

# **Time Preferences and Energy Saving: Results from the Swiss Environmental Survey**

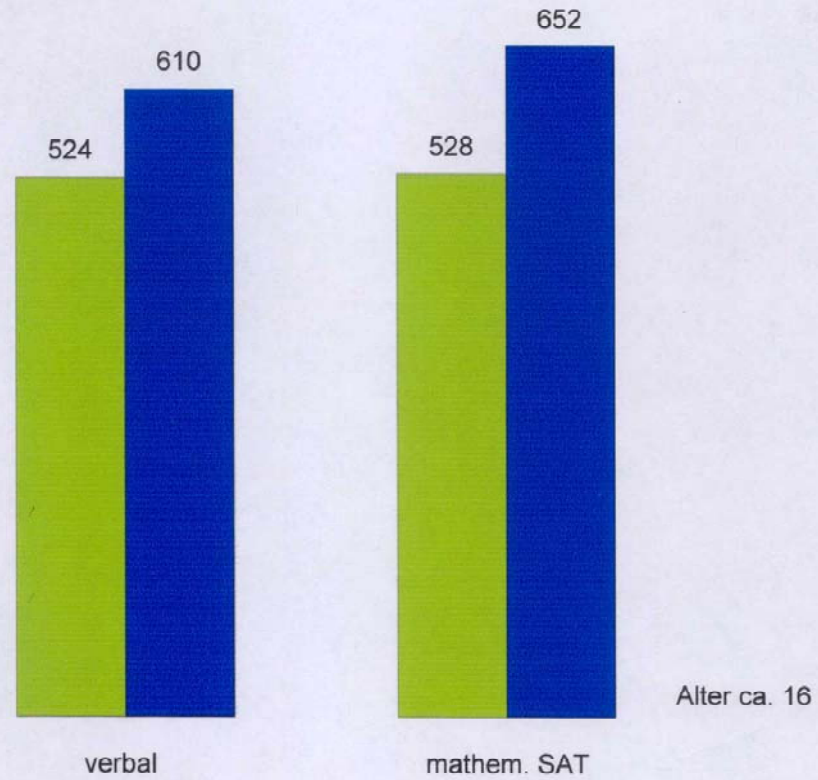
Rational Choice Seminar  
Venice

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# Time Preferences (Discounting) are relevant for:

- Life course research
- Educational choice
- Repeated interactions (cooperation)
- Environmental behaviour, e.g. investments in energy saving
- ▶ Sociologists often neglect time preferences

## „Marshmallow – Test“



■ unteres Drittel Impulskontrolle } im Alter 4  
■ oberes Drittel Impulskontrolle }

Experiment von Walter Mischel (nach Goleman 1996: 109pp)

Very efficient technologies for saving energy, e.g. for housing construction and housing modernization (insulation, heating engineering, ventilation systems, household appliances, use of renewable energy).

From 120 to 15 KWh/m<sup>2</sup>a, i.e. approx. 90% savings potential (see chair of building services, ETH Zurich).

Why are these technologies still rarely used although they are economically advantageous?



# Why Do These Sell Well?



There is a huge potential to save energy, but it is limited by time preferences

# Measuring Personal Discount Rates

Method 1: reward  $x$  on time  $t_1$  or reward  $y > x$  on time  $t_2$  ( $t_2 > t_1$ ).

Method 2: data from behavior. Indirect estimation on the basis of purchase decisions.

# Example for Method 1



# Decision Experiment



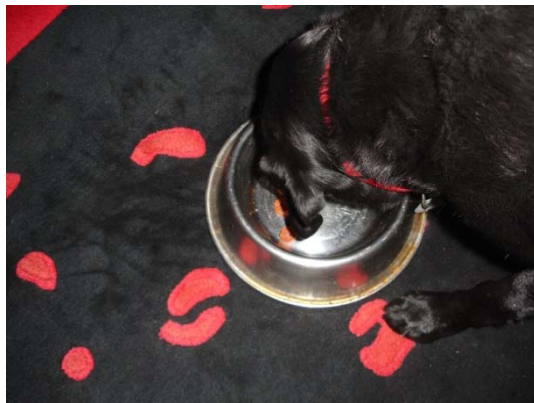
Decision  
alternative: 3  
reward units  
immediately or 6  
units after one  
hour.

# Decision Experiment



Decision alternative: 3 reward units immediately or 6 units after one hour.

Result: Alfred's personal discount rate  $> 100$  percent per hour



“I never think of future – it is coming early enough!”

Albert Einstein

## Example for Method 2

## An Arithmetic Example

Making a decision about the purchase of household appliances: Should we purchase a more expensive but energy efficient appliance or a cheaper, less efficient one? Example (simplified for one period):

	acquisition costs	consumption costs
A	1000	300
B	800	600

$$B > A \Rightarrow 800 + (1/(1+r))600 > 1000 + (1/(1+r))300$$

$r > 0.50$  or discount rate in percent  $> 50\%$

## Real Example: Half-Fare Card: One or Two Years?

**Half-fare card:**

<b>A</b>	1 year	CHF 150.-
<b>B</b>	2 years	CHF 222.-

**Two periods:**

	start period 1 (t=0)	start period 2 (t=1)
<b>A</b>	150	150
<b>B</b>	150 <u>+72</u> 222	

