Nijmegen School of Management
Department of Economics and Business Economics
Master's Thesis Economics (MAN-MTHEC)

The impact of temporal discounting on education level and sustainable behaviour

By Anouk van der Pal (s1073094)

Nijmegen, 25 June 2024

Abstract

This study aimed to determine whether temporal discounting affects the relation between level of education and sustainable behaviour. Five underlying determinants of sustainable behaviour were used for this analysis: car travel, plane travel, meat consumption, water saving and energy conservation. Reliability tests predicted to use these indicators as isolated behaviours, and not combined as one systematic factor for sustainable behaviour. Moderation and mediation analysis were executed to answer the question whether temporal discounting affects the relation between education level and each sustainable behaviour proxy. Results indicated that moderation analysis results in one isolated sustainable behavioural factor to be affected if an alpha of .10 were to be accepted, namely the relation between plane travel and educational level. Mediation analysis has proven temporal discounting to have no significant effect on the relation between educational level and the aforementioned determinants of sustainable behaviour. Hence, I indicate that the influence of temporal discounting on the relation between level of education and the isolated sustainable behaviours is insufficient. However, due to some limitations, it remains statistically difficult to conclude that temporal discounting is of significance in the relation between education level and sustainable behaviour.

Keywords: *temporal discounting, education, sustainable behaviour, moderation analyses, mediation analyses*

Table of Contents

List of Tables

List of Figures

1 Introduction

Humans are the only known species capable of incorporating considerations for the future into their daily decision-making process. However, they often fail to apply this ability consistently; there is a predominant focus on the present. Short term pleasure is chosen over long term costs, both individually and collectively. This trade-off is based on a concept called temporal discounting, which conceptualizes that our preferences change across time as a function of time progression and impatience (Rhode, 2019). The effects of temporal discounting can be seen in unhealthy behaviours (e.g. smoking), pension funds and sustainable behaviour (Wilson et al., 2015; De Wit et al., 2007; Farias, Coruk & Simão, 2021). Sustainable behaviour is a prerequisite to combat climate change. Encouraging collective action to act upon climate change is a complex challenge that has persisted in the past decades and remains an issue present day. Aside from temporal discounting, social factors (Goldstein, Cialdini & Griskevicius, 2008; Griskevicius, Tybur & Van den Bergh, 2010), personal identity (Trudel, Argo and Meng, 2016) and demographic factors (Akhtar et al., 2021; Shiel, do Paço & Alves, 2020; De Silva & Pownall, 2014) allow for this complexity. Demographic factor education is suggested as a strong systematic indicator for sustainable behaviour (De Silva & Pownall, 2014; Pearson et al., 2017). Moreover, education is a determinant for temporal discounting (Perez-Arce, 2017; Lee et al., 2013), as temporal discounting has been found to be shaped by education (Wilson et al., 2015).

The idea that education affects temporal discounting as well as sustainable behaviour, coupled with the impacts of temporal discounting on sustainable behaviour, raises to the question whether the relation between education and temporal discounting amplifies their effects on sustainable behaviour. Studies have indicated that a relation between temporal discounting and education directly affects behaviour (Wilson et al., 2015; Tate et al., 2015). However, to date, no study has assessed whether temporal discounting is possibly moderating or mediating the relation between education and sustainable behaviour. The aim of this study is to investigate in what manner temporal discounting has an effect between level of education and sustainable behaviour. The research question of this study thus states:

"How does temporal discounting alter the relation between level of education and sustainable behaviour?"

Discovering an answer to this research question can aid in policy making. Individuals value policies concerning sustainability differently based on the given time frame (Faccioli et al., 2016). This indicates that temporal discounting is a factor to consider when performing policy making. Additionally, demographic factors are of importance for evidence-based policymaking (United Nations, 2016). As mentioned, many studies have proven that demographic factors are affected by temporal discounting. Understanding the effect of temporal discounting on the relation between the demographic of education and sustainable behaviour can help assist in comprehending the diversity of policies needed depending on the given time frame.

This paper starts off with stating previous findings, followed by hypotheses to answer the research question. The methodology chapter concerns where data was obtained, restructured and tested. Results are then critically analysed and presented. The discussion puts the results of this study in perspective of the previous findings, including limitations and recommendations.

2 Literature review

2.1 Sustainable behaviour

There is a trade-off between short-term pleasure and long-term consequences. This trade-off occurs both at an individual level, such as the instant pleasure of smoking a cigarette in contrast with associated long-term health complications, as the collective level, as evidenced by sustainable behaviour (Farias, Coruk & Simão, 2021). Choosing a car over cycling or public transport for short distances represents a short-term individual pleasure, yet collectively, harms the environment. Transportation behaviour is an example of sustainable behaviour which significantly impacts the environment by consuming large numbers of energy and corresponding emissions. Most polluting within the transportation sector are road and air transportation (European Commission, Directorate-General for Mobility and Transport, 2023). These are two examples of proxies determining sustainable behaviour. Sustainable behaviour is a complex matter, which differs per individual and presents itself through several methods. Dietary preferences is one of these methods, where meat consumption is a widely discussed matter in debates on climate change and sustainable food systems (Sanford et al., 2021; Willet et al., 2019). Meat consumption is excessively present in high income countries, possibly generating the need for collective pressure to decrease meat consumption in these regions (Godfrey et al., 2018). However, collectively changing the dietary

preferences to a full vegetarian lifestyle is unnecessary to achieve sustainability goals (Parlasca & Qaim, 2022). Saving water is another method attributing to sustainable behaviour. To help preserve freshwater and minimize shortages, collectively implementing water-efficient practices within households is needed (UNESCO World Water Assessment Programme, 2018). However, collectively implementing these practices might become difficult when there is a difference in eagerness to save water. Households with a higher-education level are often more eager to save water compared to lower-educated households (Gilg & Barr, 2006). Counterfactually, De Oliver (1999) presented results determining the lower educated households to be more engaged in water saving activities. A final method for sustainable behaviour to be discussed here is energy conservation. Households are significant consumers of energy (Barr & Prillwitz, 2013; Fahy & Rau, 2013). Energy use is one of the largest contributions to the greenhouse gas emission by humans (Choriyeva & Eshkoraev, 2022). Decreasing household consumption by 10-35% will contribute to a more sustainable lifestyle, without having to compromise the household's comfort (Owens & Wilhite, 1988). Higher educated individuals consume more energy than lower educated individuals (Wang, Xie & Wu, 2020). Home heating is mentioned as one of the manners through which households wish to decrease their energy consumption (Poortinga et al., 2003).

2.2 Level of education

Education is one of the demographic factors for sustainable behaviours (Michalos et al., 2011; De Silva & Pownall, 2014). The original theory of the Environmental Kuznets Curve indirectly suggests that income growth generated by higher education levels enables access to polluting energy, such as cars, consequently impacting the environment negatively (Hill & Magnani, 2002; Gangadharan & Valenzuela, 2001). The Environmental Kuznets Curve is a concept which suggests that high level of per capita income causes a deterioration of the environment (Stern, 2004). Over the years, the Environmental Kuznets Curve has evolved to include demographic factors other than income per capita (Voumik et al., 2023; Balaguer & Cantavella, 2018). These serve as evidence for indicating a clear correlation between education and the environment. Results propose that education directly affects environmental deterioration in a negative matter (Voumik et al., 2023; Balaguer & Cantavella, 2018). Corresponding, studies analysing the 2011 OECD survey on Greening Household Behaviour discovered a negative relation between level of education and sustainable behaviour as well (Grafton, 2014; Millock, 2014; Palatnik et al., 2014).

Despite the evolvement of the Environmental Kuznets Curve, there have been critiques focused on the econometric measures and gaps of this model (Stern, 2004; Leal & Marques, 2022). These critiques suggest that the arguments based on the Environmental Kuznets Curve, stating the negative relation between education and the state of the environment, may be biased and therefore questioning the conclusions drawn from this method. For example, using a different method, Li et al. (2019) proposed that educational level is no crucial factor to explain sustainable behaviour, which is contrary to previous predicted results. Nevertheless, without using the Environmental Kuznets Curve either, level of education has proved to affect pro-ecological behaviour (Sautkina et al., 2022; Osuntuyi & Lean, 2022). Individuals with a higher level of education are more aware of the environment and pollution, affecting their environmental behaviours (Sun et al., 2020). Moreover, higher educated individuals are more concerned with social welfare, resulting in increased pro-environmental activities (Meyer, 2015).

