an earlier study (Sjöberg, 1983). The events and states were selected to cover as completely as possible both positive and negative aspects of continued smoking and of quitting. Pregnant women (groups A and B) rated an additional 9 events and states (36-44) related to smoking and pregnancy.

Events and states are given in Table 3 in appendix. All rating scales, unless otherwise stated, consisted of seven categories.

All events and states were presented in a random order given in Table 3 , always to be used in all subsequent sections of different types of ratings of these events and states. They were rated in terms of how bad or good they were on bipolar ratings (*value ratings*).

Then the subjects made ratings of *probability* and *time*:
a. given continued smoking
b. given quitting or smoking for each of the 35 events and states; for pregnant women including the additional 9 events and states (36-44).

Version 2. (used at days 2-7): In addition to making ratings of the events and states, subjects were to report if they had kept to their commitment and, if not, to report their mood at the time of the failure in terms of tension, activation and hedonic value; three basic mood dimensions according to Sjöberg, Svensson and Persson (1979). They were then to describe the circumstances of relapse in terms of situation, reasoning when they decided to smoke, feeling after smoking, and current feeling about smoking and quitting smoking.

They were also asked about whether they would try to quit again, how resolute they were in their attempt and to judge how likely they were to succeed to quit. Finally, all subjects (also non-quitters) were asked how they liked smoking.

Version 3. The same as version 2, but in addition, on day 14 they rated how often 11 different coping techniques (Table 3 in appendix) were used when abstaining from smoking. Each technique was rated on a 7-point category scale (never - almost all of the time).

3 RESULTS

3.1 Index construction

For some of the variables the subjects were to rate events. The events were expressed as both negative and positive ones. The subjects were asked to perform the ratings as regards
-the value, if it was good or bad, if the event should occur
-how likely the events were, if they went on smoking
-how likely the events were, if they quit smoking
-when the events would happen, if they went on smoking
-when the events would happen, if they quit smoking.

It was argued in the same way as in the work by Sjöberg (1983), that the main issue was to describe the overall evaluation of the choice alternatives and that they were relevant to decision making.

The homogeneity of the events and states was investigated by means of a factor analysis of the value ratings. Four factors, accounting for 42 percent of the variance,

were extracted and rotated obliquely. The same events and states were used as by Sjöberg (1983), and the same two factors could be extracted and interpreted in a meaningful way. These two factors were identical with the factors found by Sjöberg in the previous study. Thus, one factor was loaded in events and states (see Table 3) 2, 3, 10, 11, 34. These events were oriented toward somatic health effects. This factor will, in the same way as in the study by Sjöberg, be called Soma. The other factor was loaded in events 21 (-), 22(-), 28 (-), 29(-). These events are oriented towards moods and social relations. In accordance with Sjöberg it will be called Rel. Hence, the factors of Soma and Rel were the same as the two factors found by Sjöberg for the same collection of events and states. This provides validation of the factors. Intercorrelations obtained showed that the selected variables formed fairly homogeneous clusters.

In addition, a third factor was found, related to the state of pregnancy. This factor, called Grav, was loaded in events 37, 38, 39, 40, 41, 42, 43 and 44, all the events related to pregnancy. For further analysis some transformations of the primary data were performed.

Value ratings were transformed to obtain the range -1 to +1.

Value	***Soma and Grav***	***Rel***
old values	***new values***	***new values***
1	-1	1
2	-.67	.67
3	-.33	.33
4	0	0
5	.33	-.33
6	.67	-.67
7	1	-1

The variables of probability and time were transformed to the range 0-1

Probability and time	***Soma and Grav***	***Rel***
old values	***new values***	***new values***
1	0	1
2	.17	.83
3	.33	.67
4	.50	.50
5	.67	.33
6	.83	.17
7	1	0

The variables of Rel were expressed as positive events, whereas the Soma and Grav variables were expressed as negative events. To make them comparable in that respect the events of Rel were transformed to negative variables.

Value (A):

The transformations performed (translation and normalization) were:

$$A_{Soma} = \frac{x-20}{15} = \frac{(translation)}{(normalization)}$$

$$A_{Rel} = \frac{16-x}{12}$$

$$A_{Grav} = \frac{x-32}{24}$$

Probability (B, C) and time (D, E):

The transformations (translation and normalization) performed were:

$$(B,C,D,E)_{Soma} = \frac{x-5}{30} = \frac{(translation)}{(normalization)}$$

$$(B,C,D,E)_{Rel} = \frac{28-x}{24}$$

$$(B,C,D,E)_{Grav} = \frac{x-8}{48}$$

where x denoted the sum over variables and number of variables are:
Soma = 5, Rel = 4, Grav = 8

The data were analyzed separately for the two main groups pregnant, non-pregnant (1 and 2), and the four sub-groups.

3.2 Plan of results reported

I Ratings of the variables value, probability and time
This first analysis was performed to study how the ratings of the three separate variables of value, probability and time of outcome changed over time. This analysis was done in order to obtain information about estimation of value, probability and time related to the 35 events and states, and the additional 9 events and states for pregnant women. For the variables of probability and time information was obtained for the two conditions:
a) given continuing smoking
b) given quitting smoking.

The analysis was performed on the three separate factors of Soma, Rel and Grav. In addition, the results were analysed separately for the four different subgroups formed

by the variables pregnant/non-pregnant and quitting/ non-quitting. All analyses were related to changes over time to get information about processes during an attempt to quit smoking.

Therefore, for each group and for every day mean ratings were computed of:
-the value, if it was good or bad, if they should occur
-how likely the events were, if they went on smoking
-how likely the events were, if they quit smoking
-when the events would happen, if they went on smoking
-when the events would happen, if they quit smoking.

II The product of value and probability
This analysis was performed to study the expected utility of smoking, given continued smoking and given quitting smoking. The analysis was performed to test the Value Model and to make a comparison possible with results earlier obtained in the study by Sjöberg (1983), where the product of value and probability also was computed.

For the three factors of Soma, Rel and Grav, and for each of the days (1-7, 14), the pooled products value*probability were calculated. This work was done twice:

1. Product = value*probability, given continued smoking (AB). This was the expected utility for smoking.

2. Product = value*probability, given quitting smoking (AC). This was the expected utility for not smoking.

III Expected utility difference between smoking and not smoking over time
This analysis was performed to study the difference between the alternatives of smoking and not smoking as regards expected utility.

For a more detailed testing of the Value Model, in the same way as performed by Sjöberg (1983), these differences were computed for the variables of Soma and Rel. In the present study the variable of Grav was also analysed in testing of the model, as the condition of being pregnant might be expected to have an impact on the estimations of events and states.

Mean utility differences between Not Smoke and Smoke for Soma, Rel and Grav as a function of time elapsed since the initiation of the attempt to quit smoking were computed.

IV Correlations (intra-individual) between value and probability
This analysis was performed to study the concordance between estimations of the two variables of value and probability of the events in order to test the Action Model.

Earlier studies by Örtendahl and Sjöberg (1979) had shown intricate relationships between these variables in gambling situations. The relationship between these two variables with an assumed time effect was further tested here in a health-related situation of addictive behavior. The analyses were preformed on different subgroups

formed by the variables of quitting/non-quitting and pregnant/non-pregnant. The results are reported under the following headings:

3.3.1 Pregnant/Non-pregnant
3.3.2 Pregnant-Not trying to quit/Pregnant-Trying to quit
3.3.3 Non- Pregnant/Not trying to quit/Non-Pregnant-Trying to quit

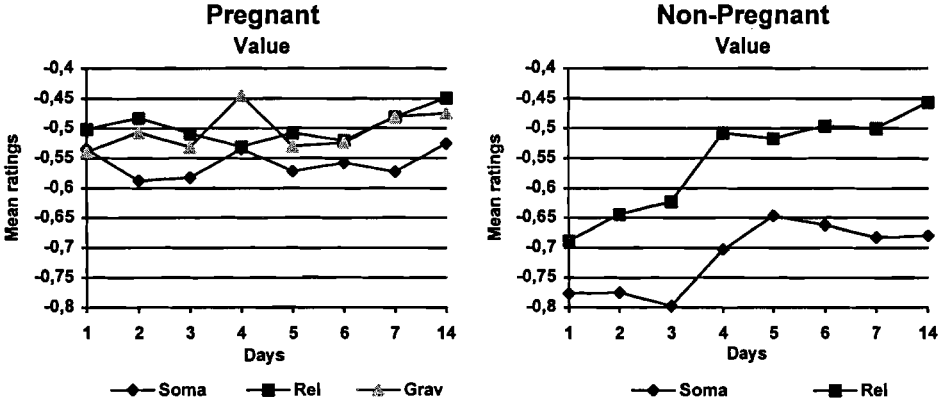
3.3 Results

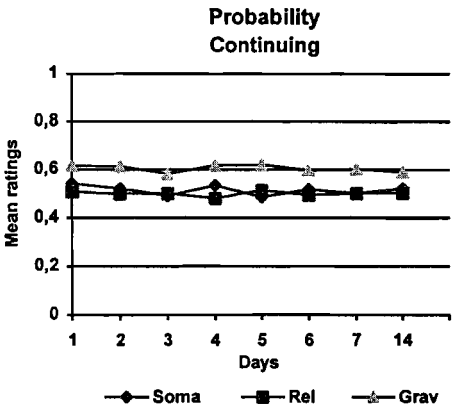
3.3.1 Results

I Ratings of the variables value, probability and time.
Pregnant/ Non-pregnant

For each group mean ratings over time were computed of:
-the value, if it was good or bad, if they should occur
-how likely the events were, if they went on smoking
-how likely the events were, if they quit smoking
-when the events would happen, if they went on smoking
-when the events would happen, if they quit smoking

The means are given in Figure 2.




Probability
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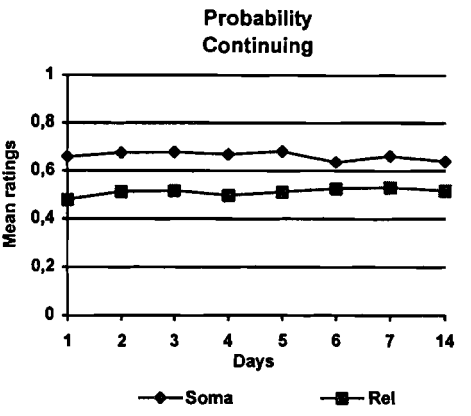
0,4
0,2
0
1 2 3 4 5 6 7 14
Days
Soma
Rel
Grav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Mean ratings
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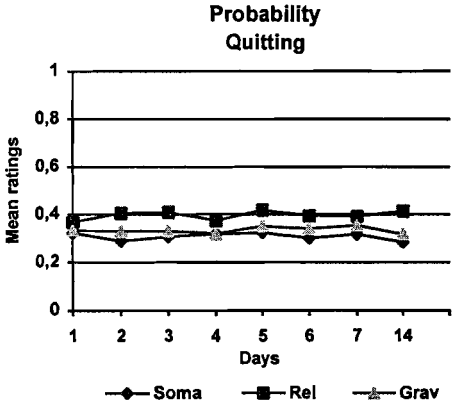
0,6
0,4
0,2
0
1 2 3 4 5 6 7 14
Days
Soma
Rel


Probability
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Mean ratings
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0,4
0,2
0
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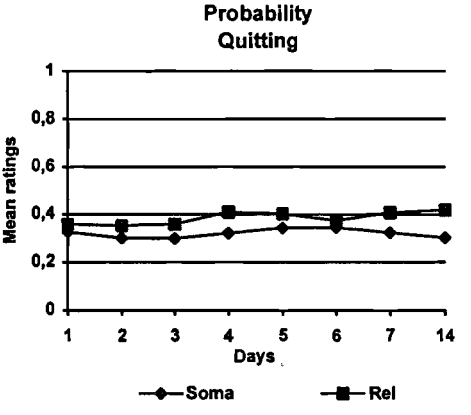
Days
Soma
Rel
Grav


Probability
Quitting
Mean ratings
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0,6
0,4
0,2
0
1 2 3 4 5 6 7 14
Days
Soma
Rel

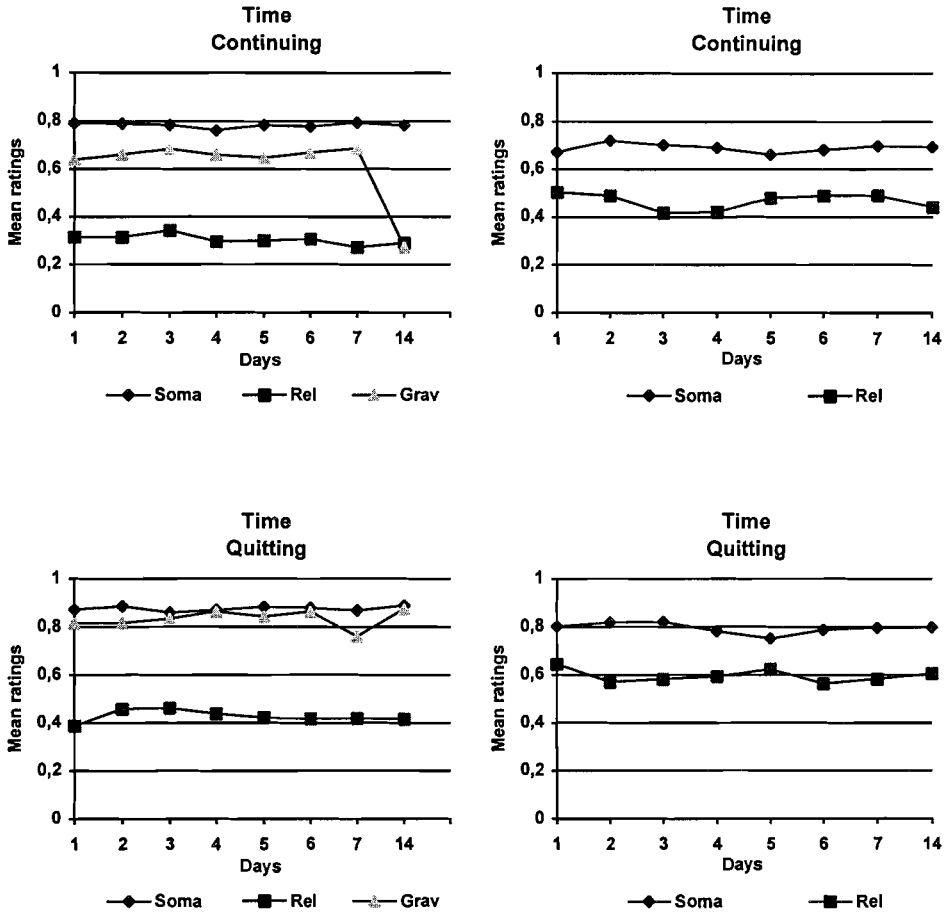


Figure 2. Ratings of the value, probability (given continuing and quitting smoking) and time of events (given continuing and quitting smoking) over the time period; Pregnant and Non.Pregnant

-the value, if it was good or bad, if they should occur

The means were plotted over time - from day 1 to day 14. For non-pregnant women the values were rated quite negatively at start, but became somewhat less negative. The value was estimated as somewhat less negative during the period until day 4-5, and after that there was no change. However, the change in estimations during day 1-4 was small, and the estimations were all the time quite negative. For non-pregnant the Rel variable was less negatively rated compared to the Soma variable. The Grav variable was varying somewhat over time, and estimated as less negative at day 4.

-how likely the events were, if they went on smoking
For non-pregnant women there was a difference in estimation of the probability between Soma and Rel. This did not apply to pregnant women - for them the Grav variable was estimated as a little more probable compared to the other two variables.

-how likely the events were, if they quit smoking
For both groups the probability of the event to occur was rated as less likely to occur if they quit smoking. This seems reasonable, as the events were expressed as negative aspects of smoking.

For the pregnant group the effect of quitting smoking was considered as somewhat more pronounced for the variable of Grav. This result also seems reasonable. For the non-pregnant group the effect of quitting smoking had the largest impact on the probability for the Soma variable to occur - it was considered less probable if quitting smoking. This, too, seems a a reasonable result.

-when the events would happen, if they went on smoking
The Rel variable was supposed to occur earlier compared to the Soma and Grav variables. This meant a shorter time span for the Rel variable compared to the Soma and Grav variables.

-when the events would happen, if they quit smoking
The negative effects of smoking were rated to occur somewhat later if quitting smoking.