If A is preferred to alternative B, the cash value of CHF 150 after one year is equals CHF 72 today, i.e.:

$$72 = (1 / (1+r)) 150$$

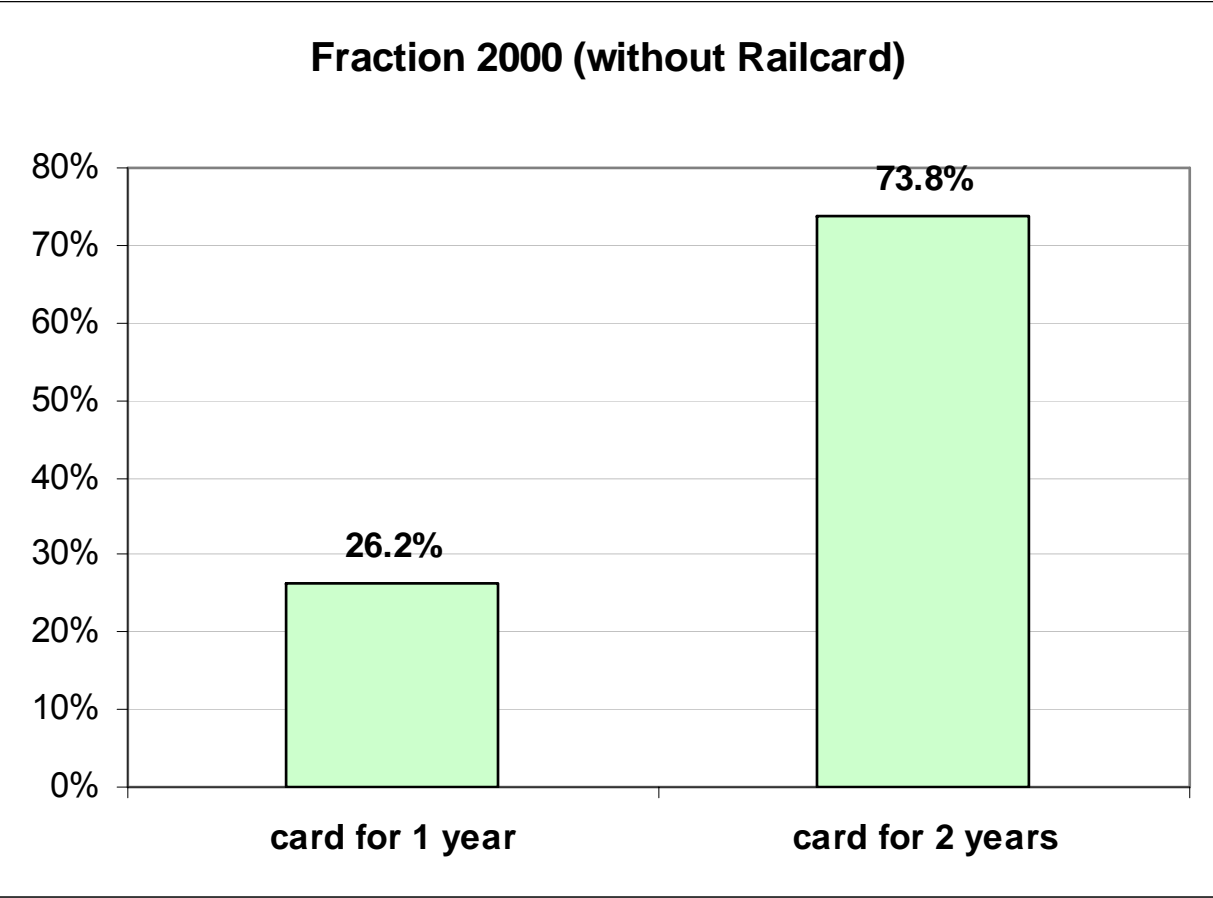
$$(1+r) 72 = 150$$

$$r\% = (150/72 - 1) 100 = 108\%$$

**A>B** come up to an implicit discount rate of 108 percent!

→ What proportion of passengers with a half-fare card choose the 1 year card (A)?

# Half-Fare Card: One or Two Years?



# Individual Discount Rates and the Purchase and Utilization of Energy-Using Durables

		INITIAL COST	MONTHLY OPERATING COST	
			3.8¢/kWh	10¢/kWh
<b>SEARS</b>	(1) high-efficiency	\$478	\$4.00	\$10.50
	(2) low-efficiency	444	5.30	13.90
<b>WHIRLPOOL</b>	(1) high-efficiency	485	4.00	10.50
	(2) low-efficiency	473	5.30	13.90
<b>GE</b>	(1) high-efficiency	518	3.80	9.90
	(2) low-efficiency	475	5.40	14.30

	ELECTRICITY PRICE	
	3.8¢/kWh	10¢/kWh
<b>SEARS</b>	45%	120%
<b>WHIRLPOOL</b>	130%	300%
<b>GE</b>	45%	125%

Dermot Gately (1979): Bell Journal of Economics 10: 373p  
17 cu.ft. refrigerators