2.3 Temporal discounting

The previously mentioned trade-off between short-term pleasures and long-term costs occurs due to an asymmetry between past and future event. The focus on the present may even neglect the consideration of future events (Kim & Zauberman, 2009; Wittmann & Paulus, 2009). This temporal myopia is visible in experimental designs where immediate rewards are preferred over delayed rewards. This holds true even when the delayed rewards yield more. The result of delaying future rewards may reflect delaying future issues, resulting in temporal discounting plausibly affecting on sustainable behaviour. Temporal discounting is the prioritization of immediate rewards and/or desires over postponing gratification, despite the potential for superior outcomes in the future (Frederick, Loewenstein & O'donoghue, 2002). An individual discount rate is determined based on the present biasedness of the individual, indicating whether their focus is greater for current events than for future events (Benhabib, Bisin & Schotter, 2010), and the individual time preference, which can change dynamically based on short-term situational demands or on long-term societal crises.

Sustainable behaviour requires costly individual and collective up-front investments to battle climate change. However, the fruits of these investments are to be reaped by future generations only, making it more difficult for current generations to make these investments (Carson & Roth Tran, 2009). Moral concern might be a cure for this, were it not that moral concern is highest with

future oriented individuals, who are already better in anticipating future concerns due to their ability to analyse morally relevant behaviour, subsequently sustainable behaviour (Agerström & Björklund, 2013). Future orientation is an important predictor for sustainable behaviour, more important than having a sustainable attitude (Arnocky et al., 2014). Concerningly, individuals discount the willingness to act upon sustainable matters significantly more than their concern on sustainability (Sargisson & Schöner, 2020). Moreover, when individuals imagine their future self intensively, they show a higher sustainability performance (Piskorski, 2020). The role of individual dissimilarities in time perspectives is a key factor in explaining dissimilar behaviours promoting sustainable behaviour (Wittman & Sircova, 2018). Additionally, the effect of temporal discounting has been found to be negative, where a high discounting of future rewards results in less sustainable behaviours (Farias, Coruk & Simão, 2021; Sahraeian, Khanahmadi & Sadeghiyeh, 2021). This aligns with the idea that personal internal factors may shape an individual's perception on and action towards sustainable behaviour where temporal discounting is an example of an internal factor (Kollmuss & Agyeman, 2002; Sahraeian, Khanahmadi & Sadeghiyeh, 2021). Contrarily, results by Lades, Laffan and Weber (2021) suggest that temporal discounting does not significantly affect sustainable behaviour.

Temporal discounting is an educated behaviour (Wilson et al., 2015) giving the impression that level of education affects temporal discounting. Wittman and Sircova (2018) implied education to be a key factor in achieving a balanced time perspective and therefore minimizing high temporal discounting. The effect of education on temporal discounting has been consistently established, displaying a negative relation (Reimers et al., 2009; Lee et al., 2013; Perez-Arce, 2017; König-Kersting & Trautmann, 2023). Hence, higher levels of education are associated with lower discounting rates (De Wit et al., 2007).

2.4 Moderating or mediating?

Temporal discounting is affective on the relation between level of education and behaviour. Grossman (2006) stated that time preferences in combination with education predicts individual health behaviours, suggesting a moderation effect of time preferences on the relation between behaviour and education. Temporal discounting has additionally been predicted as an important indicator of level of education when concerning certain behaviours, such as smoking or exercising (Wilson et al., 2015; Tate et al., 2015). The relation between temporal discounting and level of

education is therefore a predictor of behaviour, suggesting temporal discounting to be a moderator in this relation (Liang & Gou, 2021; Farias, Coruk & Simão, 2021).

Contrarily, Corral-Verdugo, Fraijo-Sing and Pinheiro (2006) established that temporal discounting has an indirect effect on the relation between level of education and water saving, the latter being an act of sustainable behaviour. This suggests that temporal discounting acts more as a mediator instead of a moderator in the relation between level of education and sustainable behaviour. Grandin et al. (2022) supported this theory by indicating that temporal discounting is mediating the relation between socioeconomic status (including solely income and education) and pro-environmental behaviour.

2.5 Conclusion

This study aims to test whether temporal discounting has a mediating or moderating effect on the relation between sustainable behaviour and level of education. Sustainable behaviour has been determined to consist of at least five methods, all of whom are used as proxies of sustainable behaviour in this study. The first two concern transportation methods; car and air travel. The third proxy is meat consumption. The final two concern water saving and energy conservation.

3 Methodology

Based on the outline of literature as described above, three hypotheses have been constructed in order to answer the research question of this study:

(1) Hypothesis 1: Level of education positively affects sustainable behaviour

(2) Hypothesis 2: An interaction effect between level of education and temporal discounting impacts the effect on sustainable behaviour

(3) Hypothesis 3: Temporal discounting mediates the relation between level of education and sustainable behaviour

Figure one shows a visualization of the research question and the corresponding hypotheses.

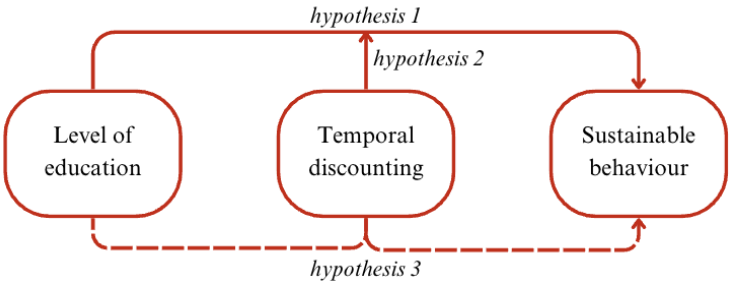

Figure 1. Visualization of research question

The hypotheses are tested using pre-existing quantitative data. Data were obtained through Longitudinal Internet studies for the Social Sciences (LISS) panel, enabling me to guarantee consistency of demographic variables across the datasets. LISS Panel is an organization associated with Tilburg University and sets out questionnaires to a vast set of Dutch participants, who can voluntarily participate in the studies (LISS Panel, 2024). A total of four LISS Panel data sets were combined, including a dataset concerning temporal discounting, one concerning sustainable behaviour and two datasets on demographic variables corresponding to the time frame concerning the retrieval date of the first two mentioned datasets. I merged and recoded the dataset in order to run proper analyses to determine possible relations as described by the hypotheses and research question of this study. The first analysis is a regular regression model testing the relation between level of education and sustainable behaviour without any interference of temporal discounting. Second and third are the moderation and mediation analysis, of which the empirical frameworks are further explained in this chapter.

After merging the dataset, the sample consisted of the following characteristics:

Table 1. Descriptive statistics

Variable	Description	N	M	SD
Gender	Gender of household member (0= female, 1= male)[1]	1,586	.507	.500
Age	Age of household member[1]	1,584	57.28	17.39
Gross income	Personal monthly gross income in Euro's[1]	888	2880.40	4005.89

Notes: [1] retrieved from LISS Panel's demographic variables (2018; 2019)

Table one visualizes the sample of this study, which represents an equal division between male and female participants, an average age of 57 years and an average gross monthly income of €2,880.40. Due to gross income being used as a covariate, the sample size of this study consists of

888 individuals. To handle possible outliers and ensure normal distribution, the natural logarithm of gross income was used for the analysis.

3.1 Dependent variable: Sustainable behaviour

The first data set concerns the dependent variable; sustainable behaviour. As mentioned, sustainable behaviour is measured using the five proxies from the literature: car travel, plane travel, meat consumption, water saving and energy consumption. These proxies are retrieved from the data set "The energy transition from a citizen's perspective" (De Kluizenaar & De Wilde, 2019), which was concerned with sustainable behaviour questions amongst other topics. A total of five questions relating to the proxies were selected. Cronbach's Alpha was calculated to test the inter-reliability when combining these five indicators as one sustainable behaviour variable. The reliability of combining the proxies as one variable ($\alpha = .17$) showed to be far below the threshold of .70 (Taber, 2018). Based on this outcome, the five indicators have been used as separate proxies in the analyses of sustainable behaviour.

