

Smokers, Smoking Deprivation, and Time Discounting

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Abstract

This paper investigates whether smoking people show higher time discounting than non-smokers, and how short-time deprivation of smoking affects time discounting. A unique feature of our experiment is to give rewards to subjects according to their choice not only in money session but also in tobacco session to elicit their true want. We unequivocally confirmed that smokers are more impatient than non-smokers, which is consistent with previous studies. On the other hand, temporal deprivation of smoking makes smoker impatient. These results suggest that nicotine concentration gives different effects in the short- and long-run.

JEL Classifications: D03, D90, I10, Q57

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1 Introduction

It is known that smoking makes people impatient (Brick et al. 1999, Mitchell 1999, Baker et al. 2003, Ohmura et al., 2005; Reynolds 2004; Reynolds et al., 2004, 2007). Experiments using animals suggest that this is due to a chronic (but not acute) increase in nicotine concentration (Dallery and Locey, 2005).

The purpose of this study is two folds. The first aim is to confirm the results that smoking people really show higher time discounting than non-smokers. The second aim is to investigate the effect of short-time deprivation of smoking on time discounting.

To address these two questions, we conduct an experiment to compare time discounting between smokers and non-smokers as well as between deprived smokers and smokers under usual smoking condition. Salient difference from the previous studies such as Mitchell (2004) and Field et al. (2006) is that our subjects are requested to select between earlier and later smoking. Meanwhile,

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Mitchell (2004) asks their subjects to compare the number of cigarettes (up to 60) and US\$10 with a delay receipt (up to 365 days) in his delay cigarette-money task. Although deprived smokers are expected to prefer earlier smoking, subjects of Mitchell's experiment cannot smoke earlier regardless of their choice in the task. In addition, receipt of 60 cigarettes does not mean that the subjects smoke 60 cigarettes at a one-time. Thus, in the delay cigarettes-money task in Mitchell (2004), the subjects should have compared the monetary value of cigarettes with the later receipt of money, which would have produced the same results of money-money task, in which subjects compare earlier and later receipt of money. Surprisingly, however, Mitchell (2004) gets the result that the deprived subjects became more impulsive in cigarette-money session, but not in money-money session.

2 Experimental design

Experiments were conducted 12-14 January (the first wave) and 20 and 21 February (the second wave), 2010 at Osaka University, Japan. Subjects consist of 50 smokers (male=49, female=1) and 17 non-smokers (male=13, female=4). All the non-smokers joined the first wave. Among smokers, 14 subjects (all male) joined the first wave and the rest of the subjects, 36 (male=35, female=1) joined the second wave of the experiment.

Our subjects consist of three groups: non-smokers, smokers who smoke as usual on the day of experiment, and smokers who are deprived of smoking since 12 hours prior to the beginning of experiment. Those who were members of 'usual smoker group' in the first day's experiment became members of 'deprived smoker group' in the next day's experiment and vice versa.

Subjects are requested to choose one of the two options, A or B, displayed on a computer in front of each subject. Option A is to get smaller reward earlier, and option B is to get larger reward later.

Real tobacco sessions Let us start with the explanation of real tobacco session, because this is a unique session, which has, to our knowledge, not been done before. Want for smoking is the primary desire and emotional rather than rational, so that the belief that rewards will be really paid (subjects can smoke) is necessary to elicit true want. For this purpose, we design the experiment to smoke the exact amount at the exact timing specified in the selected options.

Hypothetical tobacco sessions Although "real tobacco session" is powerful to elicit the subjects' preference by giving incentive to subjects, "real tobacco session" alone cannot specify a variety of experimental conditions due to the limited time (50 minutes maximum) in giving the reward of smoking at the end of the experiment. To ask questions with longer delay and interval, we added "hypothetical tobacco session," where subjects actually do not smoke at the end of the experiment regardless of their choice.

Money sessions Three rewards are considered in the money session; 1000, 2000, and 3000 yen. Five delays are considered; today, one, two, three, and four weeks. The interval is fixed at

two weeks. Six annual rates of returns are set; 0, 50, 100, 150, 200, and 300 (%). Based on these conditions, 16 questions are asked for each delay, so that 80 questions are asked in total in the hypothetical tobacco session.