Pregnant women: the Rel variable was estimated to occur approximately in 3-4 weeks, if continuing smoking, and approximately 2-6 months, if quitting smoking. The Soma variable was estimated to occur 13 months or later if continuing and 13 months or later up till never, if quitting. For the Grav variable the ratings were 7-12 months, if continuing, and 13 months or later, if quitting.

Non-pregnant women: The negative effects of the Rel variable was estimated to occur approximately in 2-6 months, if continuing smoking, and 2-6 months to 7-12 months if quitting smoking. The Soma variable was estimated to occur in 7-12 months, if continuing, and in 13 months or later, if quitting.

In summing up, all the negative effects of smoking for all the variables of Rel, Soma and Grav were estimated to occur later if quitting smoking.

3.3.2 Results

I Ratings of the variables value, probability and time
Pregnant women, not trying to quit /Pregnant women, trying to quit

-the value, if it was good or bad, if they should occur
There was no clear trend, but the Soma factor was estimated as somewhat more negative compared to Rel and Grav, both for not trying to quit smoking and for trying

to quit smoking. For those trying to quit the value between day 7 and 14 was becoming less negative; for those not trying to quit the value between day 7 and 14 was becoming more negative.

-how likely the events were, if they went on smoking
For those trying to quit the estimations were somewhat more likely, and for both groups the Grav variable events were estimated as most likely to occur compared to the other two variables.

-how likely the events were, if they quit smoking
The probability of a negative event to occur was estimated as less likely if quitting smoking compared to the likelihood for the events to occur if continuing smoking. This applied both to those trying to quit and those not trying to quit. The difference between estimations, given continuing and quitting, was largest for the quitting women. The lowest probabilities were, as expected, for those trying to quit with the estimated condition how likely the events were if they quit smoking.

-when the events would happen, if they went on smoking
There was no large difference between the two groups pregnant women, not trying to quit and pregnant women, trying to quit. Moreover, for both groups- trying to quit and not trying to quit - the Rel variable was estimated to occur closer in time.

-when the events would happen, if they quit smoking
There was no large difference between the two groups.
The Rel variable was also in this condition estimated to occur closer in time.

Also for the groups pregnant women, not trying to quit and pregnant women, trying to quit the negative effects of all the variables Rel, Soma and Grav were estimated to occur later if quitting.

3.3.3 Results

I Ratings of the variables value, probability and time
Non-Pregnant women, not trying to quit/ Non-Pregnant women, trying to quit

-the value, if it was good or bad, if they should occur
There was no large difference in estimation between the two groups-not-pregnant women not trying to quit and trying to quit. For both groups the variable of Soma was estimated, as more negative compared to the Rel variable. For those trying to quit there was no discrepance betwen Soma and Rel when starting the attempt to quit smoking.

-how likely the events were, if they went on smoking
For both groups the variable of Soma was estimated as more likely to occur compared to the Rel variable.

-how likely the events were, if they quit smoking
The variable of Soma was now estimated as more unlikely to occur compared to the Rel variable. For both groups the relationship between Rel and Soma had changed. If quitting, the negative effects were generally estimated as less likely to occur.

-when the events would happen, if they went on smoking
For both groups the Rel variable was estimated to occur closer in time compared to the Soma variable.

-when the events would happen, if they quit smoking
Also for this condition the Rel variable was estimated to occur closer in time compared to the Soma variable. If quitting the events were generally estimated to occur later.

3.3.4 Summary of results

I Ratings of the variables value, probability and time

In summing up the results for the separate groups of pregnant/non-pregnant women for the different variables, it was shown that the Soma variable was rated as more negative than the Rel variable. The Grav variable on rated over time showed somewhat less negative ratings at day 4. It could be speculated that this is due to short-term transitory effects. When estimating the likelihood for events to occur, there was a difference between Soma and Rel for the non-pregnant group. If continuing smoking the Soma variable was more likely to occur than the Rel variable. If quitting smoking the Rel variable was more likely to occur than Soma. For the pregnant group there was a slight difference between Grav and the other two variables when continuing smoking.

If quitting smoking, the negative events and states were in general rated as less likely to occur. If continuing smoking the negative effects first affected the Rel variable, but if quitting, the negative events for all the variables of Soma, Rel and Grav were rated to occur somewhat later.

Analysis was also performed on the four subgroups formed by pregnant/non-pregnant and quitting/non-quitting. For pregnant women, with trying and not trying to quit constituting two separate groups, the analysis showed that the Grav variable was rated as most likely to occur if continuing smoking. This could be interpreted as Grav being the most important variable for the judgments performed by pregnant women in this respect.

There was no large difference between trying to quit and not trying to quit. For all conditions the Grav variable was a little more stressed and the Rel variable was affected earliest. One difference obtained was, that for those trying to quit the value became less negative between days 7 and 14. The opposite trend was obtained for those not trying to quit. A hypothesis is that the negative effects for those trying to quit occurred within a short time period.

Analysis was also performed separately for non-pregnant not trying and trying to quit. For all the groups (A-D) Soma was rated as somewhat more negative compared to Rel. If continuing smoking, the negative effects of smoking were judged as most likely to occur for Soma, but if quitting most likely for Rel.

In summing up, there was no large difference between the four different groups formed by pregnant/non-pregnant and quitting/non-quitting when rating the states and events.

For pregnant women the Grav variable was estimated somewhat different compared to the Rel and Soma variable. For the non-pregnant women the Soma variable was more affected by smoking than was the Rel variable. A larger difference was obtained for the probability of somatic events and states to occur between the conditions of continuing and quitting smoking than for the Rel variable. Some short-term effects could be noted, but no general trend over time.

What factors influenced judgments of the separate variables of value, probability and time in women was to some extent depending on bodily conditions like being pregnant or not. One example of this is, the estimations of value of events and states over time, where a difference was obtained between pregnant and non-pregnant women, the non-pregnant becoming somewhat more positive in judgments over time. Being pregnant also had an influence on ratings of likelihood if continuing smoking, the variable of Grav being estimated as somewhat more likely to occur compared to the variables of Soma and Rel.

The relationships between the three extracted variables of Soma, Rel and Grav varied with different groups of being pregnant or not, if continuing smoking. Also the variable of not trying to quit/trying to quit had an impact on the relationship between the variables of Soma, Rel and Grav, for example in the case of the probability variable. If quitting smoking and being non-pregnant, the negative effects on the variable of Soma was considered as less likely to occur than the variable of Rel. If continuing smoking the opposite relationship between Rel and Soma was obtained, with the negative effects of smoking more likely to occur on the variable of Soma. For all the groups, the negative effects of all the variables Rel, Soma and Grav were estimated to occur later it quitting. In some specified cases time had an affects on judgments related to health. However, to what extent time had an effect varied somewhat depending on value, probability (given continuing smoking and given quitting smoking), and time (given continuing smoking and given quitting smoking). If quitting smoking, the probability of negative events to occur was estimated as smaller, and they also were estimated to occur later.

The time effect also varied with pregnant/non-pregnant and quitting/non-quitting For non-pregnant women, not trying to quit smoking there was a slight tendency to become less negative during the time period. This was not evident for pregnant women, both not trying to quit and trying to quit. The time effect also varied with with functions related to somatic variables (Soma), relational variables (Rel) and pregnancy variables (Grav). Finally, the time affects could be observed over all the time period and as transitory short term effects.

3.4 Results

II The product of value and probability

For the three factors of Soma, Rel and Grav, and for each of the days (1-7, 14), the pooled products value x probability were obtained. This work was done twice:

1. Product = value * probability, given continued smoking (AB = Smoke). This was the expected utility for smoking.
2. Product = value * probability, given quitting smoking (AC = Not Smoke). This was the expected utility for not smoking.

The products of AB and AC were computed for all subjects for each day separately. There is a difference compared to computing for each individual separately when there are data missing. At inspection of data very few missing data were found, and the procedure chosen, therefore, seemed appropriate.

The overall difference in expected utility of smoking and not smoking obtained was:

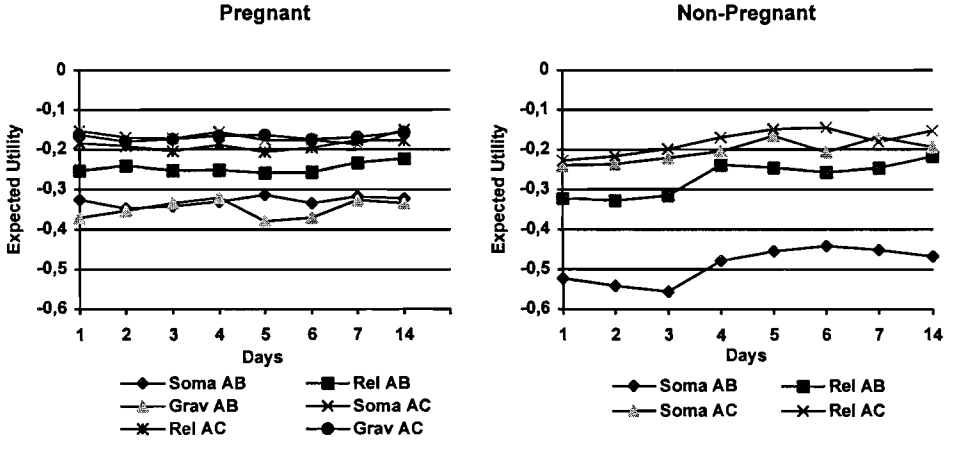
$$\frac{\sum AB}{nAB} - \frac{\sum AC}{nAC}$$ where n is the number of observations

Suppose *nAB* = *nAC*. This gives:

$$\frac{\sum AB - \sum AC}{nAB} = \frac{\sum (AB - AC)}{n}$$

The assumption is that computing is performed on pairs of data (value and probability) data.

The means were plotted over the time period in Figure 3.



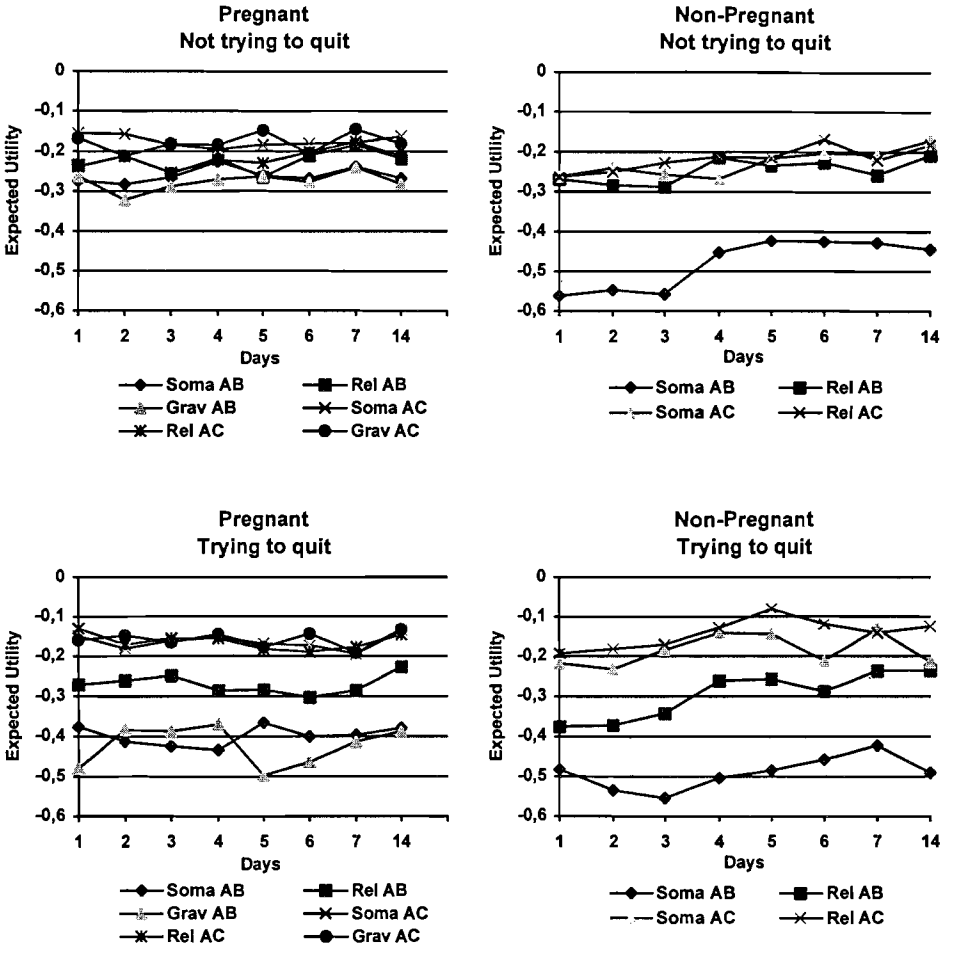


Figure 3. Mean expected utilities for the alternatives Smoke (AB) and Not Smoke (AC) as a function of time elapsed since the initiation of an attempt to quit smoking for (a) mood and social relations (Rel) and (b) physical health (Soma), and (c) pregnancy (Grav)

Like results reported by Sjöberg (1983) both alternatives Smoke and Not Smoke were negative for all conditions, and that Smoke (AB) was more negative than Not Smoke (AC). All Not Smoke (AC) conditions were least negative, and there was no large difference between them. For pregnant women Smoke (AB) for Grav and Soma were most negative, and after that Smoke (AB) Rel. For non-pregnant women Soma AB was rated more negative than Rel AB. Sjöberg argues (1983), that it is reasonable to assume that smokers find both smoking and not smoking to be negative, but for different reasons. The explanation presented by Sjöberg implies that the constellation of two negative options generates an avoidance-avoidance conflict earlier described by Lewin (1946).

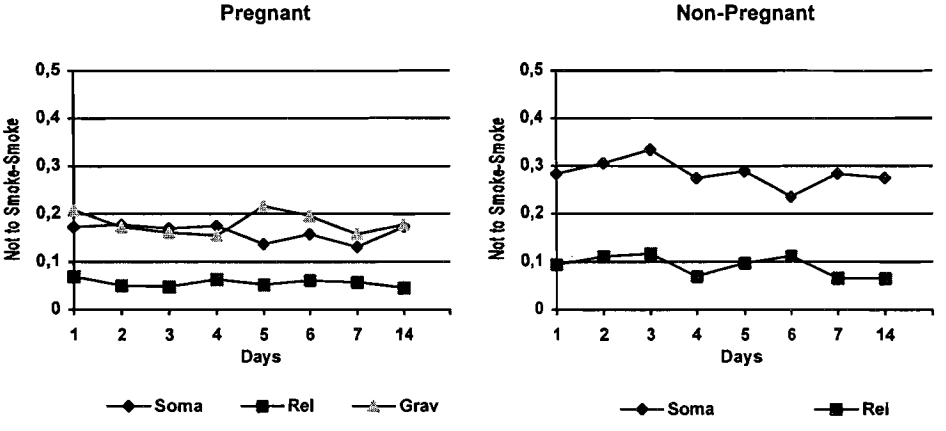
Figure 3 shows that the alternative Smoke exhibited a somewhat larger change over time compared to the alternative of Not Smoke. However, this tendency was only very slight, and should be interpreted with caution. The difference between the Smoke and Not Smoke was smallest for the Rel data. Moreover, the alternatives of Not Smoke (AC) were more uniformly rated, whereas there was a somewhat larger variation between the Soma, Rel and Grav alternatives for Smoke (AB). This might indicate a more uniform attitude towards the alternative of Not Smoke alternative compared to the Smoke alternative. Not Smoke is considered as consistently less negative. In contrast, Smoke produces somewhat varying degrees of negativity in opinion. For pregnant women trying to quit the Smoke alternative was rated somewhat more negative compared to those not trying to quit. This difference between not trying to quit/trying to quit was not obtained for Non-Pregnant women.

In summing up, some of the results earlier obtained by Sjöberg (1983) were supported, as both alternatives Smoke and Not Smoke were negative for all conditions, and Smoke (AB) being more negative than Not smoke (AC). However, no diverging tendency between the two alternatives was obtained as predicted by the Action Model by Sjöberg (1983). Sjöberg obtained the alternative of Not Smoke to become increasingly favored but significant only for Soma. In the present study the difference between the two alternatives of Smoke (AB) and Not Smoke (AC) seemed fairly constant over time. Neither was the Value Model by Ainslie (1975) supported by data in the present study, as the Value Model predicts an early rise of the value of Smoke. The results obtained in the present study is in that respect in accordance with the result obtained in the study by Sjöberg.