Robustness checks have been conducted to avoid any misinterpretation of the results. The regression analysis has been tested for multicollinearity and heteroskedasticity. The results, as can be found in the appendix, indicated plane travel, meat consumption and energy conservation to be further analysed with robust standard errors due to predicted heteroskedasticity.

3.2 Independent variable: Education

The second and third data set concern the demographic variable level of education. Considering the data set for temporal discounting and the data set for sustainable behaviour were retrieved in a different time setting, two data sets of the background variables matching the time settings of the previous mentioned data sets were obtained for the variable education. Level of education is extracted as independent variable for the analysis. Level of education is measured on the level dictated by Statistics Netherlands, leading to a total of six levels of education. In order to follow the distinctions of higher and lower education as predicted in previous literature, I have recoded the level of education into a binary variable with "theoretical" as one (higher) and "practical" (lower) as zero for educational levels (Centraal Bureau voor Statistiek, 2019). College and university levels are included in the theoretical variable. All other levels of education are assigned to the practical variable.

3.3 Moderating/Mediating variable: Temporal discounting

The fourth dataset is obtained from the data set "time preferences and financial decision" (Trautmann, 2018). The initial section of the dataset concerning time preferences is to be used for this study. To detect an individual's discount rate, participants were given a choice between receiving €100 in five weeks or €115 within five weeks at the start. Continuing, the €100 remained an option to receive in five weeks. The collection time of €115 was delayed by five weeks per each following question. Additionally, there was a second run where the reference point had become eight weeks instead of five weeks. The rewards and delays remained similar.

König-Kersting & Trautmann (2023) presented a formula to calculate the discount rate based on both runs. I have used this formula and their methodology to determine the average discount rate.

$$(1)\ average\ discount\ rate\ r = \frac{\frac{52*\ln(1.15)}{t_5-5} + \frac{52*\ln(1.15)}{t_8-8}}{2}$$

In the formula, the number fifty-two stands for the number of weeks in a year. The logarithm of 1.15 represents the factor by which the delayed reward is increased. t_5/t_8 represent the turning points (the moment an individual shifts their choice) respectively. The numbers five and eight represent the number of weeks before the switching point is reached. The individual discount rates are added to one another and divided by two in order to determine the average discount rate. This average discount rate is used as the determinant of temporal discounting.

3.4 Empirical framework moderation analysis

Moderation analysis is the second analysis run in this study. This analysis tests whether temporal discounting moderates the relation between level of education and sustainable behaviour. In order to test this, an interaction term between level of education and temporal discounting is generated. The following formula presents the moderation analysis performed in this study (Hair et al., 2022):

$$(2)\ SB = \beta_0 + \beta_1 EDU + \beta_2 TD + \beta_3 (EDU * TD) + \beta_4 Gender + \beta_5 Age + \beta_6 GrossIncome + \epsilon$$

Where SB is the dependent outcome, namely sustainable behaviour. β_0 is the intercept. $\beta_1 EDU$ is the coefficient of the independent variable level of education. $\beta_2 TD$ is the coefficient of the moderating variable temporal discounting. $\beta_3 (EDU * TD)$ is the coefficient for the interaction term

between level of education and temporal discounting. The control variables for this model are $\beta_4 Gender$, $\beta_5 Age$ and $\beta_6 GrossIncome$.

To legitimately perform the moderation analysis, both level of education and temporal discounting are centred prior to generating the interaction term (Field, 2018). Centring the predictor variables prevents possible multicollinearity to occur. The non-centred variables of education and discount rate are added to the model as controlling variables.

3.5 Empirical framework mediation analysis

The third and final analysis of this study is the mediation analysis. The mediation model according to Baron & Kenny (1986) has been used to perform the analysis. The following formula has been used to do so:

$$(3)\ SB = cEDU + \gamma_3 Gender + \gamma_4 Age + \gamma_5 GrossIncome + e_y$$

$$(4)\ TD = aEDU + \gamma_3 Gender + \gamma_4 Age + \gamma_5 GrossIncome + e_z$$

$$(5)\ SB = bTD + \gamma_1 EDU + + \gamma_3 Gender + \gamma_4 Age + \gamma_5 GrossIncome + \epsilon_3$$

In these three equations, EDU, TD and SB are the independent, mediator and dependent variable accordingly. Gender, age and gross income are the control variables. For the hypothesis concerning mediation to be true, a total of four relations have to be significant: (1) education significantly affects the sustainability proxy, (path *c'*); (2) level of education significantly affects temporal discounting (path *a*); (3) temporal discounting significantly affects the sustainability proxy (path *b*); and (4) the relation between level of education and the sustainability proxy diminishes when temporal discounting is integrated in the model compared to when it is excluded (Field, 2018). The paths are visualized in figure 2.

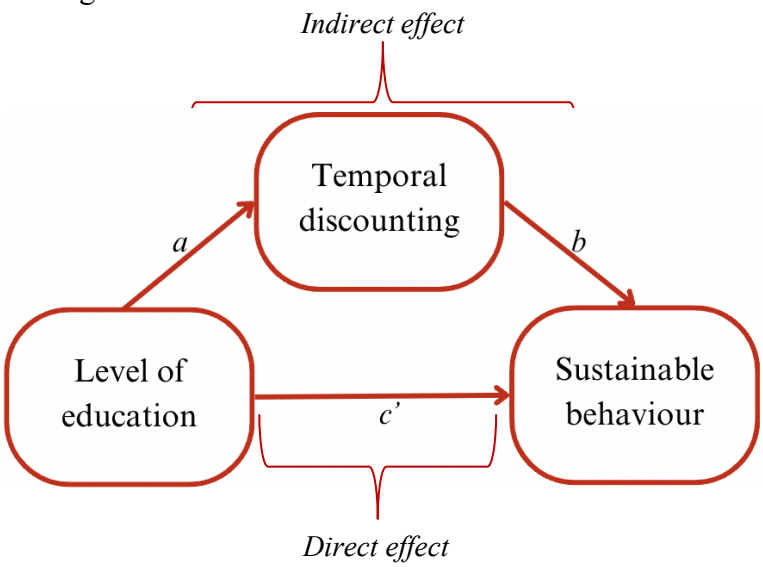

Figure 2. Diagram of mediation model

Mediation analysis is often discouraged when the data set consists of cross-sectional data, due to several issues (Anguinis, Edwards & Bradley, 2017). One of these issues pointed out was the risk of endogeneity. Robustness checks controlled for possible endogeneity. Based on the results, the covariate gross income was excluded from further analysis for the proxy water saving due to predicted endogeneity when included in the model. This covariate is henceforth excluded from all analysis concerning the proxy water saving. Additionally, Mackinnon, Fairchild and Fritz (2007) have determined that despite the differences with longitudinal datasets, cross-sectional data sets can be used for mediation analysis. Therefore, this study continues using mediation analysis as predicted by Baron and Kenny (1986).

4 Empirical results

This chapter provides the results of the previous described analyses. Each proxy of sustainable behaviour is separately measured through three different models: a simple regression model, a moderating regression model and a mediating regression model.

4.1 Regression level of education and sustainable behaviour

This study aimed to determine how temporal discounting alters the relation between level of education and sustainable behaviour. Therefore, it is important to first understand the existing relation between level of education and the sustainable behaviour proxies. Table two presents the results of the regression analysis, testing hypothesis one.