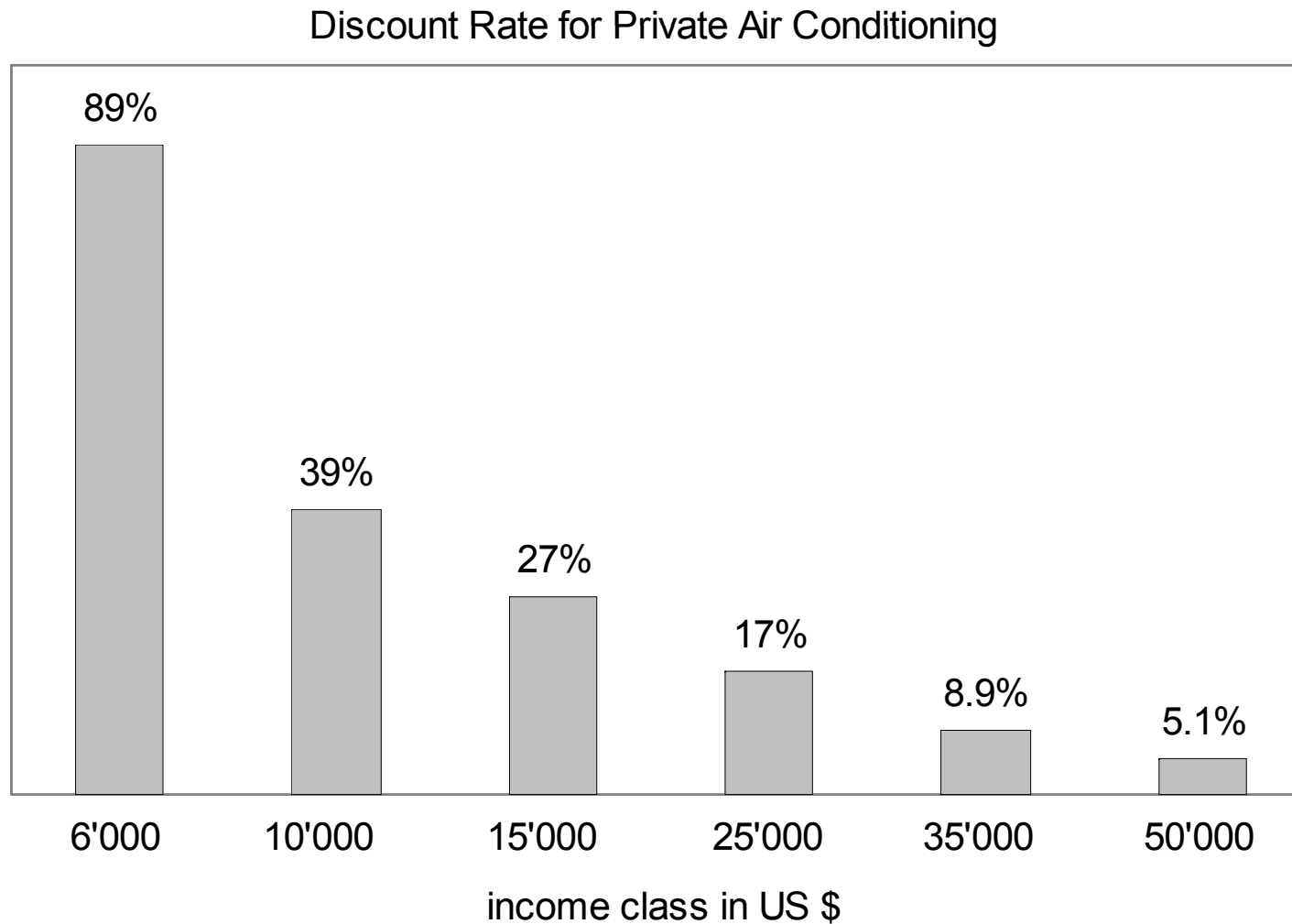


## Estimated Discount Rates for Several Appliances\*

Gas central heating	45.1%
Oil central heating	85.1%
Air conditioning (room)	17.3%
Air conditioning (central)	16.1%
Electric water boiler	243.2%
Gas water boiler	102.0%
Fridge	59.2%
Chest freezer	138.2%

\* USA, 1980. Source: Rudermann, Levine, McMahon (1987:46)

# Dependence of Discount Rate from Income



Source: Hausman 1979

# ENVIRONMENTAL SURVEY 2007

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## Replication



### Environmental Attitudes

- Replication of the 1994 study after approximately ten years
- Analyze changes in attitudes toward the environment and related behavior
- Take stock of the current situation

The last detailed nationwide Swiss survey on environmental attitudes, perception of environmental problems, knowledge on environmental issues and various aspects of related behavior such as recycling, consumption, mobility and energy use (along with the respondent households' sociodemographic characteristics) was conducted in 1994.

## New

### Joint Projects on Traffic Behavior



- Geographically expanding social networks generate a large fraction of non-commercial traffic
- Projected cooperation with the Institute for Transport Planning and Systems (IVT) at ETH Zurich
- EMPA CCEM Project: payment preferences for CO2 reducing technologies

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## New

- Examine the relationship between «objective» environmental stressors (GIS data) and the respondents' subjective experience and health
- Distribution of environmental pollution among different social groups



### Environmental Justice

## DESIGN

- Nationwide survey, target population is all German-, French- or Italian- speaking Swiss residents over 18
- Respondents were selected randomly in a two-stage procedure
- More than 3300 respondents
- Supplemented by GIS data
- Analysis with multivariate statistical techniques
- Data will be made available to interested researchers

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Grant: SNF, BFS, BAFU and Swiss Cantons

## New

- Focus on households' «strategic» decision making and its impact on households' eco balance, in cooperation with the EMPA LCA Group
- **Time preferences and energy saving: measurement and identification of determinants of personal discount rates**