3.5 Results

III Utility difference between smoking and not smoking over time

Mean utility differences between Not Smoke and Smoke for Soma, Rel and Grav as a function of time elapsed since the initiation of the attempt to quit smoking are reported in Figure 4.



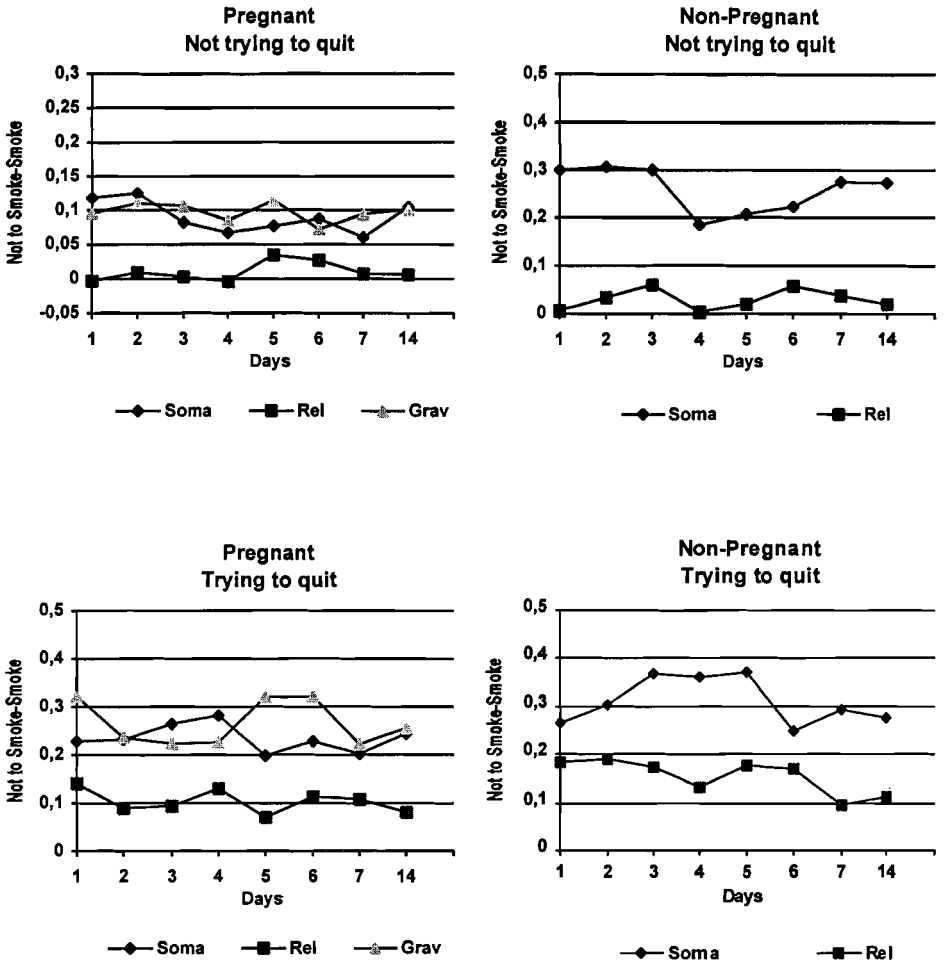


Figure 4. Mean utility differences between Not Smoke and Smoke as a function of time elapsed since the initiation of an attempt to quit smoking for a) mood and social relations (Rel) and b) physical health (Soma), and c) pregnancy (Grav)

Mean utility differences between Not Smoke and Smoke showed that the utility difference was smallest for the variable of mood and social relations (Rel) and about the same difference for the variable of physical health (Soma) and pregnancy (Grav).

For all the groups there was a slight tendency to decline in difference between not to smoke and smoke between day 3 to 6, indicating short-term transitory effects. The figure indicates that for all groups there was a tendency to increase in the negativity during that period.

No increasing difference between smoking and not smoking over time was found, as reported by Sjöberg (1983). Thus, the Action Model was not supported by these data in the present study. For pregnant women not trying to quit the difference between smoking and not smoking was somewhat less positive than for pregnant women trying to quit.

3.6 Results

IV Belief value correlations and the Action Model.

In order to further test the Action Model correlations between beliefs and values were computed for each person and day. All data for pairwise complete cases were used.

Pearson product-moment correlation coefficients were computed between ratings of value and probability given continued smoking (AB), and given quitting smoking (AC). The coefficients were computed for each day and subject separately. The mean correlation coefficients were used in the analysis.

The mean correlations for the four different groups formed by pregnant/non-pregnant and quitting/non-quitting were computed for the conditions Smoke and Not Smoke. In Figure 5 there is a plot of means of correlations over time.

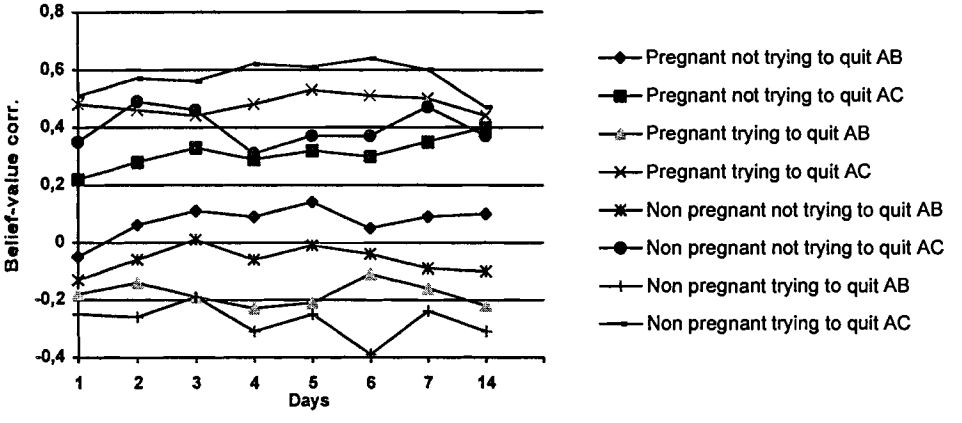


Figure 5. Belief-value correlations for different groups for the alternatives of Smoke and Not Smoke over time

The data showed no tendency for belief value correlations to change over time. This applied to both alternatives of Smoke and Not Smoke. However, large differences between the alternatives Smoke and Not Smoke could be noted for the two subgroups trying to quit. For those trying to quit there was a large discrepance in rating for the Smoke and Not Smoke alternatives, whereas the difference between

Smoke and Not Smoke was much smaller for those not trying to quit. The pregnant and non-pregnant women exhibited approximately the same pattern. The important variable, thus, seemed to be quitting/non-quitting.

For all groups no large variation over time could be noted. A slight tendency for the correlations to decrease on Day 3-4 could be noted.

In summing up, no strong support was obtained for the Action Model or the Value Model. The relevant factor in belief value correlations seemed to be commitment to an attempt to quit smoking. The factor of pregnancy did not seem to be very important.

3.7 Results

V Analyses of variances with days as a repeated measure

ANOVAs with the two factors of quitting/non-quitting and pregnancy/non-pregnancy, and days as a repeated measure were also performed. Table 5 (in appendix) shows analyses of the factors of value, probability (given continuing and quitting smoking) and time given continuing and quitting smoking). The analyses of variance were performed on the separate variables of Soma, Rel and Grav. Quite few significances were obtained, and quitting/non-quitting and pregnancy/non-pregnancy had an effect on different variables.

Table 6 (in appendix) gives ANOVAs with repeated measures for quitting/non-quitting and pregnancy/non-pregnancy on expected utility for smoking (AB) and expected utility for not smoking (AC). For Soma AB there was a significance for pregnancy/non-pregnancy. For Rel AB there was a significance for days, and quitting for AC.

Table 7 (in appendix) shows ANOVA with repeated measures for AC - AB. For Soma there was significance for pregnancy and quitting and the interaction between quitting and days. Quitting was also significant for Rel and Grav.

Thus, quitting/non-quitting had an impact on estimated difference between expected utility for alternatives Smoke and Not Smoke. This applied to all the variables of Soma, Rel and Grav. The factor of being pregnant or not had an influence on utility difference between Not Smoke and Smoke for physical health (Soma). There was also a significance for the interaction between quitting and days for Soma.

In summing up, analyses of variance performed showed that the quitting/non-quitting variable had an impact on the utility difference between Not Smoke and Smoke over time. This is in accordance with results reported above.

4 DISCUSSION

The study was performed on smoking young women in Bulgaria. According to World Health Organization statistics Bulgaria is on place number 10 in the world in cigarette consumption. In the population over age fifteen 39.4 percent are smokers. 48 percent of men more than 20 years old are smokers, and the number of female smokers has increased to become close to the number for men. Among boys of age 17 habitual smokers constitute 26.6 percent, and 50 percent smoked permanently or sometimes. For girls the figures are the same.

In the present study the mean age for the different groups was 24.1-26.7 years (total mean 25.1), the mean number of years of smoking varied between 5.5-8.7 for the different groups (total mean 6.5), with the longest period for smoking non-pregnant women trying to quit 8.7 and for those not trying to quit 6.0. The pregnancy period was approximately 4.8 months, that is in the middle of the pregnancy period. The age for starting smoking was 18-20 years. The mean number of cigarettes smoked per day varied between 9.4-11.4 for the different groups (total mean 10.5).

In the study by Sjöberg (1983) the mean age of the participants was 27.3 years, they had been smokers on an average for 10.7 years, and smoked an average of 23 cigarettes per day. In the present study the number of years of smoking was less and the number of cigarettes smoked per day was only half of the average number of cigarettes per day in the study by Sjöberg (See Table 1).

Important reservations have to be made when comparing results obtained in the present study with results in the study by Sjöberg. Sjöberg studied smokers after the initiation of an attempt to quit or reduce smoking, whereas the present study as a special group also included subjects not willing to quit smoking. Moreover, the earlier study included both those trying to quit entirely and those trying to reduce smoking, and the present study was restricted to those trying to quit entirely.

Another reservation has to be made when comparing the result from the present study and the result previously obtained in the study by Sjöberg. In the study by Sjöberg those subjects not successful in their attempts to quit smoking still continued to take part in the study. In the present study, however, those who were not successful in their quitting were excluded from the study. Other subjects willing to participate were included to fill up the number to 20 subjects for each group. Consequently, the group trying to quit only included those who were successful (groups B and D) in the present study.

In the study by Sjöberg 40 smokers were recruited. They declared to be willing to quit or reduce smoking for one week. Of these 40 smokers 17 subjects changed their mind and gave up immediately. 7 out of 23 remaining subjects failed at least once during the week they were followed in the study. The 16 subjects not failing were analysed separately and they exhibited the same trend as the whole group. Those failing and those succeeding did not differ in important aspects according to the analysis (Sjöberg, 1983). Thus, the analysis could, according to Sjöberg, be regarded as performed on successful quitters, whereas the model presented by Ainslie rather

describes the processes behind relapses based on theoretical prefererences deduced from time data on animals. This discrepance in background of the two models might indicate that they have different areas of potential application. The study by Sjöberg included both men and women, whereas the present study only included women. Moreover, in the present study an additional variable was introduced, the factor of how pregnancy influenced an attempt to quit smoking.

Another difference between the two studies is the manner in which the subjects were recruited. In the study by Sjöberg they were recruited by informal contacts. In the present study the subjects were recruited through policlinics. When contacting a policlinic there, maybe, already is an awareness of health-related problems in smoking, creating a larger difference in attitude towards smoking/not smoking, explaining the results obtained in the present study with a difference at start between expected utilities for Smoke and Not Smoke.

Thus, the groups are not totally comparable in the two studies, and conclusions should, therefore, be made with caution. It should also be pointed out that the results obtained are restricted to the time intervals studied. For other, longer time intervals the results might be modified.

The design of the present study could to a somewhat larger extent be regarded as focused on testing the Action Model and to a lesser extent the Value Model. The Value Model is restricted to the variable of reward value, whereas the present study encompasses judgments of both the variables of value and probability, as well as the variable of time.

Sjöberg (1983) points out that values rather than probabilities are changed, which is in accordance with results obtained in the present study, where ratings of the variable of probability exhibited less variation over time than the variable of value (See Figure 2). The smaller variability of probability might be an explanation of Ainslie's model only taking value into account when explaining time-related behavior.

Therefore, an extended version of the Value Model was tested in the present study, where both the variables of value and probability were taken into account. Taking both these variables into consideration, decision theory with the concept of expected utilities was used as a basis.

The Action Model introduced by Sjöberg (1983) has the advantage of being based on both of the factors of values and beliefs. It is predicted that optimistic bias improves mood and thereby strengthens action. Optimistic bias gives high belief-value correlations, predicting success in attempts to quit an addictive behavior such as smoking. However, the Action Model did not to a full extent account for the changes over time. No increasing difference between smoking and not smoking in belief-value correlations was found as in the study by Sjöberg (1983). This increasing difference found by Sjöberg was especially noted in the beginning of the period. A large difference between the two alternatives of not to smoke and smoke should reflect a low degree of choice stress. This is in accordance with the theory by Marlatt and

Gordon (1979). Thus, when committed to an attempt to quit smoking a low degree of stress is of importance for success.

In the study by Sjöberg (1983) an increase in positive belief-value correlations was found for the alternative of not to smoke, whereas the smoking alternative showed a more limited change over time. Thus, the Action Model was partially supported in that study.

An advantage of the theory by Sjöberg is that it does not neccesitate a definition of a crossing point between the two different alternatives, only that there are increased belief-value correlations, negative for smoking and positive for non-smoking. However, for no condition in the present study, pregnant/non-pregnant or quitting/non-quitting, was a diverging tendency for the two alternatives found. The two different curves of belief-value correlations for Smoke and Not Smoke, respectively, showed about the same tendency plotted over time.

The Value Model predicts the value of smoking to be lower than the value of not smoking in the beginning of the time period. The difference diminishes up to a certain point where there is an intersection of the values. After that intersection the value of smoking increases faster compared to the alternative of not smoking and the difference between the two alternatives increases. Thus, there are different relations before and after the intersection.

No main difference at any time period between the two alternatives smoking and not smoking based on the values and beliefs does not support the Value Model. The most relevant factor seemed to be Quitting/Non-Quitting where a large difference between the alternatives of Smoke and Not Smoke was obtained. This is supported by ANOVAs performed (Table 7 in appendix). It is also documented in belief-value correlations computed over time (See Figure 5).

It is to be noted that in the present study the difference between Smoke and Not Smoke was smallest for the Rel factor (See Figure 3). In the present study a larger difference for Not to smoke-Smoke between the judgments of somatic functions and relations was obtained compared to the study by Sjöberg (See Figure 4).

In the study by Sjöberg the alternative of Not Smoke became increasingly favored, but only significant for Soma. Quitting smoking, thus, might be expected to have the largest impact on the Soma or Grav variables, assuming that bodily functions are perceived as more basic than social relations.

The ratings of the events related to value, probability and time indicated that the value of mood and relations was rated less negative compared to the somatic functions and the functions related to pregnancy. The effect of quitting/non-quitting in responding to the items had an impact for the variable of probability. The judgment of time aspects showed, that the negative effects of all the variables of Rel, Soma and Grav were estimated to occur later if quitting.

The aim of the present study was to study different aspects of time effects when trying to quit smoking. A restriction of the Value Model, is that it is focused on anticipated waiting time. This kind of waiting time could be related to a pure time discounting effect. Indeed, a distinction must be made, which is pointed out by Sjöberg (1983), between anticipated waiting time and actual waiting time, the actual waiting time being supposedly more aversive.

The present study has a new design compared to earlier studies as the subjects made ratings both at the start of the study, and during the time passing during an attempt to quit an addictive habit. This makes it possible to obtain information about both time discounting effects and effects of changes over time when studying the processes leading to success or relapse.

The subjects performed two different judgments of time: when the events would occur if continuing smoking and if quitting smoking. For both conditions there were only small changes over time implying a function independent of passing time.

One possible explanation is that the judgments encompass a time span of this week to 13 months or later and in its extreme, never. The time period for the study was, on the other hand, only 14 days.