Table 2. Simple regression model

	Dependent variables				
	Car travel	Plane travel	Meat consumption	Water saving	Energy conservation
Education	-.006	.314***	-.251**	-.031	-.053
	(.085)	(.075)	(.088)	(.074)	(.157)
Gender	.094	-.184*	.524***	-.017	.006
	(.089)	(.079)	(.095)	(.071)	(.164)
Age	-.007**	-.015***	-.001	-.019***	-.012**
	(.002)	(.002)	(.002)	(.002)	(.005)
Income	.155*	.400***	-.193*	-	.011
	(.066)	(.058)	(.081)		(.123)

Table 2. Continued

Intercept	1.145*	-.468	5.665***	4.207***	2.897**
	(.524)	(.461)	(.640)	(.125)	(.998)
Observations	800	800	799	1,585	799
R-squared	.0208	.1320	.0507	.0533	.0098
Adjusted R^2	.0159	-	-	.0515	-
F Statistic	4.23***	28.95***	9.37***	29.65***	1.90
	(df = 4; 795)			(df = 3; 1,581)	

Note: coefficients with standard errors in parentheses. No additional R^2 or df functions available for proxy's plane travel, meat consumption and energy conservation due to use of robust standard errors. $^{\dagger}p = < .1$, $^{*}p = < .05$, $^{**}p = <.01$, $^{***}p = <.001$

The results of the regression indicate that two proxies are significantly affected by education, namely plane travel and meat consumption. Theoretical education significantly correlates with more use of the plane travel (p = .000) and thus more unsustainable behaviour. Contrarily, theoretical education is significantly associated with less meat consumption (p = .004), which is predicted as more sustainable. The other three proxies seem to be insignificant. Nevertheless, the direction of the coefficient indicates that the theoretical educated use the car for short distance transportation less frequent (p = .944) and are more concerned in conserving energy through their thermostat (p = .739). Additionally, the direction of the coefficient of water saving shows that practical educated individuals intend to shower for a longer period (p = .681). However, despite mentioning these directions, no conclusion could be drawn upon car travel, water saving and energy conservation due to the absence of statistically significant outcomes.

Due to the lack of reliability when combining all proxies to visualize sustainable behaviour, I have to conclude on the hypothesis per isolated behaviour. Based on the given results of the regular regression, I have not been able to conclude supporting evidence for hypothesis one concerning the proxy's car travel, water saving and energy consumption due to missing statistically significant outcomes. Additionally, I have not found supporting evidence for the proxy of meat consumption due to a constated negative relation between level of education and meat consumption. Contrarily, I have found supporting evidence for hypothesis one only for the sustainable behaviour proxy plane travel, which has shown to be significantly affected by level of education.

4.2 Moderation analysis

Table three shows the results of the regression of the interaction effect between temporal discounting and level of education and its relation to the proxies of sustainable behaviour. The relation is controlled for the separate factors of education and temporal discounting, as well as the previously used control variables gender, age and gross income. As mentioned, the covariate gross income has been excluded from the analysis of water saving due to detected endogeneity.

Table 3. Moderation analysis using interaction of education and temporal discounting

	Dependent variable:				
	Car travel	Plane travel	Meat consumption	Water saving	Energy conservation
Interaction education x discounting	.006 (.019)	-.027† (.014)	-.020 (.018)	.009 (.016)	.023 (.034)
Education	-.011 (.085)	.308*** (.074)	-.266** (.087)	-.042 (.075)	-.035 (.157)
Temporal discounting	.019* (.010)	-.012† (.007)	.019* (.009)	.008 (.008)	-.021 (.017)
Gender	.089 (.089)	-.177* (.079)	.521*** (.094)	-.016 (.071)	.009 (.164)
Age	-.007** (.002)	-.015*** (.002)	-.001 (.002)	-.019*** (.002)	-.012* (.005)
Income	.170* (.067)	.388*** (.058)	-.182* (.081)	-	-.002 (.124)
Intercept	1.008† (.528)	-.359 (.462)	5.556*** (.643)	4.197*** (.126)	3.019* (1.004)
Observations	800	800	799	1,583	799
R-squared	.0262	.1381	.0560	.0542	.0119
Adjusted R-squared	.0188	-	-	.0512	-
F Statistic	3.55* (df = 6; 793)	20.12***	7.15***	18.08*** (df = 5; 1577)	1.70

Note: coefficients with standard errors in parentheses. No additional R^2 or df functions available for proxy's plane travel, meat consumption and energy conservation due to use of robust standard errors. $^{\dagger}p = < .1$, $^{*}p = < .05$, $^{**}p = <.01$, $^{***}p = <.001$

The relation on the interaction term indicates how the relation between level of education and each isolated sustainable behaviour changes upon an increase of temporal discounting. Results indicate that plane travel is the sole proxy significantly affected by the interaction effect between education and temporal discounting if I were to accept a ten percent chance of a type one error ($\alpha = .10$). The relation indicates that the practical educated combined with a lower level of temporal discounting results in more use of the plane as a transportation method compared to a theoretical educated individual with a similar level of temporal discounting ($p = .051$).

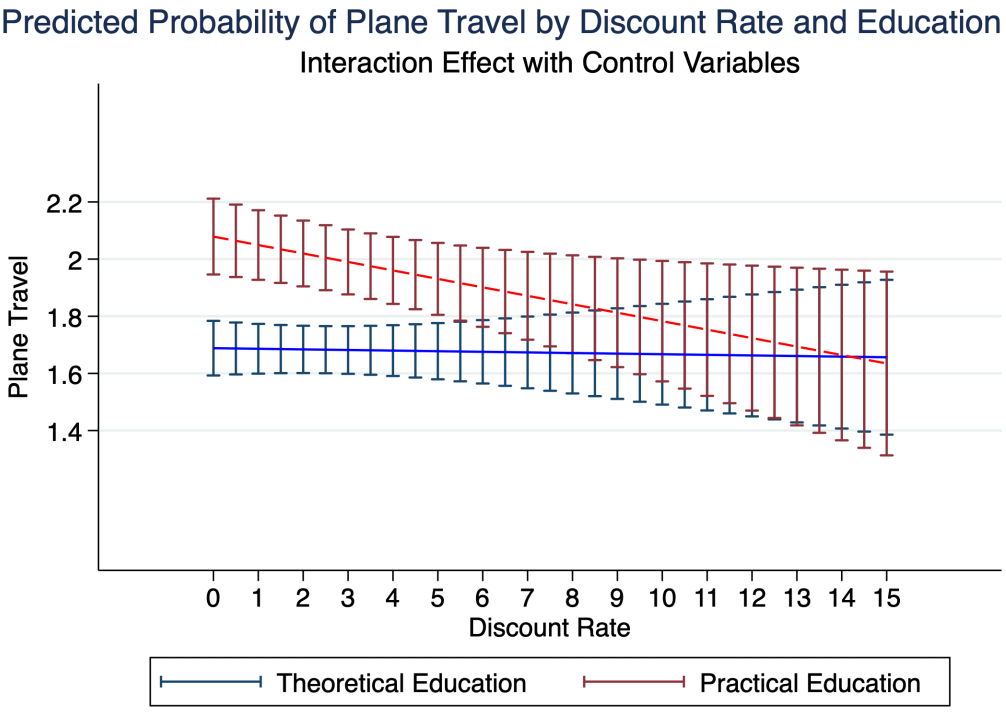

Figure 3. Simple Slopes Model Plane Travel

Figure three shows the predicted occurrence of individuals to use the plane as a form of transportation based on their educational background and temporal discount rate. The model visualizes that this occurrence remains relatively constant at 1.6 for individuals with a theoretical education background, regardless of their temporal discounting. Contrary accounts for the individuals with a practical education background. At a discount rate of (near) zero, their prediction of engaging in plane travel is higher, but this effect diminishes as the discount rate increases, converging to the travelling behaviour of individuals with a theoretical education background.

The other proxies, as presented in table three appear to show an insignificant relation to the interaction term. Nevertheless, the directions of the results show that a similar direction as plane travel is the case of meat consumption ($p = .272$). This indicates that the theoretical educated with a certain level of temporal discounting consume less meat. Therefore, based on the two aforementioned proxies, the theoretical educated at a certain level of temporal discounting show more sustainable behaviour on the accounted isolated behaviours than the practical educated individuals when temporal discounting moderates the relation. However, no conclusion could be drawn due to missing statistically significant outcomes Contrarily, the direction of the coefficient suggests that the theoretical educated use the car more often for short distances ($p = .740$), conserve less energy ($p = .500$), and save less water ($p = .582$) when temporal discounting increases. These three proxies show the theoretical educated exhibit less sustainable behaviour than their practical educated peers when temporal discounting increases. To conclude, the proxy plane travel appears to be significant at an acceptance level of $\alpha = .10$. This significant relation, as well as the insignificant relation between meat consumption and energy conservation, visualize that theoretical educated individuals present more sustainable behaviour. For the remaining proxy's, the directions of the relation have been stated, but no conclusion could be drawn due missing statistically significant results.