### Strategic Decision Making and Time Preferences



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- Survey plus decision experiment:

Evaluating the threshold starting with:

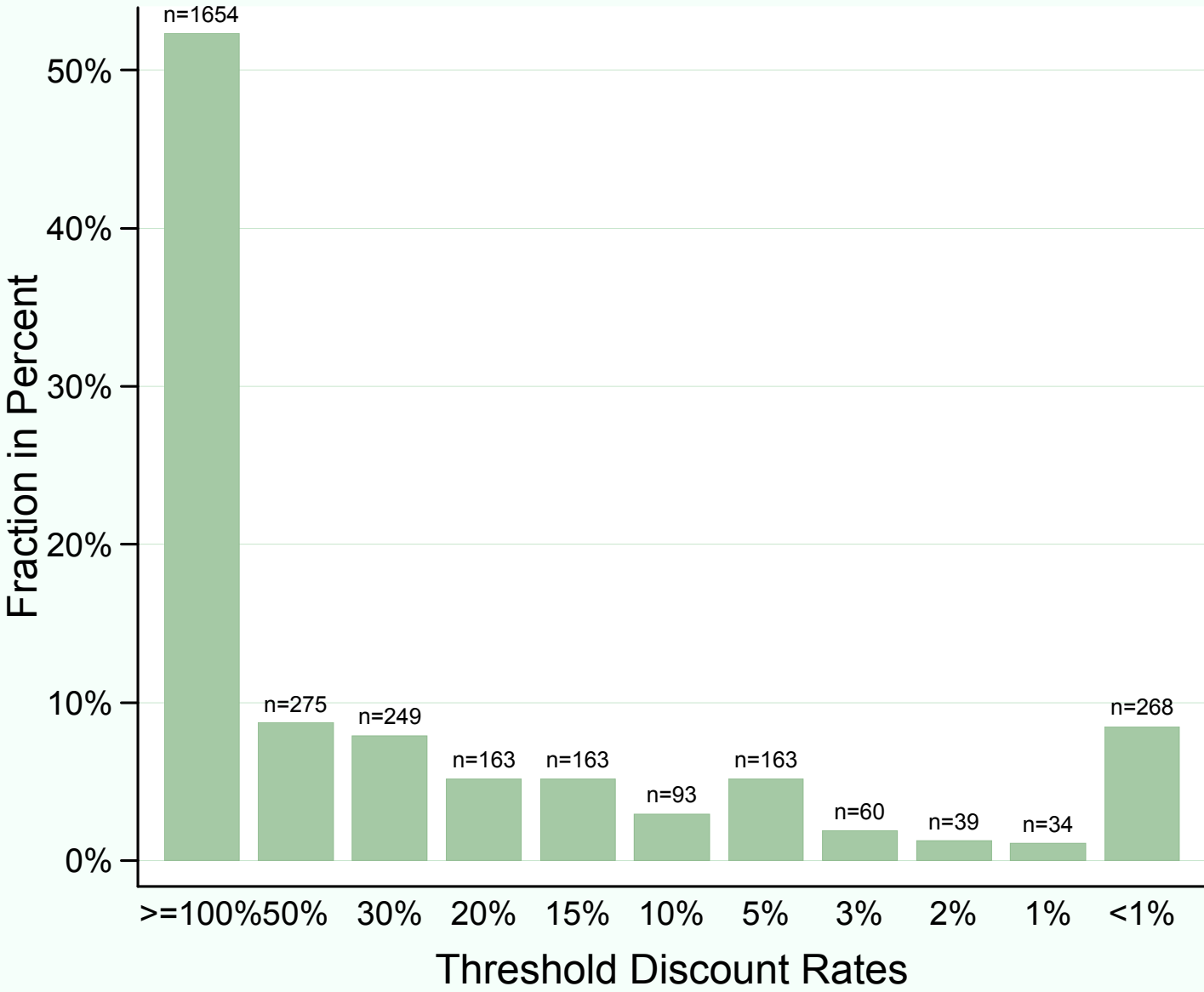
1000 now versus 2000 in one year

1000 now versus 1500 in one year

1000 now versus 1300 in one year etc. the payment was drawn by lot (in collaboration with U. Fischbacher, IEW)