The total period of the study was 14 days. During this period changes over time could be noted. The difference between Not to smoke and Smoke exhibited a slight tendency to decline starting with day 3 (See Figure 4). Around day 6 the decline seemed to have been recovered. This tendency was also found, but to a smaller extent, in the study by Sjöberg (1983). Previous results obtained by Sjöberg showed a common starting-point at the same level for the alternatives Smoke and Not Smoke with an increasing difference up to day 3, after which day the difference between Smoke and Not Smoke levelled off. The changes of attitude for Smoke and Not Smoke indicate, that the very beginning and after the time period immediately following day 3, are critical periods when trying to quit smoking.

The result obtained in the present study with short-term transitory effects applies both to the pregnant and the non-pregnant group and for all the variables of Soma, Rel and Grav. Factors aggravating nicotine abstinence during this period might explain the result obtained. These factors seem to have a confusing and negative effect on the decision to quit smoking.

Addicts on chemical substances like nicotine have according to Goldstein and Kalant (1990) two characteristics. The first is development of tolerance. Tolerance is by Herrnstein and Prelec (1992) represented as a steeply negative relation between long-term consumption rates and hedonic yield per unit of consumption. The second is physical dependence giving short-term withdrawal symptoms. This is also indicated by a change in belief value correlations between value and probability to become somewhat more negative in the interval day 3-4.

Transitory effects are according to Herrnstein and Prelec (1992) common for relatively unconstrained addictions such as smoking. Therefore, models need an elaboration to account for these effects also found in the present study.

So far models presented have not taken into consideration these transitory effects. This necessitates different value functions relevant to earlier consumption levels and short-term withdrawal symptons.

According to the opponent-process theory of motivation (Solomon & Corbit, 1973) the interaction between past consumption level, in this study of nicotine, and present state of motivation could be explained by homeostatic mechanisms. The homeostatic mechanisms explain this interaction with actions which try to keep certain bodily variables within a certain limited range.

A chemical substance like nicotine changes the affective state. If this state is positive or pleasant the opponent or counteracting affect is unpleasant. This opponent process is acting in a slower way. According to the theory, the organism gets a diminished initial reaction to the original agent with a lingering opponent reaction.

The present results show a somewhat diversified picture indicating that discounted utility in addictive behavior could not fully be described by a single determinant.The estimations of all the three variables of value, probability and time exhibited a varying pattern. Differences in estimations between those trying to quit and those not trying to quit could be noted.

A comparison between smoking pregnant women not trying to quit and trying to quit showed a difference in trend between day 7 and 14, implying that those trying to quit were becoming less negative in estimations of the value of events, whereas for those not trying to quit, the valuation of events was becoming more negative between day 7 and 14.

In the present study there was a difference between those not trying to quit and those trying to quit as regards the number of earlier quitting attempts for pregnant women; 1.8 and 2.4 respectively and for non-pregnant women 1.7 and 4.0 respectively.

Thus, the probability for successful quitting attempts was related to the number of earlier attempts. The result indicates that succeeding is preceded by a certain number of quitting attempts, and that the chance is improved by every attempt.

Of course, there is an increased statistical probability, but there is also an increased psychological probability. In addition, non-pregnant women, trying to quit, who had smoked the longest period (8.7 years), also exhibited the highest number of previous attempts quit (4.0). It is expected that the number of trials is related to length of smoking period.

The factor of smoking/non-smoking is probably most salient when pregnant, as smoking affects not only the mother but also the child. However, the effect of being pregnant or not, did not have a large impact on ratings performed. The estimation of

states and events related to pregnancy showed a variation, but not to the fact of being pregnant or not. The estimations for the pregnant group gave a somewhat more complex picture, and the factor of pregnancy and the concomitant estimated variable of Grav contributes to this complexity.

Discounting behavior encompass different anomalies. The approach of three factors (value, probability and time) is, therefore, preferable. Research on decision making under uncertainty has to a large extent focused on expected utility (EU) and behaviors that violate this axiom. Intertemporal choices have to a less extent been investigated from this point of view. Discounted utility (DU) is, however, also in need of a model that takes into account anomalies in discounting utility behavior.

Earlier empirical findings on time preference have reported different anomalies that represent a challenge to normative theory. A common difference effect is reported, implying that preferences between two delayed outcomes switch when both options are incremented by a given constant amount. This phenomenon gives rise to inconsistent behavior, such as discount rates decreasing as a function of time delay (e.g. Benzion, Rapoport & Yagil, 1989).

A second point is an absolute magnitude effect where large amounts are proportionally less discounted than small amounts (e.g. Thaler, 1980). When it comes to smoking it is not defined what value range is discounted in an absolute sense. Value discounting is, therefore, uncertain and unpredictable.

Moreover, losses are discounted at a lower rate than gains (Loewenstein, 1988). Losses and gains have different value functions connected at a reference point. This phenomenon has earlier been analyzed in work on decision making under uncertainty (Kahneman & Tversky, 1979). Applied to discounted utility of smoking, curves could be supposed to vary with the gains of a smokefree life and the loss of immediate satisfaction of smoking.

A fourth anomaly presented by Loewenstein (1988) is an asymmetry preference between speeding up and delaying consumption. Delaying a reward needs generally more compensation compared to speeding up the consumption. Also this anomaly, with a large loss due to delayed reward when quitting smoking, may have importance for the results obtained in the present study.

From the above it is evident, that there are many intertemporal choice anomalies that are contrary to the predictions of discounted utility. It also follows that one individual will exhibit varying discount rates depending on context factors and how the choice is formulated.

Another context factor presented by Loewenstein and Prelec (1992) is that people are relatively insensitive to changes in timing when there already is a delay. In the case of smoking, this factor would support the theory presented by Sjöberg (1983) with increasing positive belief-value correlations for the Not Smoke alternative and negative correlations for the Smoke alternative, and also an increasing difference between the two alternatives.

Intertemporal choices often tend to involve an internal struggle for self-command (Schelling, 1984). At the moment the impulse to consume is overwhelming, it is often recognized at the cognitive level, that this decision is contrary to long-term self-interest.

A striking feature of addictive behavior is the self-destructive consequences in contrast to a central concept of rational pursuit of self-interest. Generally behavior is assumed to maximize utility. Addictive behavior is harmful to the person consuming the substances. Moreover, the addicts want a change of behavior, but their actual behavior is inconsistent with their stated preference.

From the results reported above, it appears that intertemporal choice represents a complex pattern and is not easily described by a single function in a deterministic manner. Therefore, simple mathematical models of Ainslie's type could hardly describe all these patterns of cognitions and behavior.

The circumstance that addiction is a complex behavior is possibly reflected by the large number of disciplines studying it. From the present study it could, among other things, be concluded that the usefulness of psychological factors, such as emotional stress, for the models on self-control behavior has to be rediscovered.

Moreover, models so far have mostly been applicable to short-range decisions with simple outcomes. Judgments involving long-term planning such as decisions about smoking have not been investigated to the same extent. When sequences of outcomes are concerned there seems to be a preference for steady improvement (Loewenstein & Prelec, 1992).

The present study of smoking exhibits a varying pattern over time. The results indicate that although there is a common underlying rate of time preference there could be different styles of mental bookkeeping producing different degrees of impatience.

Earlier studies have tended to be concerned with one-shot choices, and therefore they cannot study choice across a time span. In fact, however, many phenomena are present in a series of choices that occurs over long periods of time. This links the research to the area of smoking and other addictions.

If, for example, smoking would be presented as a one-shot choice, it would probably never have been chosen. The addictive lifestyle could be regarded as sequences of choices, where the addict does not perceive the whole picture. When at a certain point in the sequence there is a choice between smoking and nonsmoking, the rate of the two alternatives intersects depending on various factors having an impact on value.

However, the intersection of the two alternative curves is basic in discounting theory. It is also possible for the two curves to rise initially, and after that to intersect. This kind of curves has been presented by Herrnstein and Prelec (1992).

People vary in their tendency to self-destructiveness implying that the slope of the value functions is individual. It is also reasonable to expect slopes of value functions to vary with different addictions. Moreover, the slope of the curves would change with the environment or individual drives. The configuration of curves needs further exploration when it comes to different addictive behaviors in different contexts.

Any action or habit that makes a supposedly purposeful activity to be fragmented into a series of isolated, separate choices, where each choice has a simple intertemporal trade-off, increases the possibility of making impatient choices. On the other hand, if the series of events could be mentally integrated into a sequence frame a concern for the future goal will be promoted.

Hence, it highlights the importance of framing intertemporal choices as sequences of outcomes to influence behavior. Health promotion and disease prevention programs, and future evaluations of these campaigns, would benefit from an approach taking time period sequence into account.

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APPENDIX

Table 2

Two scales of health motivation and health consciousness

1. I try to prevent health problems before I feel any symptoms.
2. I am concerned about health hazards and try to take action to prevent them.
3. I try to potect myself against health hazards I hear about.
4. I do not worry about health hazards until they become a problem for me or someone close to me.
5. There are so many things that can hurt you these days, I am not going to worry about them.
6. I often worry about the health hazards I hear about, but do not do anything about them.
7. I do not take any action against health hazards I hear about until I know I have a problem.
8. I would rather enjoy life than try to make sure I am not exposing myself to a health hazard.
9. I reflect about my health a lot.
10. I am very self-conscious about my health.
11. I am generally attentive to my inner feeling about my health.
12. I am constantly examining my health.
13. I am alert to changes in my health.
14. I am usually aware of the state of my health as I go through the day.
15. I am aware of the state of my health as I go through the day.
16. I notice how I feel physically as I go through the day.
17. I am very involved with my health.

Table 3
Events and states

The events and states for all subjects:

1. You eat less.
2. Your physical condition becomes worse.
3. You get a heart disease.
4. You have a bad smell of tobacco at home.
5. You develop pride because of your successful self-control.
6. You become irritated.
7. You become depressed.
8. You become more relaxed.
9. You feel pleasure and satisfaction.
10. You get a pain in the chest.
11. You get lung cancer.
12. Your taste sensitivity increases.
13. You are less likely to get a cold.
14. You feel forced to act in a certain way.
15. You live in a nice home.
16. Your emotional stability improves.
17. You spend money in a stupid manner.
18. Your life expectation becomes shorter.
19. Your home is cleaner.
20. You get an uneasy feeling.
21. Others like you.
22. You have good relations with other.
23. You set a bad example for your children.
24. You have to search often for cigarettes and matches.
25. You cause damage to other people´s health.
26. You become aggressive.
27. You get to be fat.
28. You feel free to do whatever you wish.
29. Your self-confidence improves.
30. You satisfy others who worry about your health.
31. You stop worrying about whether you can quit smoking.
32. You drink more alcohol.
33. You get a negative attitude to people who smoke.
34. You lose some of your physical strength.
35. You become more attractive.

The additional events and states only for pregnant women:

36. You worry about the health of your future child.
37. You influence the condition of your fetus in a negative manner.
38. Your home environment is unhealthy for children.
39. Your own health during pregnancy is at risk.
40. Your home environment can cause allergy in children.
41. Your child will become a smoker.
42. You get a miscarriage.
43. You get a child with a low birth weight.
44. You have a difficult child delivery.

Table 4
Techniques used to abstain from smoking

1. Pursuing some other activity in smoke tempting situations.
2. Breaking habits connected with smoking.
3. Avoiding difficult situations where smoking is likely.
4. Obtaining social support and reinforcement for quitting.
5. Thinking and talking about motives for not smoking.
6. Diverting attention from smoke tempting thoughts.
7. Trying to get insight into why I wish to smoke.
8. Setting up partial and realistic goals in my attempt to quit smoking.
9. Running away (physically) from a temptation to smoke.
10. Proceeding slowly with quitting smoking, allowing myself occasional relapses.
11. Using substitutes for smoking such as food, drugs or alcohol.

TABLE 5

Anova with repeated measures for variables of pregnancy / non-pregnancy, quitting / non-quitting and days. Ratings of value, probability (given continuing and quitting smoking), and time (given continuing and quitting smoking).

RATINGS OF STATES AND EVENTS AS TO	HYPOTHESIS	VARIABLE SOMA		VARIABLE REL		VARIABLE GRAV	
		F-value	Prob	F-value	Prob	F-value	Prob
VALUE	PREGNANT	5.45	*0.0223**	1.36	*0.2465*	–	–
	QUITTING	0.27	*0.6046*	0.01	*0.9257*	0.46	*0.5039*
	DAYS	1.92	*0.0646*	2.90	*0.0056**	0.41	*0.8981*
	PREGNANT*QUITTING	0.10	*0.7531*	0.02	*0.8831*	–	–
	PREGNANT*DAYS	1.15	*0.3301*	2.54	*0.0141**	–	–
	QUITTING*DAYS	0.58	*0.7711*	1.31	*0.2451*	1.04	*0.4013*
	PREGNANT*QUITTING*DAYS	0.98	*0.4453*	0.95	*0.4683*	–	–
PROBABILITY continuing smoking	PREGNANT	15.34	*0.0002**	1.00	*0.3251*	–	–
	QUITTING	3.67	*0.0593*	14.90	*0.0002**	6.18	*0.0175**
	DAYS	0.65	*0.7149*	1.04	*0.4032*	0.85	*0.5454*
	PREGNANT*QUITTING	5.02	*0.0279**	0.31	*0.5807*	–	–
	PREGNANT*DAYS	1.69	*0.1091*	0.34	*0.9341*	–	–
	QUITTING*DAYS	0.56	*0.7848*	1.57	*0.1405*	0.73	*0.6449*
	PREGNANT*QUITTING*DAYS	1.98	*0.0560*	0.96	*0.4615*	–	–
PROBABILITY quitting smoking	PREGNANT	0.20	*0.6599*	0.11	*0.7393*	–	–
	QUITTING	1.24	*0.2688*	0.12	*0.7350*	1.69	*0.2015*
	DAYS	1.00	*0.4301*	0.37	*0.9202*	0.80	*0.5888*
	PREGNANT*QUITTING	0.31	*0.5792*	0.25	*0.6218*	–	–
	PREGNANT*DAYS	0.28	*0.9609*	1.56	*0.1463*	–	–
	QUITTING*DAYS	2.07	*0.0450**	1.33	*0.2355*	1.80	*0.0869*
	PREGNANT*QUITTING*DAYS	1.20	*0.2992*	0.57	*0.7827*	–	–
TIME continuing smoking	PREGNANT	2.19	*0.1431*	8.16	*0.0055**	–	–
	QUITTING	4.41	*0.0391**	0.07	*0.7857*	0.77	*0.3843*
	DAYS	0.51	*0.8277*	0.14	*0.9946*	12.45	*0.0001**
	PREGNANT*QUITTING	0.12	*0.7349*	0.17	*0.6815*	–	–
	PREGNANT*DAYS	0.71	*0.6661*	0.63	*0.7279*	–	–
	QUITTING*DAYS	0.75	*0.6318*	1.20	*0.3016*	1.94	*0.0643*
	PREGNANT*QUITTING*DAYS	0.85	*0.5428*	1.20	*0.3004*	–	–
TIME quitting smoking	PREGNANT	0.50	*0.4822*	9.03	*0.0036**	–	–
	QUITTING	0.03	*0.8595*	5.21	*0.0252**	0.08	*0.7819*
	DAYS	0.47	*0.8585*	0.73	*0.6483*	2.35	*0.0240**
	PREGNANT*QUITTING	0.45	*0.5034*	0.15	*0.6957*	–	–
	PREGNANT*DAYS	1.01	*0.4217*	1.20	*0.3011*	–	–
	QUITTING*DAYS	0.92	*0.4915*	1.43	*0.1890*	2.18	*0.0359**
	PREGNANT*QUITTING*DAYS	1.19	*0.3073*	0.460	*0.8649*	–	–

Note: PREGNANT, QUITTING and PREGNANT*QUITTI NG based on df = 1;
DAYS, PREGNANT*DAYS, QUITTING*DAYS and PREGNANT*QUITTING*DAYS based on df=7;
*p = 0.05;

TABLE 6

Anova with repeated measures for variables of pregnancy / non-pregnancy, quitting / non-quitting and days. The product of value and probability (given continuing smoking) = AB, and the product of value and probability (given quitting smoking) =AC.