Hypothesis two stated: "*An interaction effect between level of education and temporal discounting impacts the effect on sustainable behaviour*". As previously mentioned, due to lacking reliability evidence, this hypothesis was analysed through the use of sustainable behaviour proxies. I could not find supporting evidence for hypothesis two for sustainability proxy's car travel, meat consumption, water saving and energy consumption. When accepting a ten percent chance of having a type one error, I conclude to have found evidence to support hypothesis two if concerning plane travel as a sustainable behaviour factor.

4.3 Mediation analysis

Table four shows the mediating effect of temporal discounting on the relation between level of education and the proxies of sustainable behaviour. The proxies plane travel, meat consumption and energy conservation have been analysed with robust standard errors, as previously predicted. For this analysis too, the covariate of gross income has been excluded for the analysis of sustainable behaviour proxy water saving.

Table 4. Path analysis from SEM method for mediation analysis

		Education	Temporal discounting	Gender	Age	Gross Income	R^2
Car travel	Path a	.365	-	.255	.021*	-.735**	. 0439
		(.315)		(.332)	(.009)	(.246)	
	Path b	-	.020*	-	-	-	
			(.009)				
	Path c’	-.006	-	.094	-.007**	.155	
		(.084)		(.090)	(.002)	(.067)	
	Indirect effect	.007	-	.005	.000	-.014†	
		(.007)		(.007)	(.000)	(.008)	
Plane travel	Path a	.365	-	.255	.021*	-.735**	.1456
		(.325)		(.327)	(.009)	(.228)	
	Path b	-	-.013†	-	-	-	
			(.007)				
	Path c’	.314***		-.180**	-.015***	.390***	
		(.007)		(.078)	(.002)	(.058)	
	Indirect effect	-.004	-	-.003	-.000	.009	
		(.004)		(.004)	(.000)	(.006)	
Meat consumption	Path a	.385	-	.299	.022**	-.751**	.0721
		(.324)		(.325)	(.008)	(.227)	
	Path b	-	.018*	-	-	-	
			(.009)				
	Path c’	-.251**	-	.524***	-.001	-.193*	
		(.087)		(.094)	(.002)	(.081)	

Table 4. Continued

Meat consumption	Indirect effect	.007	-	.005	.000†	-.013†	
continued		(.007)		(.006)	(.000)	(.007)	
Water saving	Path a	.539*	-	-.169	.030***	-	.0710
		(.242)		(.230)	(.007)		
	Path b	-	.009	-	-	-	
			(.008)				
	Path c’	-.036	-	-.018	-.019***	-	
		(.074)		(.071)	(.002)		
	Indirect effect	.005	-	-.002	.000	-	
		(.005)		(.002)	(.000)		
Energy conservation	Path a	.384	-	.299	.022**	-.751**	.0315
		(.324)		(.325)	(.008)	(.227)	
	Path b	-	-.020	-	-	-	
			(.017)				
	Path c’	-.053	-	.006	-.012**	.011	
		(.157)	-	(.163)	(.005)	(.123)	
	Indirect effect	-.008	-	-.006	-.000	.015	
		(.009)		(.008)	(.000)	(.013)	

Note: coefficients with standard errors in parentheses. $^{\dagger}p = < .1$, $*p = < .05$, $**p = <.01$, $***p = <.00$

Table four shows the final results of this study to determine whether temporal discounting has a mediating effect on the relation between level of education and the aforementioned five separate proxies of sustainable behaviour. As predicted in model two, to determine a mediating effect, all three paths need to show a significant relation. Proxy car indicates only path b to be significant (p =

.039), which shows that temporal discounting and the use of car for distances is significantly correlated to one another. The direction of the relation visualizes a positive relation, showing that the higher an individual's discount rate, the more likely they are to use their car for short distances, therefore engaging in an unsustainable practice. However, there seems to be no significant relation between level of education and car travel ($p = .944$), or between level of education and temporal discounting ($p = .246$). Moreover, the indirect effect measure based on the analysis indicates that temporal discounting does not significantly act as a mediator on the relation between level of education and the proxy car travel ($p = .312$).

Plane travel shows to be significant for path b ($p = .056$), the relation between temporal discounting and plane travel, if I were to accept the chance of a type one error at a ten percent level ($\alpha = .10$). The direction of this relation indicates that a higher discount rate correlates with less use of air traffic, therefore engaging more in sustainable practices. Path c' shows a significant result as well ($p = .000$), indicating a positive relation between education and plane travel. However, the other paths, path a ($p = .260$) and the indirect effect ($p = . 362$) appear to be insignificant for this proxy. The results indicate that temporal discounting does not mediate the relation between level of education and the proxy plane travel.

Meat consumption shows to be significantly affected by temporal discounting, representing path b ($p = .042$). The path shows a negative relation indicating that individuals with a low discount rate consume more meat. Path c' is significant as well, indicating a negative relation between educational level and meat consumption. Hence, based on the ranking of meat consumption, individuals with a higher educational level consume meat more frequently. Despite path b and c' being significant, no mediation effect of temporal discounting on the relation between education and meat consumption could be determined due to a lack of significance on path a ($p = .235$) and the indirect effect ($p = .291$).

As previously mentioned, the covariate gross income was excluded with the analysis of water saving due to predicted endogeneity upon inclusion. Path a, the relation between level of education and temporal discounting show to be significant within the mediation model of water saving ($p = .026$), which can occur due to two separate factors: inclusion of the proxy water savings or the exclusion of gross income as covariate. The positive relation denotes that individuals with a theoretical education background discount more. Due to the other paths lacking significance (path b, $p = .248$; path c', $p = .581$; indirect effect, $p = .305$), I cannot conclude temporal discounting to

be of a mediating factor on the relation between level of education and the sustainable behaviour proxy water saving. The final proxy of sustainable behaviour to discuss is energy conservation. Results indicate that none of the paths on the mediating effect of temporal discounting on the relation between level of education and energy conservation is significant (path a, p = .235; path b, p = .230; path c', p = .775; indirect effect, p = .380).

Based on the results, it appears that temporal discounting does not significantly mediate the relation between level of education and each individual proxies of sustainable behaviour. Hence, I was unable to find evidence to support hypothesis three, which stated "*Temporal discounting mediates the relation between level of education and sustainable behaviour*".

4.4 Conclusion

To conclude, table two showed that level of education significantly affects sustainable behaviour proxies plane travel and meat consumption. When temporal discounting is introduced as a moderating factor in the relation between level of education and each sustainable behaviour proxy, the proxy plane travel is significantly affected in case of accepting an alpha of .10. The mediation analysis predicted that temporal discounting and level of education are significantly related when uncontrolled for gross income as was done for the proxy water saving due to predicted endogeneity upon inclusion. Temporal discounting showed to have a direct effect on car travel, plane travel (upon acceptance of alpha is .10) and meat consumption. No indirect effect of temporal discounting on the relation between level of education and sustainable behaviour proxies was detected.

5 Discussion & Conclusion

5.1 Discussion

This study aimed to answer the research question "How does temporal discounting alter the relation between level of education and sustainable behaviour?" I am unable to give a complete answer to this question, due to the inability to extract a single sustainable behaviour variable. Hence, I have worked with isolated sustainable behaviour practices which were used as proxies. The results for these proxies varied greatly.