- Additional question and experiment in the written questionnaire

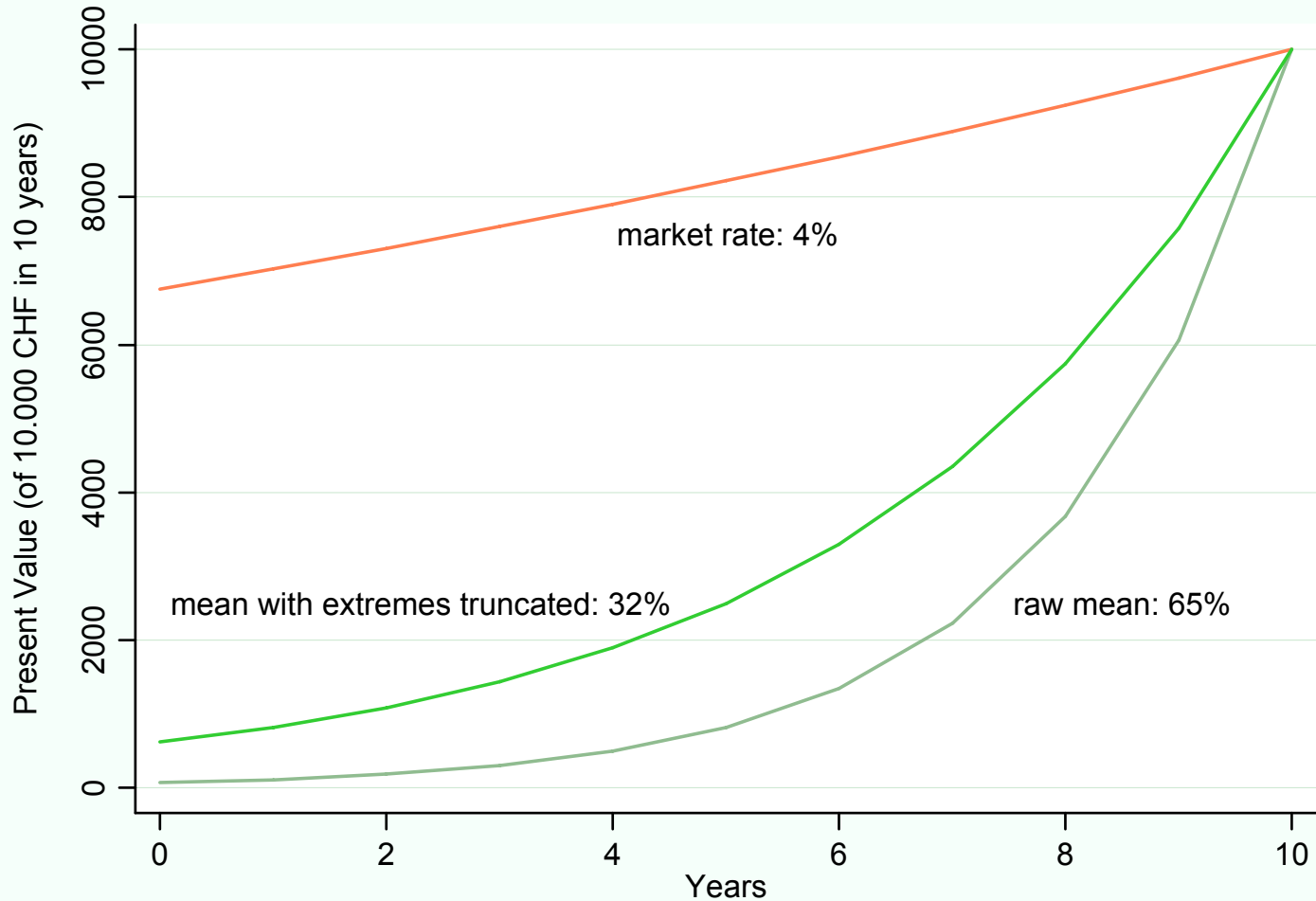
# Distribution Thresholds Discount Rates from Experiment



Source: Swiss Environmental Survey 2007

# Swiss Environmental Survey 2007

## Estimates of Personal Discount Rates and Present Values



Exploitation of time preferences: low acquisition costs versus high consumption costs (“inkjet printer economics”)

Source: Swiss Environmental Survey 2007

Estimates by multivariate regression: Effect per year of education: - 2.3%, Income in 1000 CHF: - 1.0 %, Age: + 0.2% per year, women + 7%

OLS Regressions Discount Rate:	All	All	All	Without extreme values discount rate
Woman	0.07** (4.32)	0.07** (4.28)	0.06** (3.99)	0.04** (2.90)
Age (x 10 yrs)	0.02** (4.64)	0.02** (3.63)	0.01** (3.26)	-0.00 (-0.28)
Pers. Income (per mo. in thd.)	-0.01** (-6.84)	-0.01** (-4.18)	-0.01** (-4.04)	-0.00 (-0.74)
Years of Education		-0.02** (-7.28)		
Apprenticeship			-0.08** (-3.35)	-0.08** (-3.02)
Vocational High School			-0.15** (-4.86)	-0.09** (-2.76)
High School, Teacher's Training			-0.18** (-5.09)	-0.13** (-3.64)
University of Applied Science			-0.20** (-5.42)	-0.06 (-1.61)
University			-0.21** (-6.70)	-0.08** (-2.76)
Constant	0.57** (21.01)	0.85** (18.23)	0.69** (20.34)	0.34** (9.48)
Adj. R-Square	0.040	0.058	0.062	0.016
N	2717	2717	2717	1303

Note: t-statistics in brackets

Significance Levels: + p<0.10, \* p<0.05, \*\* p<0.01

# Correlations between Three Indicators of Time Preference

	Discount rate	Refrigerator	Amount of money
Discount rate	1.00**		
Refrigerator	0.06**	1.00**	
Amount of money	0.60**	0.11**	1.00**

Discount rate: Threshold (by telephone, with lottery)

Refrigerator question: Type X (CHF 350 capital cost & CHF 90 electric) **or**

Type Y (CHF 500 & CHF 60)

Amount of money: CHF 500 **or** CHF 600 a year later (by questionnaire, hypothetical)



# Effects of the Discount Rate

Estimation of OLS and logistic regressions.  
Investigating the influence of the discount rate on personal behaviors that impact the environment:

1. Energy saving investments: energy saving bulbs, heat pump etc.
2. Other environment related behavior patterns
3. Cooperation: blood donation, organ donation card
4. Addiction: Smoking