PRODUCT	HYPOTHESIS	VARIABLE SOMA		VARIABLE REL		VARIABLE GRAV	
		F-value	Prob	F-value	Prob	F-value	Prob
AB	PREGNANT	9.82	*0.0025**	0.84	*0.3637*	--	--
	QUITTING	1.79	*0.1855*	2.06	*0.1557*	2.66	*0.1111*
	DAYS	1.94	*0.0616*	2.40	*0.0348**	0.46	*0.8649*
	PREGNANT*QUITTING	1.57	*0.2144*	0.01	*0.9062*	--	--
	PREGNANT*DAYS	1.04	*0.4052*	1.95	*0.0603*	--	--
	QUITTING*DAYS	0.80	*0.5886*	0.65	*0.7109*	0.88	*0.5248*
	PREGNANT*QUITTING*DAYS	0.66	*0.7027*	1.15	*0.3301*	--	--
AC	PREGNANT	1.69	*0.1974*	0.15	*0.6960*	--	--
	QUITTING	0.89	*0.3495*	7.13	*0.0092**	0.28	*0.5971*
	DAYS	0.89	*0.5128*	1.58	*0.1400*	0.16	*0.9921*
	PREGNANT*QUITTING	0.44	*0.5093*	0.18	*0.6731*	--	--
	PREGNANT*DAYS	1.63	*0.1236*	1.89	*0.0691*	--	--
	QUITTING*DAYS	1.11	*0.3541*	0.78	*0.6028*	1.25	*0.2756*
	PREGNANT*QUITTING*DAYS	1.28	*0.2558*	0.93	*0.4799*	--	--

Note: PREGNANT, QUITTING and PREGNANT*QUITTI NG based on df = 1;
DAYS, PREGNANT*DAYS, QUITTING*DAYS and PREGNANT*QUITTING*DAYS based on df=7;
*p = 0.05;

TABLE 7

Anova with repeated measures for variables of pregnancy / non-pregnancy, quitting / non-quitting and days. The difference between the product of value and probability (given quitting smoking) =AC and the product of value and probability (given continuing smoking) = AB.

DIFFERENCE	HYPOTHESIS	VARIABLE SOMA		VARIABLE REL		VARIABLE GRAV	
		F-value	Prob	F-value	Prob	F-value	Prob
AC - AB	PREGNANT	8.27	*0.0052**	2.57	*0.1134*	--	--
	QUITTING	5.07	*0.0272**	20.98	*0.0001**	4.81	*0.0345**
	DAYS	0.96	*0.4631*	0.81	*0.5791*	0.59	*0.7668*
	PREGNANT*QUITTING	1.10	*0.2969*	0.34	*0.5622*	--	--
	PREGNANT*DAYS	0.85	*0.5463*	0.97	*0.4493*	--	--
	QUITTING*DAYS	2.31	*0.0254**	1.14	*0.3371*	0.75	*0.6300*
	PREGNANT*QUITTING*DAYS	0.82	*0.5680*	0.93	*0.4848*	--	--

Note: PREGNANT, QUITTING and PREGNANT*QUITTI NG based on df = 1;
DAYS, PREGNANT*DAYS, QUITTING*DAYS and PREGNANT*QUITTING*DAYS based on df=7;
*p = 0.05;

IV

STUDY VII

COPING MECHANISMS AND ATTITUDE CHANGES OVER TIME.

A STUDY OF QUITTING SMOKING BY PREGNANT WOMEN

Monica Örtendahl

1 INTRODUCTION

1.1 Pregnancy and smoking

It is a well-established fact that smoking is a habit which is very detrimental to health. For the pregnant woman smoking is detrimental also to the health of the fetus, the newborn and to the infant (e.g. Land & Stockbauer, 1987). Research on the health consequences of smoking has obtained results indicating that smoking is associated with, among other things, early pregnancy loss and complications of labor and delivery, in addition to intrauterine growth retardation and low birthweight .

Since Simpson (1957) first documented the relationship of smoking and low birthweight several reports have supported this finding. It has been concluded (U.S. Public Health Service, 1980) concluded that lower birthweight is caused by intrauterine growth retardation. Among mechanisms proposed are nutritional deficiency and toxic substances. The babies are symmetrical in their growth retardation, with reduction in crown-heel length, head circumference, chest circumference and shoulder circumference (fetal tobacco syndrome). It was also reported that studies indicated 11 to 14 percent of all preterm deliveries in the United States possibly to be attributable to maternal smoking. The same report concluded that the most consistent finding is a reduction in birthweight of 150 to 300 g, or an average of 200 g.

Kleinman and Madans (1985) found a strong dose-response relationship and that the odds of delivering a lowbirth weight baby increased by 26 percent for each additional five cigarettes smoked per day by the mother. The relationship between low infant birth weight and smoking has also been confirmed by Malloy, Kleinman, Land and Schramm (1988).

Moreover, recent evidence (Wen, Goldenberg, Cutter, Hoffman, Cliver, Davis & DuBard, 1990) has shown that intrauterine growth retardation (IUGR) and preterm delivery are more common among smokers as maternal age advances. In this study it is suggested that smoking pregnant women more than 35 years of age are a particularly high risk group, who specially should be a target for cessation counseling.

A study by Floyd, Zahniser, Gunter and Kendrick (1991) attributes 21 to 39 percent of low birthweight to smoking during pregnancy. However, it is pointed out that the exact mechanism of this effect is not completely understood.

Smoking cessation during pregnancy has pronounced effects. U.S. Department of Health and Human Services (1980) reported, that if a woman stops smoking by her fourth month of gestation, the risk of delivering a low birthweight baby is reduced and similar to that of a nonsmoker.

According to a report by the Institute of Medicine (1985) smoking is one of the most preventable causes of low birthweight, and many studies have shown that quitting smoking during pregnancy has many benefits for mother and child. Cessation status by the eighth month of pregnancy has been found (Hebel, Fox & Sexton, 1988) to be the strongest predictor of birthweight.

Schell, Relethford, Madan, Naamon and Hook (1994) reported that quitting by the end of the first trimester may not completely negate the effect of heavy first trimester smoking, and the adaptive value of quitting is unequal among different levels of first trimester smoking. Quitting did not eliminate the effect of heavy first trimester smoking on the frequency of low birthweight, as this frequency remained the same for quitters and continuers if they smoked heavily during the first trimester. The importance of first trimester smoking implied, that heavy smokers who were quitting delivered babies on an average 128 g less heavy than babies born to women who smoked lightly during the whole pregnancy. Quitting at the end of the first trimester caused the greatest gain in birthweight among moderate smokers. This is a promising finding as most pregnant smokers belonged to this group.

Studies have also confirmed a relationship between smoking and the incidence of placenta previa, abruptio placentae, bleeding during pregnancy and premature rupture of the membranes (U.S. Department of Health and Human Services, 1980). Statistically significant associations between smoking and spontaneous abortions were also found. The underlying mechanism seemed to be complications of pregnancy rather than from any fetal abnormality. This is in accordance with the result by Risch, Weiss, Clarke and Miller (1988) who found an increased risk for spontaneous abortion among smoking women with relative risks ranging from 1.1 to 1.8.

Additional medical findings are reported by U.S. Department of Health and Human Services (1980), which described a higher rate of sudden infant death syndrome among infants to mothers smoking during pregnancy.

Many studies have also showed an increased risk for pneumonia, bronchitis, tracheitis, laryngitis and otitis media among children with smoking parents. An increase in fetal heart rate and umbilical blood flow after smoking one cigarette is also reported. Fetal aortic blood flow increased and placental and fetal peripheral vascular resistance decreased after the smoking of two cigarettes (U.S. Department of Health and Human Services, 1986).

Baird and Wilcox (1985) found smoking to be associated with delayed conception as 38 percent of non-smokers conceived in their first cycle compared with 28 percent of smokers, and after adjusting for confounding factors, the fertility of smokers was estimated to be 72 percent of the fertility of nonsmokers. Moreover, fertility was related to extent of smoking. The finding is a warning of possible long-term damage from smoking and shows that smoking is a hazard to reproduction.

The latest finding in the research field of smoking effects is that the daughters, but not the sons, may be biologically predisposed to smoking (Kandel, 1994). It is theorized that nicotine, which can cross the placenta barrier, stimulates a fetus's receptors for dopamine, the brain chemical involved in drug addiction. It was suggested that male hormones may protect the male fetus.

From above it could be concluded that it is an important task to give information about and to influence smoking behavior. Already before a planned pregnancy, it should be pointed out that tobacco smoke contains numerous teratogenic substances which double the risk of fetal malformations. A high consumption induces an increased risk of abortion.

As an increasing number of health care professionals recognize the problem of smoking during pregnancy innovative programs probably will be developed. A study by Baric, Mac Arthur and Sherwood (1976) showed that all participants had heard about the harmful effects of smoking. Still only one-third believed smoking to be harmful and most of those were primiparons. Thus, perceived expectations are not always followed by behavioral change. The discrepancy between perceived expectations and behavioral change is also in accordance with other research findings. It is concluded that the absence of agreement has implications for health education whose aim should be
-to increase the credibility of existing knowledge of the effects of smoking.
-to use all means of transmitting information.
-to make women understand that although there were no bad effects in previous pregnancy there is no guarantee for the future.
-to make professionals talk to their patients about the risks of smoking.

In a study by Dalton, Hughes and Cogswell (1981) it was found that posters and leaflets did little to increase knowledge of smoking risks among mothers. But those who had received advice to stop smoking from medical advisers were more likely to admit dangers to the fetus and themselves.

Still and Mannion (1983) found that health risks of smoking in general were well known but that few women were aware that smoking increased the risk of miscarriage, stillbirth, premature birth, respiratory distress syndrome and birth defects.

In a research review by McIntosh (1984) it was shown that quitting smoking is an effective preventive measure. However, the possibility of getting mothers to quit is not promising, especially when it comes to heavy smokers.

Haugland, Haug and Wold (1995) interviewed 33 pregnant smokers and found that they were concerned about their smoking habits. In spite of this, they still expressed positive attitudes towards smoking, and many did not experience pregnancy as a favorable time to stop.

In spite of this, health education workers have developed several smoking cessation programs for pregnant women. Programs recommend the following strategies to motivate pregnant women to quit smoking (Windsor & Hebel, 1984) :
-Set up smoking cessation goals and determine date to quit.
-Identify situations triggering smoking for pregnant women and discuss coping strategies.

Robitaille and Kramer (1985) found that most of the reduction in cigarette smoking occurred during the first trimester of pregnancy. Their data also supported the assertion that in determining the effect of cessation program the characteristics of the individual were more important than characteristics of the program. Pregnant women most likely to stop smoking are those with positive social support and a less ingrained smoking habit (Aronson, Ershoff & Danaher, 1985). However, in summing up, the literature provides few studies with clear conclusions of how to influence and educate the pregnant smoker (Windsor & Orleans, 1986)

Between 1975 and 1985 starting smoking declined in the USA among young men while it increased among young women (Pierce et al., 1989). It has also been found (Gilchrist, Schinke & Nurius, 1989) that female adolescents appear less responsive to messages of smoking cessation as compared to male adolescents. Female adolescents comprise the largest percentage of new smokers (U.S. Department of Health and Human Services, 1992), and being female has, indeed, been identified as a predictor of smoking status (Goddard, 1992).

Smoking-preventive messages are important to pregnant women and Johnston (1980) reported that 16 percent of the pregnant women quit and 43 percent reduced smoking during pregnancy. Windsor and Hebel (1984) have presented statistics showing that of women who smoke, up to 25 percent quit when they learn they are pregnant, and that quitters tend to be light smokers.

In a study by Hickner, Westenberg and Dittenbir (1984), where no special interventions were offered, 18 percent stopped and 42 percent cut down smoking during pregnancy. Two-thirds of the women who stopped smoking have been found to do so immediately after determining they were pregnant (Stewart & Dunkley, 1985). Those who stopped smoking had initially smoked fewer cigarettes compared to those who only reduced their smoking.

Prager et al., (1984) estimated that 25 percent continue to smoke throughout pregnancy. U.S. Department of Health and Human Services (1989) reported a smoking prevalence of 32 percent for pregnant women and that prevalence was highest for women with less than 12 years of education, between 15 and 19 years old and unmarried. This is in accordance with an earlier finding (Kleinman & Madans, 1985) of more smoking with decreasing levels of education.

It has been shown, that relapse to smoking after pregnancy is about 50 percent within three months after the baby is born, and 70 percent start within one year (Fingerhut, Kleinman & Kendrick, 1990).

Therefore, relapse prevention is an important part of any prenatal smoking cessation program (Mullen, Quinn & Ershoff, 1990). It is of value to further study which interventions hold promise for keeping cessation maintenance rates postpartum. It was speculated about a rebound effect from emphasis on cessation to protect the fetus. However, no such negative effects of the intervention were found.

Achieving changes in smoking behavior in pregnant women with low-intensity interventions is difficult (Kendrick et al., 1995). Ershoff, Quinn and Mullen (1995) found that of spontaneous quitters, i.e. those, who stopped before entering prenatal care, one third relapsed prior to delivery. Law and Tang (1995) found that sudden cessation or gradual reduction in smoking were similar in their efficacy. A conclusion is that smokers who are intent on stopping should be given additional support and encouraged to use nicotine replacement therapy.

The longest time abstaining before first visit, level of belief in smoking's harm to the fetus, and motivation to smoke were related to the probability of relapsing at the end of a 36-week period. (Secker-Walker, Solomon, Flynn, Skelly, Lapage, Goodwin & Mead, 1995).

In a study by Haug, Aaro and Fugelli (1994) it was found that although pregnant women predicted they would be non-smokers in five years more often than non-pregnant women, 18 months later there was no difference between the two groups; only 8 percent of both pregnant and non-pregnant women had stopped smoking.

It has been speculated (Secker-Walker et al., 1995) that although individual smoking cessation counseling does not increase quitting rates during pregnancy it could be considered for its long-term effects.

deVries and Backbier (1994) explored the possibilities for advice especially tailored to the motivational stage of pregnant women. Five groups were formed: relapsers, precontemplators, contemplators, actors and maintainers. Precontemplators were found to have a more negative attitude toward quitting than the other groups. General motivation to change smoking behavior and confidence in one's ability to succeed have been found to vary across the five stages of readiness (Crittenden, Manfredi, Lacey, Warnecke & Parsons, 1994). Lawson (1994) obtained support that low-income pregnant adolescents perceive immediate benefits from cigarette smoking that outweigh long-term health consequences.

Most women continue to smoke during pregnancy, and most who quit relapse postpartum (Severson, Andrews, Lichtenstein, Wall & Zoref, 1995). Relapse tendency among quitters was highly related to partner's smoking. Other factors related were younger age, higher level of education, lower smoking level, and having a partner who did not smoke and not consuming alcohol.

Rose et al. (1996) found different predictors of attempts to quit and successful quitting among those attempting to quit. Women made more often quitting attempts than men, but there was no difference in success of the attempts.

It could be concluded that concentration on the prenatal period is not sufficient as prenatal smoking cessation does necessarily not carry over to the postpartum period. Moreover, in smoking cessation programs, it is important to put greater emphasis on the problem of relapse, and to encourage both the father and the mother of the infant to quit smoking.

1.2 Relapse models

Sjöberg and coworkers (e.g. Sjöberg & Olsson, 1981; Sjöberg & Samsonowitz, 1985; Sjöberg, Samsonowitz, & Olsson, 1983) have initiated a research tradition and performed substantial studies on relapse and coping mechanisms used. They found that decisions were difficult to pursue when encountered in situations containing emotional arousal, either positive or negative.

In addition, it was found that giving up quitting attempts often was preceeded by shortsighted and twisted reasoning. There was a short-sighted reasoning that they could make a temporary exception to a decision.

Moreover, it was often found that people used coping techniques to fight addictions. Different addictive groups exhibited different strategies. Smokers often used an all or none strategy. One failure caused a domino effect (Sjöberg & Johnson, 1978; Sjöberg & Samsonowitz, 1978). Obese persons used a stepwise strategy proceeding in small steps (Sjöberg & Persson, 1979; Sjöberg & Samsonowitz, 1978). Alcoholics, on the other hand, sometimes relapsed without being emotionally aroused (Sjöberg & Samsonowitz, 1985). This is consistent with having weak values. Bringing up values would give more mental energy not to give up a decision to quit, even though meeting emotional difficulties.