The first hypothesis questioned whether level of education positively affects sustainable behaviour. Plane travel and meat consumption seemed to have a statistically significant relation

with level of education. In line with the hypothesis, plane travel appeared to be positively affected by level of education, indicating that individuals with a theoretical education background engage more in air traffic. This is in line with the findings of the Environmental Kuznets Curve, which presented the idea that individuals with a theoretical background have more access to polluting energy such as transportation pollution (Hill & Magnani, 2002; Gangadharan & Valenzuela, 2001). However, this study concluded this to be only true for air transportation and not for road transportation.

Parlasca and Oaim (2022) predicted that meat consumption is more present in high income countries. Combining this idea with the Environmental Kuznet's Curve, this would mean that individuals that are theoretically educated consume more meat. The negative relation between meat consumption and level of education of this study indicates otherwise. This study showed that theoretical educated individuals consume less meat.

Moreover, despite lacking significant results, the direction on the relation between water saving and level of education appears to be similar to the findings of De Oliver (1999), where practical educated are indeed more inclined to save water. For energy consumption, the direction of the relation is also similar to previous findings (Wang, Xie & Wu, 2020), where theoretical educated individuals consume more energy through their home heating than practical educated individuals. However, the relation showed no significance in this study.

Finally, for the sustainable behaviour proxy's meat consumption and plane travel, this study could conform with the claim that education directly affects environmental deterioration based on statistically significant outcomes (Voumik et al., 2013; Balaguer & Cantavella, 2019). This is not the case for sustainable behaviour proxy's car travel, water saving energy conservation.

The second hypothesis focussed on a possible moderation effect of temporal discounting on the relation between level of education and sustainable behaviour. When accepting a ten percent chance of a type one error occurrence, results indicated that temporal discounting moderates the relation between level of education and travelling by plane. The result indicated that at a low level of discounting, practical educated individuals engage more in air travel compared to their theoretical educated peers. When the discount rate increases, the use of air transportation by practical educated individuals aligns more closely to the pattern of those that are theoretically educated. This is contrary to the beliefs of the Environmental Kuznets Curve, which predicted the theoretical educated individuals to make more use of plane travel due to better access to this type

of transportation (Hill & Magnani, 2002; Gangadharan & Valenzuela, 2001). Therefore, when including temporal discounting as a moderator on the relation between level of education and plane travel, the results no longer align with the Environmental Kuznets Curve. However, this claim can only be made upon accepting the chance of a type one error of ten percent. Despite absence of significance level, the opposite type of relation appears to be the case for the road transportation method, which shows a positive relation between car travel and the interaction effect of level of education and temporal discounting. For the other proxy's, car travel, meat consumption, water saving and energy conservation, there appeared to be no moderating effect of temporal discounting on their relation to level of education. However, the findings of the moderation analysis concerning water saving as a dependent variable are contradictory to the findings of De Oliver (1999), indicating that it is the theoretical educated that save water when temporal discounting acts as a moderator on the relation between level of education and water saving. Yet, as mentioned no conclusion could be drawn due to a non-significant outcome for water saving. For energy conservation the direction of the relation is similar to the literature once temporal discounting is presented as a moderator on the relation between level of education and energy conservation. With temporal discounting as moderator, it appears that it is in fact the theoretical educated that are more inclined to conserve energy than their practical educated peers (Wang, Xie & Wu, 2020). However, as mentioned, the results on meat consumption, water saving and energy conservation are statistically insignificant in this study.

Concluding on hypothesis two, when accepting an alpha of .10, it shows that plane travel is affected by the interaction between temporal discounting and level of education, which is in line with the finding of Grossman (2006). This result also shows that temporal discounting and level of education can be affective of behaviour (Wilson et al., 2015; Tate et al., 2015; Liang & Gou, 2021; Farias, Coruk & Simão, 2021). Contrary results were found for the remaining four proxy's: car travel, meat consumption, water saving and energy conservation.

Hypothesis three, and the final hypothesis, concerned whether temporal discounting could act as a mediator on the relation between level of education and sustainable behaviour. Here as well I continued working with the separate proxies. The mediation analysis model represents four different types of relations. The first relation is path a, which indicates whether level of education is affective of temporal discounting. The results from the proxy water saving indicated when uncontrolled for gross income, temporal discounting is in fact affected by level of education

(Wilson et al., 2015; Wittman & Sircova, 2018). Interestingly, neither of these studies included income as a control variable. The results of path a for the proxy of water saving were contrary to previous results. Path a of the proxy water saving indicated there to be a positive relation between level of education and temporal discounting (Reimers et al., 2009; Lee et al., 2013; Perez-Arce, 2017; König-Kersting & Trautmann, 2023). The results of this study indicate that it is in fact the theoretical educated that discount more compared to their practically educated peers, which is contrary to the findings of De Wit et al. (2007). For the remaining proxies, no significant relation for path a could be determined.

Path b concerned the significance level between temporal discounting and each separate proxy, controlled for gender, age and gross income, the latter being excluded for proxy water saving. Path b showed to be significant for car travel, plane travel (with an alpha of .10) and meat consumption. The relation between plane travel and temporal discounting and the relation between meat consumption and temporal discounting showed to be negative, indicating that individuals with a low discount rate make more use of air traffic as a method of transportation and consume more meat, therefore engaging in unsustainable behaviour. This is contrary to the findings of previous studies, who indicated that individuals with a high level of discounting future rewards show lower sustainable behaviours (Farias, Coruk & Simão, 2021; Sahraeian, Khanahmadi & Sadeghiyeh, 2021). Proxy's car travel did appear to have a positive relation towards temporal discounting, indicating that a high discount rate is associated with more use of the car for short distance, which is similar results as the previous mentioned studies. Path b did not show significant outcomes for proxy's water saving and energy conservation, which results are in line with Lades, Laffan and Weber (2021), who found that temporal discounting does not significantly affect sustainable behaviour. Path c' showed similar results as the normal regression model previously discussed.

Finally, the indirect effect indicated the mediating effect of temporal discounting on the relation between level of education and each separate proxy. It appeared that none of the proxies are significantly affected by level of education when temporal discounting is introduced as mediating variable. This result is contrary to the results of previous studies, who indicated that temporal discounting has an indirect or mediating effect on the relation between level of education and sustainable behaviour (Corral-Verdugo, Fraijo-Sing & Pinheiro, 2006; Grandin, 2022).

5.2 Limitations & recommendations

This study has presented some limitations worth mentioning. A considerable discussion has been mentioned in literature whether demographical differences in temporal discounting truly reflect differences in time preferences or whether these differences are influenced by liquidity limitations in poverty circumstances (Haushofer, Schunk & Fehr, 2013). Within this study, I have included income as a covariate. However, the income level does not account for poverty circumstances. I have been able to show what effect income level does have on the relation between education and temporal discounting through the proxy water saving. It showed that upon exclusion of covariate gross income, the relation between level of education and temporal discounting became significant. This yields that gross income is of utmost importance when dealing with a combination of level of education and temporal discounting.

Another limitation for this study is the use of mediation analysis despite cross-sectional data. The fact that this study could not find any significant mediating effect, despite an extensive literature review suggesting the opposite, gives cause to question the method, as criticized by Aguinis, Edwards and Bradley (2017). Nevertheless, as said MacKinnon, Fairchild and Fritz (2007) suggested this to not be an issue. However, it is recommended for future research to use opportunities for longitudinal datasets when using mediation analysis.

Battling climate change remains a challenge. Based on the reliability test, it is recommended for future studies and policy makers to combat climate change through sustainable behaviour each step at a time. This can be done by concentrating on isolated behaviours, as done in this study, instead of solely concentrating on sustainable behaviour as a systematic factor, since reliability test of this study has presented that combining indicators of sustainable behaviour may lead to biased results. It is henceforth important to note for future research and policy making to focus on separate proxies of sustainable behaviour and not include sustainable behaviour as one complete indicator.

6 References

Agerström, J., & Björklund, F. (2013). Why people with an eye toward the future are more moral: The role of abstract thinking. *Basic and Applied Social Psychology*, *35*(4), 373-381.

Aguinis, H., Edwards, J. R., & Bradley, K. J. (2017). Improving our understanding of moderation and mediation in strategic management research. *Organizational research methods*, *20*(4), 665-685.