Preliminary results: most of the coefficients are in the expected direction but often insignificant

# Time Preference as Explanatory Variable for Environmental Behavior

Investments and Renouncement for Future Gains	Expected	Observed	
		Method 1	Method 2
Heat pump	–	–	–
Low- or zero-energy house	–	+	+
Soundproof windows	–	–	–
Isolation when house was built	–	+	+
Subsequent isolation	–	–	–
Do you use energy-saving lamps in your household?	–	–	–
Low-price fridge with high energy consumption	–	–*	–*
Yearly number of manual tire pressure controls on your car (without automatic control system)	–	+*	+
Seasonal tickets for public transportation, i.e. half-price ticket, free ticket or rover ticket	–	–*	–
Half-price ticket for 2 or 3 years	–	–*	–*
Consumption of organic products	–	–	–

\* Significant for  $p < 0.05$

Method 1: Threshold Method, Experiment in Telephone Interview

Method 2: 500 versus 600 Swiss Francs a year later, Written Interview

Controls: Age, Sex, Education, Income, Language Region, Environmental Attitudes

# Time Preference as Explanatory Variable for Environmental Behavior

Cooperative Behavior and Addiction	Expected	Observed	
		Method 1	Method 2
<i>Cooperative Behavior</i>			
Ever donated blood	-	-	-
Organ donor card	-	-*	-*
<i>Addiction</i>			
Smoker	+	+	+

# Time Preference as Explanatory Variable for Environmental Behavior

Environmental Behavior (not purely altruistic)	Expected	Observed	
		Method 1	Method 2
Number of week days with meat consumption	+	-	-
Other reaction than increasing the radiator output when it is cooler than comfortable in your apartment in winter	-	-*	-*
Turning off the radiator	-	+	-
Turning off the TV by using the remote control only	+	+	+
Turning off the lights wenn leaving a room	-	-	-

# Time Preference as Explanatory Variable for Environmental Behavior

Environmental Behavior	Expected	Observed	
		Method 1	Method 2
Do you normally use recycled toilet paper in your household?	–	–*	–
If you write or print something at home, do you normally use recycled paper?	–	+	–
Signed a petition concerning an environmental issue	–	–*	–
Subscribed money in favor of an environmental organization	–	–	–
Participated in a protest action or demonstration, collected signatures or raised money to protect the environment	–	+	–
Participation in national elections	–	–	–

# Context dependence of personal discount rates

## Do pretty women inspire men to discount the future?

Margo Wilson\* and Martin Daly 2003

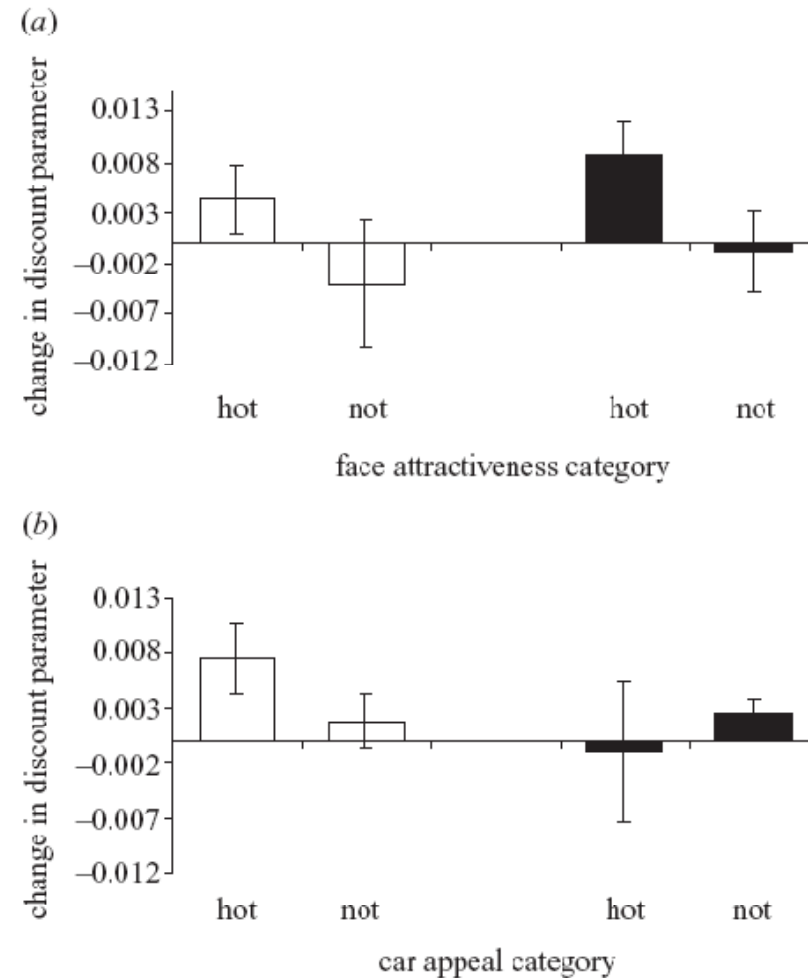
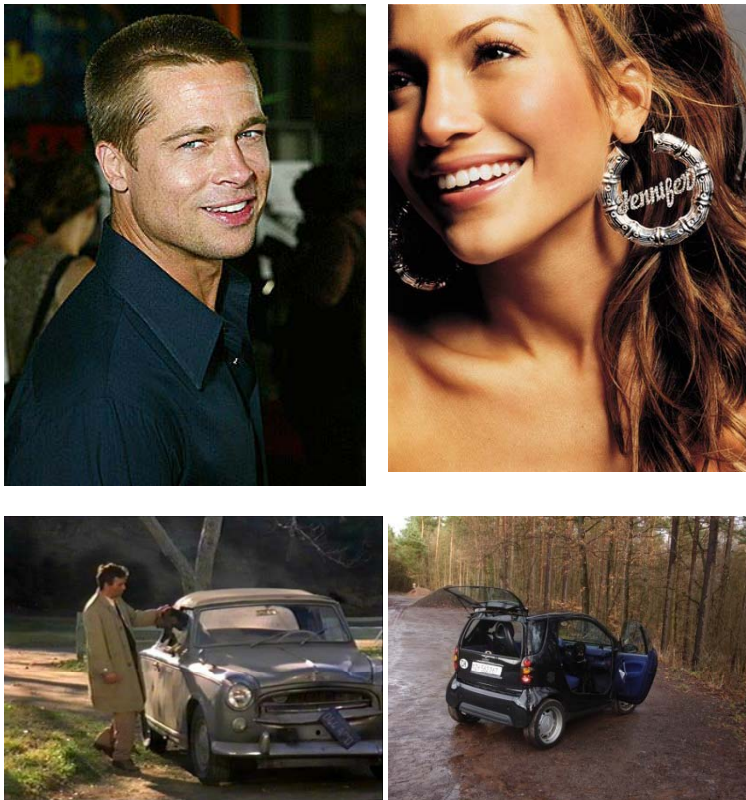