Marlatt and Gordon (1985) have defined lapse as a process, behavior or event. Moreover, it is a single event; a corrective action can be taken, and control is not lost completely. The individual's response to these lapses determines whether relapse has occurred. Brownell et al. (1986) has defined lapses as slips or mistakes that may not lead to an outcome of relapse.

A relapse prevention model requires an analysis of the client's smoking or drinking behavior to determine the high risk situations for the individual client. Different models have been outlined by a number of writers. Shiffman's relapse prevention model (1986) postulates an interaction between characteristics of the tempting situation and the particular characteristics of the exsmoker in his or her response to that situation.

Shiffman (1989) has suggested that three variables influnce relapse: enduring personal characteristics, background variables and precipitants. Personal characteristics are associated with a constant-risk model of relapse proneness.

Background variables are associated with a cumulative-risk model, and precipitating factors are related to an episodic-risk model of relapse proneness. In a cumulative model it is posited that relapse proneness increases or decreases cumulatively over time. In contrast, discrete precipitous relapse episodes are emphasized in the episodic model.

Brownell et al. (1986) have shown that the probability for survival for the entire group increases with time. This is explained by the fact that persons at highest risk are the most likely to leave the sample. According to Brownell et al. (1986) relapse increases with time because more disturbances could occur. However, another explanation proposed is that an individual learns to cope effectively as time passes and that those who survive beyond the initial period are those who will succeed.

Brownell et al. (1986) also discussed a safe point, i.e. a point in time before which relapse is likely and beyond which relapse is unlikely. Earlier research has not supported the notion of a specific safe point (Wilson & Brownell, 1980).

1.3 The role of coping

Carmody (1992) stated that any response that prevents relapse is referred to as a coping response. Coping responses have been categorized as either behavioral or cognitive. Relapse studies have also focused on how to reduce addictive behavior by developing alternative coping behavior in relapse situations.

Shiffman (1982) and Marlatt and Gordon (1985) found that most temptations to relapse occurred in situations involving negative affect. They discussed 8 different categories of relapse situations. These were unpleasant emotions, physical discomfort, pleasant emotions, testing personal control, urges and temptations, conflict with others, social pressure, and pleasant times with others.

Shiffman, Read and Jarvik (1985) reported that smoking relapse episodes could be grouped into three categories involving positive affect (i.e. partying, unwinding at home and craving cigarettes) and two categories involving negative affect (i.e. depression and work-related general stress).

Shiffman (1986) cited stress as a negative affect and a precipitant of relapse for a majority of ex-smokers. Specifically, frustration and anger triggered relapse in over 50 percent of the cases, whereas depression was associated with 20 percent of relapse crises. Quitters were found to cope more effectively than relapsers with relapse crisis situations involving negative mood in a study by Abrams et al. (1987).

To sum up, the findings to date generally indicate that relapse is most likely to occur during periods of stress and negative mood states, although a large number of relapses also occur during enjoyable social events, such as parties and celebrations (Carmody, 1992). Most of the relapse crises (60 percent) occurred in connection with food and alcohol consumption. Alcohol consumption appeared to inhibit behavioral coping, which may explain its role in relapse.

Prochaska and DiClemente (1986) have also described a smoking cessation model related to relapse where coping mechanisms used were found to vary with time and stages. The two interrelated dimensions, stages of change and processes of change, have also in later research been found to be needed to adequately assess behavior modification of smoking (Prochaska, DiClemente & Norcross, 1992; Prochaska, Velicer, DiClemente & Fava, 1988). The model presents five stages of change: precontemplation, contemplation, action, maintenance and relapse.

Ten behavior-change processes have been investigated in relation to these five stages: Consciousness raising, self-liberation, social liberation, self-reevaluation, environmental reevaluation, counterconditioning, stimulus control, reinforcement management, dramatic relief and helping relationships.

The different steps have been defined as follows: In the precontemplation stage quitting within the next six months is not seriously being considered. In the contemplation stage quitting within the next 6 months is seriously being considered; however, quitting within the next 30 days is not being considered. The preparation stage means seriously considering quitting in the next 6 months and planning to quit within the next 30 days.

Other definitions related to smoking cessation and stages are as follows (Prochaska & DiClemente, 1983):
Relapsers have failed within the past year in their attempt to quit smoking.
Long-term quitters are related to the maintenance stage and have maintained their nonsmoking for at least 6 months.
Recent quitters are related to the action stage and have quit within 6 months.
Contemplators are related to the contemplation stage and are seriously thinking about quitting smoking in the next year.
Immotives are related to the precontemplation stage and have no intention of quitting smoking in the next year.

According to Prochaska and DiClemente (1983) both self-changers and therapy changers reported retrospectively that they had used affective and cognitive processes more during early stages of change and emphasized behavioral processes during the later stages.

In large, experiental processes are peaking in the contemplation stage and behavioral processes are peaking in the action and maintenance stage (Prochaska & DiClemente, 1986). A hypothesis is that later stage subjects may benefit from short action-oriented types of interventions. Subjects earlier in the process of change may need less intense programs.

Subjects in the precontemplation stage used the processes of change the least. This suggests that precontemplators process less information about smoking, spend less time reevaluating themselves as smokers, experience fewer emotional reactions to the negative aspects of smoking, and do little to shift their attention or their environment away from smoking.

Once in the contemplation stage the subjects are the most likely to respond to feedback and education as sources of information about smoking. Along with this increased openness to information about smoking they are feeling and thinking more about themselves in relationship to their problem behavior. During the action stage there is use of both counterconditioning and stimulus control procedures for actively changing smoking behavior and environment. Subjects experience less reinforcement during the maintenance stage although they continue to emphasize counterconditioning and stimulus-control processes for coping with temptations to smoke.

1.4 Purpose of the study

As is evident from above, the use of coping mechanisms is very important to prevent relapse and has been shown to vary over time. The purpose of the study was to investigate the usage of different coping techniques when trying to quit smoking. Another purpose was to investigate the use of coping techniques related to different aspects of changes over time.

The general strategy of the study was to follow different subgroups of smokers after an initiation of an attempt to quit smoking. The subgroups were formed by the two variables of pregnant/non-pregnant and quitting/non-quitting. In addition, it was considered to be of interest to obtain some more background data on relevant experiences and techniques in fighting temptations (cf. Sjöberg, 1983).

Earlier studies have shown (e.g. Prochaska & DiClemente, 1986) an interaction between stage of an attempt to quit and the process it creates. The subjects were studied as regards values and attitudes over time. A broad range of values were encompassed by the study to obtain all possible aspects related to smoking habits and changes over time.

2 METHOD

2.1 Subjects

Data were collected in Bulgaria. Women, half of the group pregnant, were selected as subjects as it is an important group as regards health behavior.

The respondents were 80 women smokers, 40 of them pregnant, 40 non-pregnant. More specifically, four different groups were included:

A. Smoking pregnant women, do not try to quit smoking.
B. Smoking pregnant women, try to quit smoking.
C. Smoking non-pregnant women, do not try to quit.
D. Smoking non-pregnant women, try to quit smoking.

In the analysis of results there are other groupings too:
E. Smoking pregnant women.
F. Smoking non-pregnant women.
G. Smoking women, not trying to quit.
H. Smoking women, trying to quit

20 in each of the groups A-D, in all 80 subjects, were included. They were matched in age and education.

The mean age of all the group was 25.1 years, SD= 3.86 years. Age range: 20 - 31.

All of the subjects had had high school. They had been smokers an average of 6.4 years (SD=3.71). The years of smoking varied from 1 to 16. They smoked an average of 10.5 cigarettes per day (SD=3.86); minimum=2 and maximum=20.

All of them were recruited after informal contact. They decided to quit smoking during their participation in the study.

2.2 Specifications of the sample

Table 1. *Specification of the sample based on age, months of pregnancy, number of years of smoking and number of earlier attempts to quit.*

Age	**A**	**B**	**C**	**D**
M	24.1	25.15	24.50	26.65
SD	3.28	3.96	4.10	3.86
Min	20	20	20	20
Max	30	31	31	31

Number of years of smoking	**A**	**B**	**C**	**D**
M	5.50	5.75	6.0	8.65
SD	3.15	2.51	4.07	4.22
Min	1	3	1	2
Max	11	13	15	16

Number of earlier attempts	**A**	**B**	**C**	**D**
M	1.80	2.37	1.70	4.0
SD	2.63	2.22	2.18	2.96
Min	0	0	0	0
Max	10	10	9	12

Number of cigarettes per day	A	B	C	D
M	9.35	11.20	11.35	10.20
SD	4.57	4.66	5.04	3.86
Min	4	4	4	4
Max	20	20	20	20

Months of pregnancy	A	B
M	4.80	4,85
SD	1.54	1.93
Min	2	2
Max	8	9

2.3 Procedure

The subjects were given eight questionnaires, one for each day of the first week and one for day 14 following the start of their attempt to stop or reduce smoking. They were instructed to respond to each questionnaire at approximately 6 pm each day and not to check previous questionnaires at any one day, but to answer as they felt today, right then. If they gave up the attempt, the questionnaire for that day was to be their last. Respondents who gave up were not included in data analysis. The exception was if they smoked only one cigarette during the two week period of the study. Twelve subjects failed in their attempt to quit and they stopped to participate in the study from the day of their relapse. Other subjects were invited in order to attain the number of 20 subjects for each group.

Three sets of questionnaires were not useful for analysis due to a lot of missing data, and three other respondents were recruited to participate.

The data were collected in October - December, 1994. The pregnant women were met in district policlinics in Sofia when under medical observation during pregnancy.

2.4 Questionnaires

There were three versions of questionnaires, intended for day 1, days 2-7 and day 14, respectively. These versions differed for each group of respondents, because the factors 'pregnant/non-pregnant', and 'try to quit/not try to quit' defined the design of the questionnaires for each group.

The question concerning pregnancy was only included in the questionnaires for pregnant women groups (A and B).
There were three versions of the questionnaire.

Version 1. Subjects were asked about their background data and their evaluation of smoking at the moment (for or against). They also made evaluations of their health motivation and health consciousness (see Table 2 in appendix). The quitters were asked about how resolute they were in their attempt and how likely they were to succeed in their attempt (group B and D).

All subjects then made ratings of 35 events and states. The events and states had been used in an earlier study (Sjöberg, 1983). The events and states were selected to cover as completely as possible both positive and negative aspects of continued smoking and of quitting. Pregnant women (groups A and B) rated an additional 9 events and states (36-44) related to smoking and pregnancy.

Events and states are given in Table 3 in appendix. All rating scales, unless otherwise stated consisted of seven categories.

All events and states were presented in a random order given in Table 3, always to be used in all subsequent sections of different types of ratings of these events and states. They were rated in terms of how bad or good they were on bipolar ratings (*value ratings*).

Then the subjects made ratings of *probability* and *time*:
a. given continued smoking
b. given quitting smoking for each of the 35 events and states; for pregnant women including the additional 9 events and states (36-44).

Version 2. (used at days 2-7): In addition to making ratings of the events andstates, subjects were to report if they had kept to their commitment and, if not, to report their mood at the time of the failure in terms of tension, activation and hedonic value; three basic mood dimensions according to Sjöberg, Svensson and Persson (1979). They were then to describe the circumstances of relapse in terms of situation, reasoning when they decided to smoke, feeling after the smoking, and current feeling about smoking and quitting smoking.

They were also asked about whether they would try to quit again, how resolute they were in their attempt and to judge how likely they were to succeed to quit. Finally, all subjects (also non-quitters) were asked how they liked smoking.

Version 3. The same as version 2, but in addition, on day 14 they rated how often 11 different coping techniques (Table 3 in appendix) were used when abstaining from smoking. Each technique was rated on a 7-point category scale (never - almost all of the time).

3 RESULTS

3.1 Data on quitting

Backgound data on smoking and quitting are shown in Figure 1, 2 and 3.

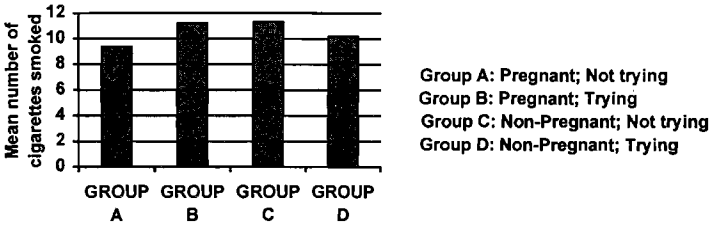

Figure 1. The number of cigarettes smoked per day for the four groups

Mean number of cigarettes smoked was 10 - 11 per day. Group B (pregnant, trying to quit) and C (non-pregnant, not trying to quit) had a somewhat larger consumption of cigarettes.

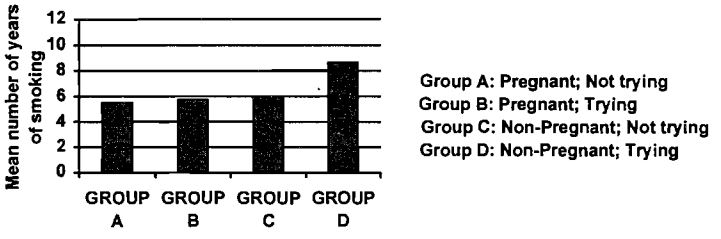

Figure 2. The mean number of years of smoking for the four groups

Group D (non-pregnant, trying to quit) had smoked a little longer, approximately 8 years; the rest 5-6 years.

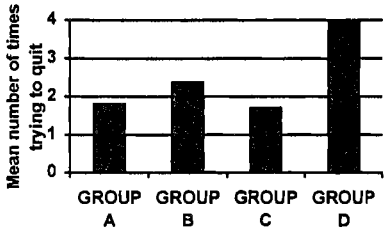

Figure 3. The mean number of times trying to quit earlier for the four groups

The groups B and D, that is those trying to quit smoking, had also tried to quit more often earlier compared to the groups of A and C. This finding could be interpreted as showing that those trying to quit smoking (B and D) had a more positive attitude to quitting compared to groups A and C (not trying to quit).

3.2 Smoking attitude

Answers to the question 'How do you like smoking?' reflects smoking attitude of the Ss. Means were calculated for the four different groups A-D and pregnant/non-pregnant (E and F) and not trying to quit/trying to quit (G and H); see Table 4.

Table 4
Means of smoking attitude for different groups

Groups	A	B	C	D	E	F	G	H	All groups
Mean	4.07	3.37	4.38	3.41	3.72	3.90	4.22	3.39	3.81
SD	1.10	1.19	0.92	1.01	1.14	1.07	0.95	1.09	1.10
N	20	20	20	20	40	40	40	40	80

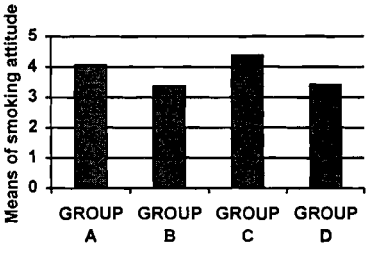

Figure 4. Smoking attitude of the four groups

Pregnant women, trying to quit (B), disliked smoking most, whereas non-pregnant not trying to quit (C), and women not trying to quit (=G) exhibited the most positive attitude towards smoking. This is also evident from Figure 4 above.

A comparison between means exhibited significant differences in smoking attitude between the four groups. t-tests showed significant differences between groups A and B (t-value = 2.03, df = 38; $p < .05$), and between groups C and D (t-value = 3.18, df = 38; $p < .003$). Moreover, in relation to smoking, groups A and C (women, not trying to quit smoking, both pregnant and non-pregnant) had similar attitudes, irrespective of whether they were pregnant or not. The same applied to groups B and D (women, trying to quit smoking, both pregnant and non-pregnant). The results reported above show that female quitters had less positive smoking attitudes compared to non-quitters.

A two-way analysis of variance with the sources pregnancy, quitting and the interaction pregnancy-quitting gave F-values of 0.78 (prob 0.3805), 6.10 (prob 0.0158) and 0.03 (prob 0.8604). All sources had 1df. The dependent variable was attitude towards smoking. Thus, for the variable of attitude towards smoking the quitting/non-quitting variable was significant at the level of 0.05, indicating the importance of quitting/non-quitting for the attitude towards smoking.

In summing up the different analyses, the most important independent variable for difference in attitude towards smoking was trying to quit/not trying to quit. The variable of pregnant/non-pregnant did not have an impact on the attitude.