Akhtar, R., Sultana, S., Masud, M. M., Jafrin, N., & Al-Mamun, A. (2021). Consumers' environmental ethics, willingness, and green consumerism between lower and higher income groups. *Resources, Conservation and Recycling*, *168*, 105274.

Arnocky, S., Milfont, T. L., & Nicol, J. R. (2014). Time perspective and sustainable behavior: Evidence for the distinction between consideration of immediate and future consequences. *Environment and Behavior*, *46*(5), 556-582.

Balaguer, J., & Cantavella, M. (2018). The role of education in the Environmental Kuznets Curve. Evidence from Australian data. *Energy Economics*, *70*, 289-296.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, *51*(6), 1173.

Barr, S., & Prillwitz, J. (2013). Household analysis: researching 'green'lifestyles, a survey approach. *Sustainability Research*, 1127.

Benhabib, J., Bisin, A., & Schotter, A. (2010). Present-bias, quasi-hyperbolic discounting, and fixed costs. *Games and economic behavior*, *69*(2), 205-223.

Carson, R. T., & Roth Tran, B. (2009). *Discounting behavior and environmental decisions* (Vol. 2, No. 2, p. 112). Educational Publishing Foundation.

Centraal Bureau voor de Statistiek. (2019). *Verschil levensverwachting hoog en laagopgeleid groeit*. Centraal Bureau voor de Statistiek *https://www.cbs.nl/nl-nl/nieuws/2019/33/verschil-levensverwachting-hoog-en-laagopgeleid-groeit/opleidingsniveau.* Accessed on April 4th, 2024.

Choriyeva, M. S., & Eshkoraev, S. S. (2022). The interaction of energy with climate change. *ISJ Theoretical & Applied Science*, *4*(108), 60-63.

Corral-Verdugo, V., Fraijo-Sing, B., & Pinheiro, J. Q. (2006). Sustainable behavior and time perspective: Present, past, and future orientations and their relationship with water saving

behavior. *Revista Interamericana de Psicología/Interamerican Journal of Psychology*, *40*(2), 139-147.

De Kluizenaar, Y., & De Wilde, T. (2019). The energy transition from a citizen's perspective [Dataset]. *The Netherlands Institute for Social Research (SCP)*

De Oliver, M. (1999). Attitudes and inaction: A case study of the manifest demographics of urban water conservation. *Environment and Behavior*, *31*(3), 372-394.

De Silva, D. G., & Pownall, R. A. (2014). Going green: does it depend on education, gender or income?. *Applied Economics*, *46*(5), 573-586.

De Wit, H., Flory, J. D., Acheson, A., McCloskey, M., & Manuck, S. B. (2007). IQ and nonplanning impulsivity are independently associated with delay discounting in middle-aged adults. *Personality and Individual Differences*, *42*(1), 111-121.

European Commission, Directorate-General for Mobility and Transport, (2023). *EU transport in figures : statistical pocketbook 2023*, Publications Office of the European Union.

Faccioli, M., Hanley, N., Torres, C., & Font, A. R. (2016). Do we care about sustainability? An analysis of time sensitivity of social preferences under environmental time-persistent effects. *Journal of environmental management*, *177*, 356-364.

Fahy, F., & Rau, H. (Eds.). (2013). *Methods of sustainability research in the social sciences*. Sage.

Farias, A. R., Coruk, S., & Simão, C. (2021). The effects of temporal discounting on perceived seriousness of environmental behavior: Exploring the moderator role of consumer attitudes regarding green purchasing. *Sustainability*, *13*(13), 7130.

Field, A. (2018). *Discovering Statistics using IBM SPSS Statistics*. Sage.

Frederick, S., Loewenstein, G., & O'donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of economic literature*, *40*(2), 351-401.

Gangadharan, L., & Valenzuela, M. R. (2001). Interrelationships between income, health and the environment: extending the Environmental Kuznets Curve hypothesis. *Ecological Economics*, *36*(3), 513-531.

Gilg, A., & Barr, S. (2006). Behavioural attitudes towards water saving? Evidence from a study of environmental actions. *Ecological Economics*, *57*(3), 400-414.

Godfray, H. C. J., Aveyard, P., Garnett, T., Hall, J. W., Key, T. J., Lorimer, J., ... & Jebb, S. A. (2018). Meat consumption, health, and the environment. *Science*, *361*(243), 1-8.

Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. *Journal of consumer Research*, *35*(3), 472-482.

Grafton, R.Q. (2014). Household behaviour and water use. In OECD (Eds), *Green household behaviour: overview from the 2011-survey.* Paris: OECD publishing,149-181.

Grandin, A., Guillou, L., Sater, R. A., Foucault, M., & Chevallier, C. (2022). Socioeconomic status, time preferences and pro-environmentalism. *Journal of Environmental Psychology*, *79*, 101720.

Griskevicius, V., Tybur, J. M., & Van den Bergh, B. (2010). Going green to be seen: status, reputation, and conspicuous conservation. *Journal of personality and social psychology*, *98*(3), 392.

Grossman, M. (2006). Education and nonmarket outcomes. *Handbook of the Economics of Education*, *1*, 577-633.

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., Ray, S., ... & Ray, S. (2021). Moderation analysis. *Partial least squares structural equation modeling (PLS-SEM) using R: A workbook*, 155-172.

Haushofer, J., Schunk, D., & Fehr, E. (2013). Negative income shocks increase discount rates. *University of Zurich Working Paper.*

Hill, R. J., & Magnani, E. (2002). An exploration of the conceptual and empirical basis of the environmental Kuznets curve. *Australian Economic Papers*, *41*(2), 239-254.

Kim, B. K., & Zauberman, G. (2009). Perception of anticipatory time in temporal discounting. *Journal of Neuroscience, Psychology, and Economics*, *2*(2), 91.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental education research*, *8*(3), 239-260.

König-Kersting, C., & Trautmann, S. T. (2023). *Grit, discounting, & time inconsistency* (No. 2023-12). Working Papers in Economics and Statistics.

Lades, L. K., Laffan, K., & Weber, T. O. (2021). Do economic preferences predict pro-environmental behaviour?. *Ecological Economics*, *183*, 106977.

Leal, P. H., & Marques, A. C. (2022). The evolution of the environmental Kuznets curve hypothesis assessment: A literature review under a critical analysis perspective. *Heliyon*, *8*(11).

Lee, N. C., De Groot, R. H., Boschloo, A., Dekker, S., Krabbendam, L., & Jolles, J. (2013). Age and educational track influence adolescent discounting of delayed rewards. *Frontiers in psychology*, *4*, 57151.

Li, D., Zhao, L., Ma, S., Shao, S., & Zhang, L. (2019). What influences an individual's pro-environmental behavior? A literature review. *Resources, Conservation and Recycling*, *146*, 28-34.

Liang, J., & Guo, L. (2021). Gratitude and sustainable consumer behavior: A moderated mediation model of time discounting and connectedness to the future self. *Psychology & Marketing*, *38*(8), 1238-1249.

LISS Panel (2024). *About the Panel*. Longitudinal Internet studies for the Social Sciences. *https://www.lissdata.nl/how-it-works*. Accessed on June 25th, 2024.

MacKinnon, D. P., Fairchild, A. J., & Fritz, M. S. (2007). Mediation analysis. *Annu. Rev. Psychol.*, *58*, 593-614.

Meyer, A. (2015). Does education increase pro-environmental behavior? Evidence from Europe. *Ecological economics*, *116*, 108-121.

Michalos, A. C., Creech, H., McDonald, C., & Kahlke, P. M. H. (2011). Knowledge, attitudes and behaviours. Concerning education for sustainable development: Two exploratory studies. *Social indicators research*, *100*, 391-413.

Millock, K. (2014). Greening Household Behaviour and Food. In OECD (Eds), *Green household behaviour: overview from the 2011-survey.* Paris: OECD publishing,183-217.

Osuntuyi, B. V., & Lean, H. H. (2022). Economic growth, energy consumption and environmental degradation nexus in heterogeneous countries: does education matter?. *Environmental Sciences Europe*, *34*(1), 48.