Figure 1. Change in hyperbolic discount parameter  $k$  after an image rating task, for women (open bars) and men (filled bars), after rating photographs of (a) opposite-sex faces or (b) cars that were either 'hot' or 'not'.

# Decisions Implying Negative Discount Rates

Preference order

French meal (F) > Greek meal (G)

Decision for voucher A or B:

A F in one month, G in two month from now

B G in one month, F in two month from now

# Decisions Implying Negative Discount Rates

Preference order

French meal (F) > Greek meal (G)

Decision for voucher A or B:

A F in one month, G in two month from now

B G in one month, F in two month from now

**57 Percent voted for B!**

(Loewenstein, in Thaler 1992)



# Choice of Wage Profile for Six Years

## Fixed-Term Employment

Year	1	2	3	4	5	6
A	40000	40000	40000	40000	40000	40000
B	30000	34000	38000	42000	46000	50000
C	50000	46000	42000	38000	34000	30000

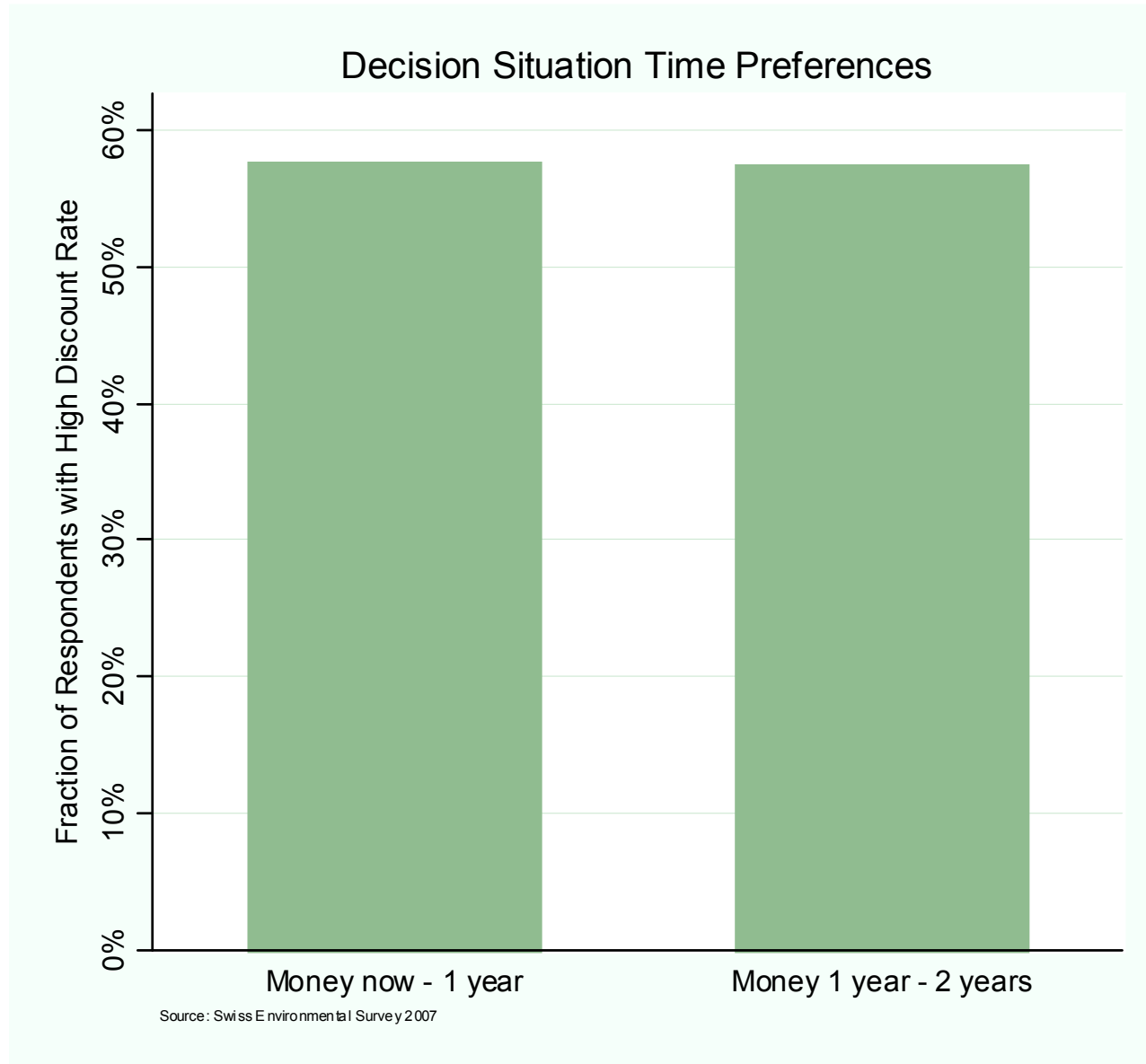
# Choice of Wage Profile for Six Years

## Fixed-Term Employment

Year	1	2	3	4	5	6
A	40000	40000	40000	40000	40000	40000
B	30000	34000	38000	42000	46000	50000
C	50000	46000	42000	38000	34000	30000

**Only 12 percent choose C!**

(Loewenstein, in Thaler 1992)