3.3 Time and smoking attitude

In order to study changes over time the attitude towards smoking was computed for all women smokers for each day separately. The results are shown in Table 5 and Figure 5 below.
Differences in attitude between different groups are reported in Figures 6 and 7.

Table 5
Changes over time in smoking attitude for women smokers. (N=80)

Day	1	2	3	4	5	6	7	14
Mean	4.10	4.02	3.91	3.75	3.78	3.65	3.65	3.57
SD	1.30	1.33	1.34	1.29	1.29	1.35	1.34	1.34

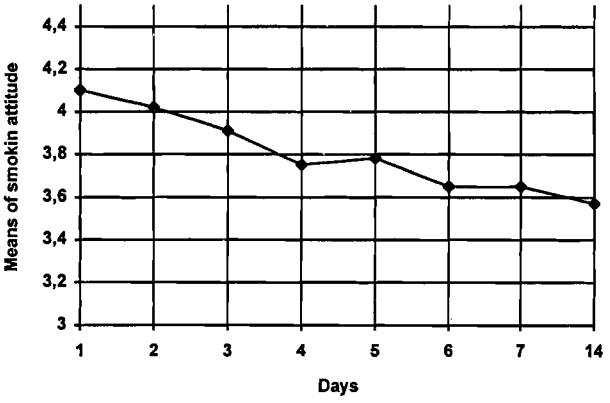

Figure 5. Smoking attitude for all women smokers during the 14 days of the study

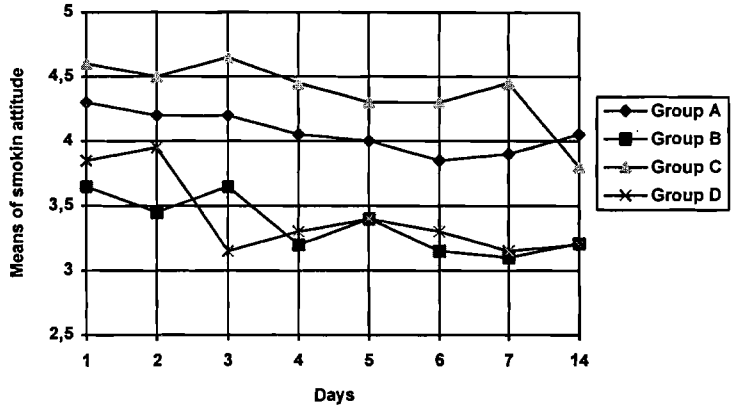

Figure 6. Changes in smoking attitude during the 14 days of participation in the study. Groups A-D

There were obvious changes of smoking attitude for the total group. The attitude changed to become more negative. This could be interpreted to show that the sensitivity toward smoking problems, that had been created during participation in the study, stimulated to a more negative smoking attitude for all groups of women.

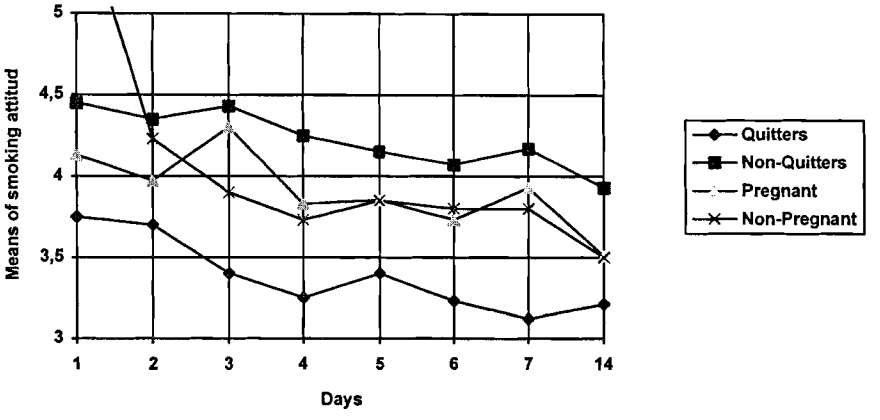

Figure 7. Smoking attitude changes during participation in the study; women not trying to quit smoking (A and C) and women trying to quit smoking (B and D) and pregnant women (A and B) and non-pregnant women (C and D)

Figure 6 showed that all groups (A-D) obtained a more negative attitude towards smoking during the study. Not pregnant women, not trying to quit, were most positive towards smoking, whereas women, both pregnant and non-pregnant, trying to quit were most negative towards smoking.

Figure 7 also showed that all groups, those not trying to quit, obtained a more negative smoking attitude. The largest difference in attitude was constantly between the groups quitting and non-quitting. For each day there was a large difference between these groups in relation to attitude towards smoking.

Pregnant and non-pregnant women did not show a clear difference between smoking attitudes of each day. The groups did not differ stably in relation to the dimension 'like smoking'.

To further study changes between groups over time, analysis of variance was also performed over time across groups (see Table 6).

Table 6
Smoking attitude changes over time; differences between groups

	Day	1	2	3	4	5	6	7	14
Group A	Mean	4.30	4.20	4.20	4.05	4.00	3.85	3.90	4.05
N=20	SD	1.08	1.06	1.01	1.05	1.03	1.04	1.12	1.32
Group B	Mean	3.65	3.45	3.65	3.20	3.40	3.15	3.10	3.21
N=20	SD	1.46	1.47	1.35	1.28	1.43	1.27	1.48	1.32
Group C	Mean	4.60	4.50	4.65	4.45	4.30	4.30	4.45	3.80
N=20	SD	.88	1.28	.99	1.15	1.26	1.38	1.19	1.32
Group D	Mean	3.85	3.95	3.15	3.30	3.40	3.30	3.15	3.20
N=20	SD	1.53	1.36	1.53	1.30	1.27	1.45	1.14	1.28
	ANOVA, F	2.30	2.34	5.53	5.03	2.57	3.32	5.43	2.11
	Sign	.083	.079	.001	.003	.060	.024	.001	1.06

The analysis of variance across groups gave statistically significant differences between smoking attitude of each group on days 3,4,6 and 7.
On day 3, non-pregnant women, not trying to quit smoking, had a less negative smoking attitude than others (M=4.65); and non-pregnant women, trying to quit smoking, had a more negative smoking attitude (M=3.15).
On day 4, non-pregnant women, not trying to quit smoking, had a more positive smoking attitude than others (M=4.45); and pregnant women, trying to quit smoking showed a more negative smoking attitude (M=3.20).
On day 6 the situation was similar; pregnant women, trying to quit smoking, had a more negative smoking attitude than others (M=3.15). On day 7 non-pregnant women, not trying to quit smoking, continued to have a more positive smoking attitude in comparison to other groups (M=4.45).

In order to investigate significance of smoking attitude changes across days, t-test for paired samples was used. The mean value of smoking attitude on day 1 was compared separately with the mean values of each of the other days (2-7, 14).
See Table 7.

Table 7
Comparison of day 1 smoking attitude mean value with smoking attitude mean values of each of the other days. T-test for paired samples (2-tail Sig.)

	Day	2	3	4	5	6	7	14
Day 1	t	- .61	-1.33	-2.21	-2.01	-2.52	-2.75	-2.87
	p	.54	.18	.03	.04	.01	.00	.005
	df	79	79	79	79	79	79	78

These results show that there were statistically significant changes of smoking attitude after the third day of the study participation. After that day all women smokers

liked smoking significantly less compared to the beginning of their participation. These trends were stable during the time period.

ANOVA with repeated measures was performed to investigate the effect of variables pregnant/non-pregnant and quitting/non-quitting on changes over time for the attitude towards smoking (See Table 5 in appendix). Significance was obtained for quitting and days, but not for the interaction quitting and days. Thus, there was a difference between quitters and non-quitters and between different days, but the difference between quitting/non-quitting was not depending on days. The result is in accordance with a constant difference between quitters and non-quitters over time.

In summing up, there were changes over time in attitude towards smoking. All the groups obtained a more negative attitude towards smoking. There were also differences in the degree of negativity between the groups. The largest difference was obtained between quitting and non-quitting women. The difference in attitude between pregnant and non-pregnant was smaller. Thus, the important variable explaining difference in attitude towards smoking was trying to quit/not trying to quit smoking. This applied constantly over all the period of 14 days of the study.

3.4 Resoluteness on day 1 (all subjects)

The pregnant women were somewhat more resolute in their decision to quit (M=5.6; N=20), compared to the non-pregnant ones (M=4.6; N=20). The pregnant women judged it as somewhat more likely that they would succeed to quit (5.6; N=20 and 4.8; N=20). Thus, this group was both more resolute and judged it as more certain on day 1 that they would succeed in their attempt to quit.

3.5 Mood if smoking

Table 8
Have you smoked since previous questionnaire or not?' (quitters)

Day	2	3	4	5	6	7	14
N	40	39	40	40	40	39	39
Yes	14	12	10	9	9	9	12

If you smoked what was your mood?'
(tense - relaxed)

Day	2	3	4	5	6	7	14
N	14	12	11	9	9	9	12
M	3.6	3.4	3.1	3.9	3.4	3.2	3.1
SD	1.5	1.8	1.0	1.6	1.0	1.0	1.3

(tired - energetic)

Day	2	3	4	5	6	7	14
N	14	12	11	9	9	9	12
M	3.1	3.4	3.6	3.8	3.3	3.4	3.2
SD	1.1	1.1	1.0	1.6	1.0	1.0	1.3

(sad - happy)

Day	2	3	4	5	6	7	14
N	14	12	11	9	9	9	12
M	3.4	3.7	3.2	3.0	3.7	3.1	3.2
SD	1.3	1.6	1.3	1.5	1.3	1.4	1.7

Table 8 shows that smoking among quitters was slightly more common on day 2, 3 and 14 than on day 4, 5, 6, 7. The mood ratings showed that the variations between different days were quite low. The Ss were somewhat more tense on day 4 and 14, tired on day 2 and 14, and sad on day 5 and 7. This indicates a slightly more negative feeling when failing in quitting attempts at the end of the period.

3.6 Coping techniques

On day 14 the subjects were asked to rate if they used any of the techniques to abstain from smoking (1=never - 7=almost all the time). The ratings are reported in Table 9.

Table 9
The use of different coping techniques for different groups

	Tot	Preg	Non preg	Pregnant Non quit	Pregnant Quit	Non-pregnant Non quit	Non-pregnant Quit
N	80	40	40	20	20	20	20
Pursuing some other activity in smoking tempting situations.							
M	4	3.9	4	3.9	3.9	2.8	4.3
SD	1.6	1.6	1.5	1.8	1.5	1.5	1.6
Breaking habits connected with smoking.							
M	3.5	3.6	3.3	3.2	4.1	2.9	3.7
SD	1.7	1.6	1.7	1.7	1.4	1.6	1.8
Avoiding difficult situations where smoking is likely.							
M	3.5	3.8	3.2	3.6	4	3	3.4
SD	1.8	1.9	1.8	2	1.8	2	1.4

Obtaining social support and reinforcement for quitting.

M	3.4	3.8	3.1	3.3	4.4	2.2	4
SD	2	2	2	2.1	1.7	1.8	1.8

Thinking or talking about motives for not smoking.

M	3.3	3.6	3.1	3.9	3.3	2.9	3.3
SD	1.9	1.7	2	2	1.4	2	2.1

Diverting attention from smoking tempting thought.

M	4.1	4.3	3.8	4.2	4.4	3.8	4
SD	1.8	1.7	1.8	1.9	1.5	1.7	2

Trying to get insight into why i wish to smoke.

M	3.8	3.5	4.2	3.4	3.5	4.5	3.8
SD	2.1	2	2.2	2	2.1	2.2	2.2

Setting up partial and realistic goals in my attempt to quit smoking.

M	3.9	4	3.9	3.9	4.1	3.8	4
SD	2	1.9	2.1	2	1.7	1.9	2.3

Running away (physically) from a temptation to smoke.

M	3.8	4.1	3.4	4.3	3.9	3	3.8
SD	1.7	1.7	1.6	1.6	1.9	1.5	1.6

Proceeding slowly with quitting smoking allowing myself occasional relapses.

M	4	3.8	4.1	4.2	3.5	3.5	4.7
SD	1.9	1.9	2	1.9	1.8	2.1	1.7

Using substitutes for smoking such as food, drugs or alcohol.

M	2.4	2.4	2.4	2.6	2.2	2.7	2.1
SD	1.8	1.8	1.8	2.1	1.5	2.3	1.3

Results showed that the three most used coping mechanisms were
'Diverting attention from smoke tempting thoughts.' (M=4.1)
'Pursuing some other activity in smoking tempting situations.' (M=4.0)
'Proceeding slowly with quitting smoking allowing myself occasional relapses.' (M=4.0)

The least used was
'Using substitutes for smoking such as food, drugs or alcohol.' (M=2.4)
For some coping mechanisms there was a difference in use between groups:
'Breaking habits connected with smoking.'
'Obtaining social support and reinforcement for quitting.'
'Trying to get insight into why I wish to smoke.'
'Running away (physically) from a temptation to smoke.'

This difference applied to the groups pregnant women trying to quit (B) and non-pregnant women not trying to quit (C) where pregnant women trying to quit more often used these strategies. These two groups also showed the largest difference as

to smoking attitude where B disliked smoking most and C exhibited most positive attitude towards smoking.

For two techniques the use was evenly distributed among the different groups. The techniques were:
'Setting up partial and realistic goals in my attempt to quit smoking.'
'Using substitutes for smoking such as food, drugs or alcohol.'

In addition, correlations between use of different coping techniques were computed and found to be quite low.

3.7 Correlations between different independent variables and use of coping techniques

Table 10
How do you like smoking? ♦ The use of different coping techniques (All Ss; N=79 and 78)

Day 5	-.10	-.36	-.20	-.11	-.13	-.20	.02	-.28	-.12	-.04	-.02
Day14	-.16	-.22	-.13	.04	-.12	-.13	-.04	-.20	-.08	-.04	-.01

The columns 1-11 are the 11 different coping techniques described above.
Table 10 shows that mostly low negative correlations were obtained between how they liked smoking and the use of different coping techniques. This applied both on day 5 and day 14.

Table 11
Correlations between background variables and the use of different coping techniques

How many times have you tried to quit before? ♦ The use of different coping techniques. (All Ss: N=78). Corr= -.06 to .21
How likely is it that you will succeed to quit? ♦ The use of different coping techniques. (Quitters: N=39). Corr= -.18 to .32
How resolute are you in your decision to quit? ♦ The use of different coping techniques. (Quitters: N=39). Corr= -.02 to .30

Table 11 shows that the correlations between the use of different coping techniques and number of quitting earlier, likelihood of success, resoluteness in decision to quit also were quite low.

3.8 Quitting behavior

Finally, correlations on both day 5 and day 14 were calculated between the variables of:

How many times have you tried to quit before ?
- *If you will try to quit now again, how resolute are you in your decision to quit? (quitters)*
- *How likely is it that you will succeed to quit?*
- *How many times have you tried to quit before? (quitters)x How do you like smoking? (All Ss)*

How many times have you tried to quit before?
- *How do you like smoking (All Ss)*
- *How resolute are you in your decision to quit (Quitters)*
- *How likely is it that you will succeed to quit (Quitters)*

All the correlations between the variables above were low (-0.33 to 0.11)

Finally, some comments will be made to the answers to some open questions.
The total number of quitting women who had smoked one cigarette was 22; 8 in group B (pregnant) and 14 in group D (non-pregnant). The subjects were asked to describe the circumstances of relapse. First they described the situation when relapsing, and it was most often at home, early in the morning with coffee for group B, and at the office or at home for group D.

The emotional state when relapsing was mostly in high spirits. However, some were also in a negative mood, such as being angry. When asked how they reasoned the most common answer was that they did not reason at all. After smoking the pregnant group felt in good condition, and the non-pregnant group felt badly. They were asked how they felt now about smoking and quitting smoking, and the most common answer for the pregnant group was neutral, whereas those not being pregnant felt sick, tense and confused.

The subjects were also asked to perform some free associations. They were presented the words 'tobacco" 'smoking' and 'smoker, women'. The words were chosen to investigate the attitude to the substance, the activity and the subject of smoking. All 80 subjects participated. They were given 5 seconds to write an association. If noting came up in their mind they would not write anything. About 44 subjects gave some association.