At the end of the experiment, one question is randomly selected out of 80 questions for money and real tobacco sessions, and subjects will receive a reward, based on their choices made in the selected question, at the time stated in the option that they chose. Smokers earned 4,450 yen for two days (usual and deprived smoking conditions) on average and non-smokers, who attend only money session for one day earned 1,923 yen. In addition, smokers and non-smokers are paid 6,666 yen (for two days) and 2,222 yen, respectively in cash as compensation for participation, so that per-capita rewards in total is 11,116 yen for smokers and 4,145 yen for non-smokers.

After the instruction of the experiment, hypothetical tobacco session, money session, and real tobacco session are conducted in this order. Only the smoking smokers' group is allowed to smoke during the breaks between the sessions. Real tobacco session is divided into five blocks, each of which asks 16 questions in three minutes. This is planned because subjects really smoke just at the time when the selected option specifies. After real tobacco session finishes, one of the 80 questions is randomly selected, and subjects smoke the amount of cigarette at the time that are designated in the selected option of the selected question. During this smoking time, subjects answer a questionnaire and are paid the fixed reward. After all the subjects smoke, they should wait for 30 minutes in the room, being allowed to do anything but smoking. That they cannot smoke for 30 minutes after the experiment is announced beforehand in the instruction, so that they should have chosen an option considering it. If we released the subjects just after the experiment, they would have had an incentive to select an earlier option because a later option becomes less attractive because they can smoke just after the longest delay designated in the experiment (i.e., 50 minutes).

3 Panel logit analysis

3.1 Estimation method

We estimate a (panel) logit regression, where dependent variable is a choice dummy which takes unity if a subject chooses a later option and zero if an earlier option. Alternatively, we could have estimated discount rate for each experimental condition specified by delay, interval, and amount of reward at the first stage and then analyze this discount rate. However, the former method has an advantage of the efficient use of all the information of 240 choices per subject. More importantly, while the two-step method premises at the estimation of discount rates that subjects make a decision based only on their specific per-period time discount rate, the former method has no need of such premise that was already found incorrect by many studies (Frederick et al. 2002, Kirby et al. 1995, Benzion et al. 1989, Loewenstein et al. 1992).

It is known that the inter-temporal choice is affected by, the delay, the interval, and the magnitude effects (e.g. Kinari et al. 2009). Therefore, it is necessary to control the conditions on delay and magnitude to see the effect of smoking and smoking deprivation on the inter-temporal

choices. Therefore, explanatory variables are experimental conditions, such as the rate of return (*RETURN*), the delay (*DELAY*), and the amount of rewards (*AMOUNT*). The key variable to compare smokers and nonsmokers is smokers' dummy (*D_SMOKER*) in "money session." If the coefficient of this dummy is positive, it implies that smokers tend to choose later option and are more patient. On the other hand, the key variable eliciting the effect of short-term deprivation of smoking is a dummy variable for deprived smokers (*D_DEPRIVATION*).

Results of three sessions are used for this analysis. We can also investigate whether domain effect exists by examining the regression results.

3.2 Results of the analysis of smokers vs. nonsmokers

Estimation results of the analysis of smokers vs. nonsmokers are presented in Table 1. Since we compare the data of smokers with non-smokers, only "money session" is applicable. In the left columns of the table, the results using variables of the delay and the amount are shown. Smokers' dummy is significantly negative, implying that smokers are more impatient. Although the amount is significantly positive, implying that subjects become patient for large amount (the magnitude effect), delay variable is not significant. Thus, the delay effect is not recognized in this case.