Left Column, Amount of money: CHF 500 now **or** CHF 600 in 1 year  
Right Column, Amount of money : CHF 500 in 1 year **or** CHF 600 in 2 years  
(Amounts of money: randomized, by questionnaire , hypothetical)

# Experiments by Ainsley (see Thaler 1992)

## Decision between Offers A and B

Decision situation I)

A 100 now.

B 150 in one year.

Decision situation II)

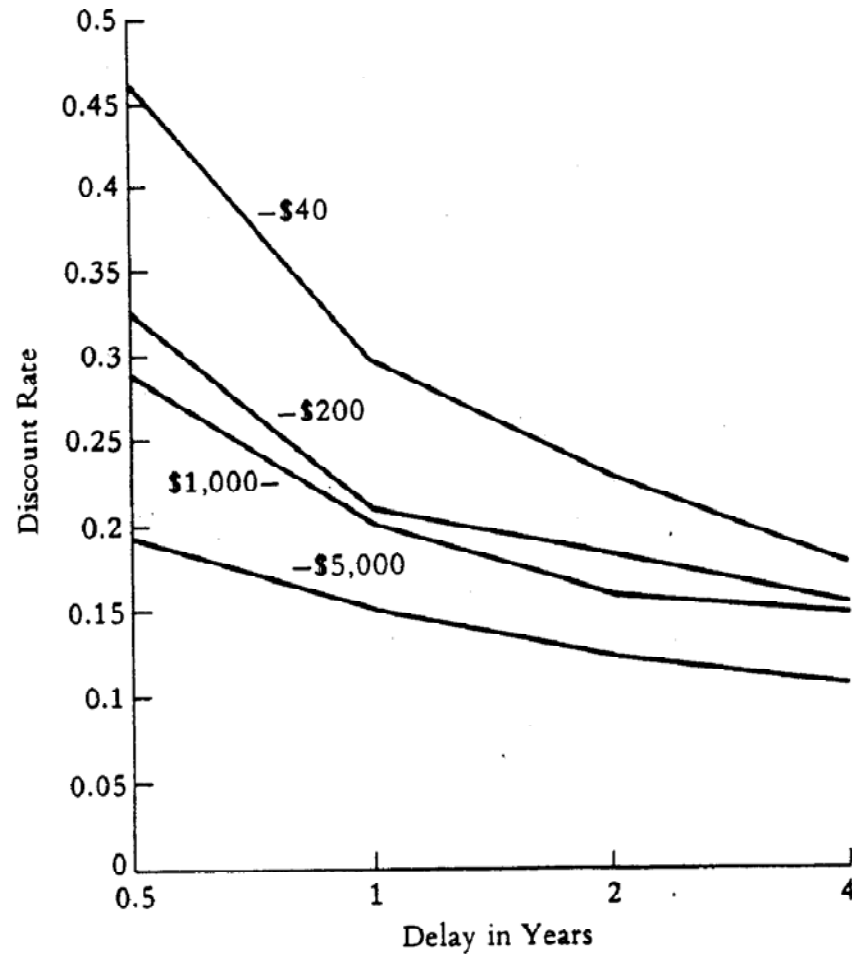
A 100 in 5 years

B 150 in 6 years

B is more often chosen in the decision situation II) than I).

High subjective discount rates now, decreasing discount rates over time („the value of future increases in the future“)

# Decreasing subjective discount rates



**Figure 8-1.** Discounting as a Function of Time Delay and Money Amount

Source: Benzion et al. (1989).

- ▶ Information, Energy labels
- ▶ Obligatory standards
- ▶ Third party intervention: Contracting
- ▶ Long-term commitments, important for climate politics

## Further Research

1. Measurement of discount rates:  
validation, tests of different variants
2. „Question Framing“
3. Investigating effects of time preference  
on energy saving investment in well  
defined decision situations