The association to tobacco (44 Ss):
Most Ss (19) associated to cigarette; some to pipe, drag, ash-tray and poison.
The association to smoking (44 Ss):
Most Ss (9) associated to smoke; some to cigarette, harm, habit, pipe and boredom.
The association to smoker, woman (44 Ss):Most Ss (41) associated to woman; some to me, stupid woman, coffee and gypsy woman (!).

4 DISCUSSION

The four groups differed somewhat as regards smoking habits. Group B (pregnant, trying to quit) and C (non-pregnant, not trying to quit) had a somewhat larger consumption of cigarettes, approximately 11 per day compared to approximately 10 per day for the two other groups. The mean number of years of smoking was a little longer, approximately 8 years, for D (non-pregnant, trying to quit), the rest 5-6 years.

One interesting fact is, that B and D (those trying to quit smoking) had tried to quit more often earlier compared to those not trying to quit. This is in accordance with results earlier found by DiClemente and Prochaska (1982). When studying smoking cessation they found that many of the successful quitters had made numerous attempts to change before finally succeeding. Quitting smoking seems, according to the authors, to be a dynamic process rather than a discrete event and most people cycle from smoking to nonsmoking repeatedly. Particularly for addictive behaviors like cigarette smoking, movement through the stages involves a cycling and recycling process (Prochaska et al., 1990) and smoker and non-smoker categories are regarded more as a process than as a dichotomous construct (DiClemente et al., 1991). In a study by Cohen et al. (1989), however, there appeared to be little relationship between previous attempts to quit and the probability of current success.

The four groups were asked how they liked smoking and it was found that pregnant women trying to quit disliked smoking most, while those not trying to quit, both pregnant and non-pregnant, exhibited a more positive attitude towards smoking. The most important variable for difference in smoking attitude was trying to quit/not trying to quit smoking, whereas no significant difference in attitude was found between pregnant and non-pregnant women smokers.

The present study was restricted to encompass a time period of 14 days, and could, therefore, only be relevant for short-term outcomes. Significant changes of smoking attitude during this time period were found. The attitude changed to become more negative for all women smokers. One interpretation proposed is, that the sensitivity is increased towards problems connected to smoking, stimulating a more negative attitude.

Group C (non-pregnant, not trying to quit) started as least negative, whereas group B (pregnant, trying to quit) started as most negative. All groups became more negative, group C (non-pregnant, not trying to quit) changed to the largest extent, being in the start the least negative. For group C the change to a more negative attitude was most pronounced during the period day 7 to day 14. It was also found that after the third day of participation there were significant changes of smoking attitude. After that day all women liked smoking significantly less compared to their attitude at the start of the study.

A comparison was made between women not trying to quit (A and C) and those trying to quit (B and D). A significant difference was found in their smoking attitude for each separate day. This was not found for the variable pregnant/non-pregnant.

ANOVA with repeated measures for days obtained a significance for the factor of quitting/non-quitting and for days, but not for the interaction between these two factors, indicating a constant difference between quitters and non-quitters over time.

The pregnant women being more resolute and more certain to succeed in their attempt to quit was probably due to a higher motivation caused by the circumstance of being pregnant.

The number of relapses was largest in the beginning and the end of the period of participation. The number of relapses on day 14 could be explained by the larger number of days when relapses could occur since the last day of the questionnaire, that is day 7. On day 2 and 3 there was a somewhat higher number of relapses. Tentatively, this could be explained by short-term abstinence symptoms described in Study VI.

In the present study the coping mechanisms most often used were 'Diverting attention from smoke tempting thoughts', 'Pursuing some other activity in smoking tempting situations' and 'Proceeding slowly with quitting smoking allowing myself occasional relapses'. The first two techniques both imply a diverting strategy.

The least common strategy was 'Using substitutes for smoking such as food, drugs or alcohol'. Other less used strategies were 'Obtaining social support and reinforcement for quitting' and 'Thinking or talking about motives for not smoking'. Both these are cognitive coping strategies.

Two groups, pregnant women trying to quit smoking (B) and not-pregnant women not trying to quit (C), differed in use of the two behavioral coping strategies 'Breaking habits connected with smoking' and 'Running away (physically) from a temptation to smoke' and the two cognitive strategies of 'Obtaining social support and reinforcement for quitting' and 'Trying to get insight into why I wish to smoke'. The pregnant group trying to quit smoking (B) used these strategies to a larger extent than non-pregnant women, not trying to quit (C).

There was also a difference in attitude between these two groups with B having a more negative attitude. This indicates a relationship between attitude towards smoking and coping strategy used. However, this relationship could only be relevant for these two groups, as correlations between attitude towards smoking and the use of different coping techniques for all subjects were quite low for attitudes both on day 5 and day 14.

For two techniques the use was evenly distributed among the different groups. These two techniques were:
'Setting up partial and realistic goals in my attempt to quit smoking' and
'Using substitutes for smoking such as food, drugs and alcohol'.

In a study by Sjöberg, Svensson and Persson (1979) on obese patients trying to regulate their eating the importance was stressed of proceeding at a slow rate and that diversions were allowed. As related above, in the present study smokers used

'Diverting attention from smoke tempting thoughts' as a coping technique. Sjöberg et coworkers also found that excessive eaters experienced less of a domino effect, that is a total failure after a relapse compared to smokers. Diverting thoughts were in that study found to be less important to eaters compared to smokers. For excessive eaters it was crucial to pursue some activity, trying to break habits, avoid difficult situations and try to obtain support and reinforcement for success.

In the present study the finding of low correlations between use of different coping methods indicates that the use of coping techniques is a complex area of relapse behavior. This is also indicated by obtained low correlations between the use of different coping techniques and various independent variables, such as the number of quitting attempts earlier, likelihood of success and resoluteness in decision to quit. Correlations between other quitting variables were also found to be low.

According to Ainslie (e.g.1975) relapses could be explained by value change over time. This has, however, been refuted in extensive research by Sjöberg and coworkers (e.g. Sjöberg, Svensson & Persson, 1979; Sjöberg & Olsson, 1981; Sjöberg, Samsonowitz & Olsson, 1983; Sjöberg & Samsonowitz, 1985) where relapses are explained by impulse and control processes. They found that techniques for fighting difficulties are not cognitive processes but rather techniques for handling and transferring psychological energy from one action system to another in order to pursue difficult decisions.

According to the studies by Sjöberg et al coping both brings up positive or negative values and induces attention shifts. This is especially important when encountering the emotional stress in daily life. Loss of control due to extraneous events of an emotionally provocative nature, or to the influence of drugs or alcohol, is an important factor. It may, therefore, be fruitful to include attempts to increase the perception of control in the programs. For those who are high in perceived control, coping skills can be taught with some advantage, as they may be able to experience a few occasional relapses without disastrous consequences.

Studies have explored self-control in smokers (e.g. Newman & Bloom, 1981) with the assumption that the response repertoire of smokers, drug addicts etc., does not contain effective control responses. Presumably, smoking reduction is a self-control problem and self-control training could involve rehearsal in confrontation with actual self-control situations.

A conclusion is, therefore, that treatment programs would benefit from the introduction of programs whose aim is to enhance of self-control. The argument presented by Sjöberg and Samsonowitz (1985) is that with a high confidence in control, occasional relapses will not cause a complete defeat. This is beneficial for the long-run result, whereas a low-control person supposedly only succeeds in the short run.

In the Action Model action is seen as a self-controlled mental process. This implies according to Sjöberg, Samsonowitz and Olsson (1983) a distinction between wishes,

actions and decisions, where decisions might be a strategic focus for further studies on addictive behavior.

Decision-making, particularly an individual's evaluation of the pros and cons of a particular behavior, has earlier been identified by Janis and Mann (1977) as a critical component in the modification of behavior. Time-related stage classifications for smoking cessation have also been related to a decision-making construct (Velicer et al., 1985) and to the processes of change for smoking cessation (DiClemente & Prochaska, 1985; Prochaska et al., 1988).

It has also been found that the time perspective used is important when evaluating the outcome. Marlatt, Curry and Gordon (1988) performed a longitudinal analysis of unaided smoking cessation over a two-year period. Variables that were associated with short-term outcome were not the same as those related to long-term outcome. A strong motivation to quit was, however, found to be related to both initial success and long-term abstinence maintenance.

Shiffman (1984) reported that the use of a coping strategy is the best predictor of resisting the temptation to smoke responses. He identified a variety of coping strategies which were equally effective in preventing relapse, including eating/drinking, engaging in a distracting activity, escape, delay, engaging in a physical activity and relaxing. He concluded that it is probably advisable to teach ex-smokers a broad repertoire of coping behaviors. It was also found that cognitive responses were more frequently used by ex-smokers than behavioral responses in coping with temptations to smoke and that combining cognitive and behavioral responses enhanced effectiveness.

However, in a later study, Shiffman (1986) argued that using combinations of cognitive and behavioral coping strategies was not more effective than using cognitive and behavioral coping strategies alone. Moreover, the presence of other smokers resulted in increased likelihood of smoking. Coping was associated with resisting the temptation to relapse, but no single coping strategy was more effective than any other in preventing relapse. He concluded that regardless of the strategy employed, all subjects need strategies to sustain cessation long-term. Bliss, Garvey and Heinold (1989) suggested that the best predictor of continued abstinence was the actual number of coping strategies used.

Shiffman (1986) has stressed the time perspective and further emphasized the importance of investigating multilevel interactions among specified relapse-promoting and relapse-protective factors. In this interactive model, types of coping responses (i.e. stress-related or temptation-related) stages of coping (i.e. anticipatory, immediate, strategic, responsive or restorative) and stages of maintenance are all differentiated.

This suggests that the interrelationship between the stages and the processes of change provides new directions and that the programs could preferably be examined for the processes they create and not only for the outcomes they produce. Moreover, the programs might be designed and evaluated on the basis of the interactions

between processes and stages. Generally, research seems to be focused on short-term cessation acticity, not long-term abstinence. Therefore, for the future, extended research on more long-term abstinence seems desirable (see Magneberg, 1995).

Cessation interventions may be able to increase success rates by being sensitive to stage and by shifting strategies depending on stage of change. Repeated contacts seem essential for early stage smokers. Feedback that focuses on stage-specific goals and strategies seems promising. The greatest benefit, however, might be to maintain contact with the individuals as they move through the cycle of change over time. The effectiveness and efficiency of inventions could be increased through paying attention to the stages of change.

Another relationship between coping and the concept of time is reported by Miller (1991) who found that personality profiles of successful remitters include future goal-orientation and self-efficacy. Personality variables contributing to the addictions may be conceptualized in terms of cognitive style i.e. a non reflective, impulsive cognitive style that relates to an inability to use inner speech and other verbal self-regulatory mechanisms to evaluate, plan and guide behavior. Miller (1991) argues that those who lack the capacity to self-regulate their impulses and behaviors, and who have a difficulty maintaining a goal-oriented mind-set due to impaired ability to anticipate future consequences can be characterized as having an impulsive, non-reflective cognitive style.

Carmody (1992) summarizes that relapse prevention with a short-term maintenance requires social support, reinforcement, coping skills, training, and use of drugs. Long-term maintenance means monitoring of temptations to smoke, preparation of non-smoking responses to high-risk situations, initiation to a general life style change, systematically graded smoking-cue exposure, stress management, and weight control. Variables reflecting past smoking behavior, reasons for smoking and self-efficacy expectations regarding quitting were all associated with long-term abstinence. In addition, according to Carmody (1992), life style balancing implies to teach the ex-smoker alternative ways of coping with stress and substituting other forms of enjoyment in place of smoking. However, there is an extreme difficulty in prompting people to adhere to long-term regimens related to fitness, diet, medication and smoking cessation.

In summing up, short-term maintenance (i.e. one to two months) has been found to be associated with more extensive affect-regulation repertoire and use of stimulus control strategies. Long-term (one year) maintenance of abstinence has been found to be related to self-monitoring of smoking during initial treatment.

Carmody (1992) concludes that it is not known whether the probability of relapse increases or decreases with time or whether there is a safe point after which the chance of relapse diminishes dramatically.

Perhaps one reason for the lack of conclusive data in this field of research may be that models used in explaining individual behavior assume that people behave rationally, once they have obtained reliable, credible, factual information. For

example, it appears to be accepted knowledge among the general population that smoking is a risky behavior, from a health perspective. As a result, many individuals make the decision, and the attempt, to quit smoking. Reported relapses, however, are common. Although a goal has been set up we seem to lack knowledge and perhaps ability to do it. The process of relapses needs to be focused upon in further studies.

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APPENDIX

Table 2

Two scales of health motivation and health consciousness

1. I try to prevent health problems before I feel any symptoms.
2. I am concerned about health hazards and try to take action to prevent them.
3. I try to potect myself against health hazards I hear about.
4. I do not worry about health hazards until they become a problem for me or someone close to me.
5. There are so many things that can hurt you these days, I am not going to worry about them.
6. I often worry about the health hazards I hear about, but do not do anything about them.
7. I do not take any action against health hazards I hear about until I know I have a problem.
8. I would rather enjoy life than try to make sure I am not exposing myself to a health hazard.
9. I reflect about my health a lot.
10. I am very self-conscious about my health.
11. I am generally attentive to my inner feeling about my health.
12. I am constantly examining my health.
13. I am alert to changes in my health.
14. I am usually aware of the state of my health as I go through the day.
15. I am aware of the state of my health as I go through the day.
16. I notice how I feel physically as I go through the day.
17. I am very involved with my health.

Table 3
Events and states

The events and states for all subjects:

1. You eat less.
2. Your physical condition becomes worse.
3. You get a heart disease.
4. You have a bad smell of tobacco at home.
5. You develop pride because of your successful self-control.
6. You become irritated.
7. You become depressed.
8. You become more relaxed.
9. You feel pleasure and satisfaction.
10. You get a pain in the chest.
11. You get lung cancer.
12. Your taste sensitivity increases.
13. You are less likely to get a cold.
14. You feel forced to act in a certain way.
15. You live in a nice home.
16. Your emotional stability improves.
17. You spend money in a stupid manner.
18. Your life expectation becomes shorter.
19. Your home is cleaner.
20. You get an uneasy feeling.
21. Others like you.
22. You have good relations with other.
23. You set a bad example for your children.
24. You have to search often for cigarettes and matches.
25. You cause damage to other people´s health.
26. You become aggressive.
27. You get to be fat.
28. You feel free to do whatever you wish.
29. Your self-confidence improves.
30. You satisfy others who worry about your health.
31. You stop worrying about whether you can quit smoking.
32. You drink more alcohol.
33. You get a negative attitude to people who smoke.
34. You lose some of your physical strength.
35. You become more attractive.

The additional events and states only for pregnant women:

36. You worry about the health of your future child.
37. You influence the condition of your fetus in a negative manner.
38. Your home environment is unhealthy for children.
39. Your own health during pregnancy is at risk.
40. Your home environment can cause allergy in children.
41. Your child will become a smoker.
42. You get a miscarriage.
43. You get a child with a low birth weight.
44. You have a difficult child delivery.

Table 4
Techniques used to abstain from smoking

1. Pursuing some other activity in smoke tempting situations.
2. Breaking habits connected with smoking.
3. Avoiding difficult situations where smoking is likely.
4. Obtaining social support and reinforcement for quitting.
5. Thinking and talking about motives for not smoking.
6. Diverting attention from smoke tempting thoughts.
7. Trying to get insight into why I wish to smoke.
8. Setting up partial and realistic goals in my attempt to quit smoking.
9. Running away (physically) from a temptation to smoke.
10. Proceeding slowly with quitting smoking, allowing myself occasional relapses.
11. Using substitutes for smoking such as food, drugs or alcohol.

Table 5
Anova with repeated measures for variables of pregnancy/non-pregnancy,quitting/non-quitting and days. The attitude towards smoking.

	HYPOTHESIS	F-value	Prob
SMOKING ATTITUDE	PREGNANT	0.73	*0.3971*
	QUITTING	13.96	*0.0004**
	DAYS	4.77	*0.0001**
	PREGNANT*QUITTING	0.27	*0.6032*
	PREGNANT*DAYS	0.85	*0.5436*
	QUITTING*DAYS	0.76	*0.6251*
	PREGNANT*QUITTING*DAYS	1.26	*0.2676*

Note: PREGNANT, QUITTING and PREGNANT*QUITTI NG based on df = 1;
DAYS, PREGNANT*DAYS, QUITTING*DAYS
and PREGNANT*QUITTING*DAYS based on df=7;
*p = 0.05;

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