Table 1: Estimation results of panel logit regression: smokers vs. non-smokers

	Coef.	p value	Coef.	p value	Coef.	p value
Constant	-2.205	[0.000]**	-1.691	[0.000]**	-1.434	[0.000]**
<i>D_SMOKER</i>	-0.658	[0.000]**	-0.662	[0.000]**	-0.663	[0.000]**
<i>DELAY</i>	0.03	[0.170]				
<i>AMOUNT</i>	0.001	[0.000]**				
<i>RETURN</i>	0.01	[0.000]**	0.01	[0.000]**		
<i>D_DELAY_M2</i>			0.3	[0.003]**	0.3	[0.003]**
<i>D_DELAY_M3</i>			0.285	[0.004]**	0.285	[0.004]**
<i>D_DELAY_M4</i>			0.201	[0.043]*	0.201	[0.043]*
<i>D_DELAY_M5</i>			0.201	[0.043]*	0.201	[0.043]*
<i>D_AMOUNT_M2</i>			0.987	[0.000]**	1.017	[0.000]**
<i>D_AMOUNT_M3</i>			1.434	[0.000]**	1.471	[0.000]**
<i>D_RETURN_M4</i>					0.84	[0.000]**
<i>D_RETURN_M5</i>					1.459	[0.000]**
<i>D_RETURN_M6</i>					1.692	[0.000]**
<i>D_RETURN_M7</i>					2.594	[0.000]**
Pseudo R2		0.184		0.184		0.185
Observation		5360		5360		5360

Note: ** indicates being significant at the 1% level and *, at the 5% level.

3.3 Results of the analysis of effect of smoking deprivation

In Table 2, we present the results of three sessions using the return, delay and amount variables. Smoking deprivation dummy is significant only in the case of real tobacco session. The coefficient

of the dummy variable is negative, implying that smoking deprivation makes subjects more impatient. In hypothetical tobacco and money session, the dummy variable is not significant. The result suggests that the subjects reveal their true preference to smoking only when incentive is appropriately given.

The delay variable shows different results depending on three sessions. It is significantly negative in real tobacco session, implying that the subjects become to prefer more to earlier smoking as the delay becomes longer. This is the reversed phenomena to the delay effect. In money session, the coefficient of the delay is significantly positive, implying that subjects show the usual delay effect. In hypothetical tobacco session, the coefficient is not significant.

The amount of rewards takes a significantly positive sign in money session, implying that the subjects choose later options, thus more patient, for larger amount, which is the usual magnitude effect. However, in real and hypothetical tobacco sessions, the amount of rewards takes a significantly negative sign, implying that they show opposite tendency to the usual magnitude effect.

Return is positive in all sessions, indicating that the subjects make a rational choice with respect to returns.

Table 2: Estimation results of panel logit regression: the effect of cessation

	Real tobacco		Hypothetical tobacco		Money	
	Coef.	p value	Coef.	p value	Coef.	p value
<i>D_DEPRIVATION</i>	-0.161	[0.006]**	0.048	[0.411]	0.089	[0.219]
<i>DELAY</i>	-0.031	[0.000]**	-0.0002	[0.951]	0.087	[0.001]**
<i>AMOUNT</i>	-1.75	[0.000]**	-1.321	[0.000]**	0.002	[0.000]**
<i>RETURN</i>	0.002	[0.000]**	0.002	[0.000]**	0.021	[0.000]**
Pseudo R2		0.208		0.201		0.432
Observation	49	7840	47	7520	50	8000

4 Conclusions

In this paper, we investigated (a) whether smoking people show higher time discounting than non-smokers, and (b) how short-time deprivation of smoking affects time discounting. We solicited smoking and non-smoking students of Osaka University and conducted an economic experiment. A unique feature of our experiment is to give rewards to subjects according to their choice not only in money session but also in tobacco session to elicit their true want.

We unequivocally confirmed that smokers are more impatient than non-smokers in money, hypothetical tobacco, and real tobacco sessions. The results are consistent with previous studies. On the other hand, temporal deprivation of smoking makes smokers impatient. The latter results are obtained only in real tobacco session, where subjects smoke following their choice of the options. This suggests that giving an appropriate incentive is crucial to elicit their true want on smoking.

Overall, these results suggest that nicotine concentration gives different effects in the short- and long-run: although long-run intake of nicotine, which implies higher nicotine concentration, makes

people addictive and impatient (Ohmura et al., 2005), short-run deprivation of smoking, i.e. lower nicotine concentration, makes smokers impatient. In other words, nicotine intake affects differently depending on addictive and non-addictive subjects. Investigation of these different pathways in brain remains as a future work.

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