Owens, J., & Wilhite, H. (1988). Household energy behavior in Nordic countries—an unrealized energy saving potential. *Energy*, *13*(12), 853-859.

Palatnik, R. R., Brody, S., Ayalon, O., & Shechter, M. (2014). Greening household behaviour and waste. In OECD (Eds), *Green household behaviour: overview from the 2011-survey.* Paris: OECD publishing, 219-245.

Parlasca, M. C., & Qaim, M. (2022). Meat consumption and sustainability. *Annual Review of Resource Economics*, *14*, 17-41

Pearson, A. R., Ballew, M. T., Naiman, S., & Schuldt, J. P. (2017). Race, class, gender and climate change communication. In *Oxford research encyclopedia of climate science*.

Perez-Arce, F. (2017). The effect of education on time preferences. *Economics of Education Review*, *56*, 52-64.

Piskorski, N. (2020). Temporal Discounting and Sustainable Behaviors. CUNY Academic Works.

Poortinga, W., Steg, L., Vlek, C., & Wiersma, G. (2003). Household preferences for energy-saving measures: A conjoint analysis. *Journal of economic psychology*, *24*(1), 49-64.

Reimers, S., Maylor, E. A., Stewart, N., & Chater, N. (2009). Associations between a one-shot delay discounting measure and age, income, education and real-world impulsive behavior. *Personality and individual differences*, *47*(8), 973-978.

Rhode, K. I. (2019). Measuring decreasing and increasing impatience. *Management Science*, *65*(4), 1700-1716.

Sahraeian, S., Khanahmadi, I., & Sadeghiyeh, H. (2021). Pro-environmental behaviors correlate with delay discounting. *SocArXiv.*

Sanford, M., Painter, J., Yasseri, T., & Lorimer, J. (2021). Controversy around climate change reports: a case study of Twitter responses to the 2019 IPCC report on land. *Climatic change*, *167*(3-4), 59.

Sargisson, R. J., & Schöner, B. V. (2020). Hyperbolic discounting with environmental outcomes across time, space, and probability. *The Psychological Record*, *70*(3), 515-527.

Sautkina, E.V., Agisova, F.B., Ivanova, A.A., Ivande, S.K., Kabanova, V.S. (2022). Pro-ecological behaviour in Russia. Systematic Review of Research. *Experimental psychology, 15*(2), 172-193.

Shiel, C., do Paço, A., & Alves, H. (2020). Generativity, sustainable development and green consumer behaviour. *Journal of Cleaner Production*, *245*, 118865

Stern, D. I. (2004). The rise and fall of the environmental Kuznets curve. *World development*, *32*(8), 1419-1439.

Sun, L., Yang, S., Li, S., & Zhang, Y. (2020). Does education level affect individuals' environmentally conscious behavior? Evidence from Mainland China. *Social Behavior and Personality: an international journal*, *48*(9), 1-12.

Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, *48*(6), 1273-1296.

Tate, L. M., Tsai, P. F., Landes, R. D., Rettiganti, M., & Lefler, L. L. (2015). Temporal discounting rates and their relation to exercise behavior in older adults. *Physiology & behavior*, *152*, 295-299.

Trautmann, S. T. (2018). Time preferences and financial decisions [Dataset]. *CentERdata Institution for data collection and research.*

Trudel, R., Argo, J. J., & Meng, M. D. (2016). The recycled self: Consumers' disposal decisions of identity-linked products. *Journal of Consumer Research*, *43*(2), 246-264.

UNESCO World Water Assessment Programme (2018). *The United Nations world water development report 2018: nature-based solutions for water*. Paris: Unesco.

United Nations. (2016). *UN stresses demographic data as key to achieve SDGs.* United Nation*. https://www.un.org/sustainabledevelopment/blog/2016/04/un-stresses-demographic-data-as-key-to-achieving-sdgs/.* Accessed on June 25th, 2024.

Voumik, L. C., Md. Nafi, S., Bekun, F. V., & Haseki, M. I. (2023). Modeling energy, education, trade, and tourism-induced environmental Kuznets curve (EKC) hypothesis: evidence from the Middle East. *Sustainability*, *15*(6), 4919.

Wang, S., Xie, Z., & Wu, R. (2020). Examining the effects of education level inequality on energy consumption: Evidence from Guangdong Province. *Journal of Environmental Management*, *269*, 110761.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... & Murray, C. J. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The lancet*, *393*(10170), 447-492.

Wilson, A. G., Franck, C. T., Mueller, E. T., Landes, R. D., Kowal, B. P., Yi, R., & Bickel, W. K. (2015). Predictors of delay discounting among smokers: Education level and a Utility Measure of Cigarette Reinforcement Efficacy are better predictors than demographics, smoking characteristics, executive functioning, impulsivity, or time perception. *Addictive Behaviors*, *45*, 124-133.

Wittmann, M., & Paulus, M. P. (2009). Temporal horizons in decision making. *Journal of Neuroscience, Psychology, and Economics*, *2*(1), 1.

Wittmann, M., & Sircova, A. (2018). Dispositional orientation to the present and future and its role in pro-environmental behavior and sustainability. *Heliyon*, *4*(10).

7 Appendix

Table 5. Mean and description for dependent, independent and control variables mean and description for dependent, independent and control variables

	Variable description	N	Mean
Dependent variable			
Car travel	How often do you use the car to travel short distances (less than 5 km)?[3] [1 = (almost) never, 2 = sometimes, 3 = regularly, 4 = often, 5 = (almost) always]	1,586	2.033
Plane travel	How often did you travel by airplane for private purposes in the past 12 months? (Note: 1 return flight counts as 1 time)[3] [1 = 0 times, 2 = 1 time, 3 = 2 times, 4 = 3-5 times, 5 = more than 5 times]	1,586	1.679
Meat consumption	How often do you eat meat (all kinds, including chicken) as part of a hot meal?[3] [1 = never, 2 = < 1 times, 3 = 1 – 2 times, 4 = 3- 4 times, 5 = 5- 6 times, 6 = always]	1,585	4.315
Water saving	When you shower, how often do you shower for less than 5 minutes?[3] [1 = (almost) always, 2 = often, 3 = regularly, 4 = sometimes, 5 = (almost) never]	1,585	3.010
Energy conservation	How often is the thermostat in your dwelling set to 15 degrees or lower at night (or in the case of underfloor heating, 17 degrees or lower)?[3] [1 = always, 2 = 5- 6 times, 3 = 3- 4 times, 4 = 1- 2 times, 5 = < 1 times, 6 = never]	1,585	2.328
Independent variable			
Education	Level of education according to Statistics Netherlands (0= practical, 1= theoretical)[1]	1,586	.358
Moderating/mediating variable			
Temporal discounting	Discount rate per individual, continuous[2]	1,584	3.020

Notes: [1] retrieved from LISS Panel's demographic variables (2018; 2019)

[2] retrieved from König-Kersting & Trautmann (2023)

[3] retrieved from De Kluizenaar and De Wilde (2019)

Table 6. Robustness checks simple regression model

	Dependent variables				
	Car travel	Plane travel	Meat consumption	Water saving	Energy conservation
Education	-.013	.318***	-.258**	-.049	-.045
	(.085)	(.072)	(.085)	(.105)	(.158)
Temporal	.020*	-.013†	.018†	-.009	-.020
discounting	(.009)	(.008)	(.010)	(.012)	(.017)
Gender	.089	-.181*	.519***	.156	.012
	(.089)	(.076)	(.090)	(.110)	(.167)
Age	-.007**	-.015***	-.001	-.017***	-.012**
	(.002)	(.002)	(.002)	(.003)	(.005)
Income	.169*	.390***	-.180**	-.260**	-.004
	(.067)	(.057)	(.067)	(.083)	(.125)
Intercept	1.012 †	-.377	5.544***	6.031***	3.034**
	(.527)	(.447)	(.531)	(.652)	(.984)
Observations	800	800	799	799	799
R-squared	.0260	.1349	.0548	.0532	.1057
Adjusted R^2	.0199	.1295	.0488	.0472	.0114
F Statistic	4.24*** (df = 5; 794)	24.77*** (df = 5; 794)	9.19*** (df = 5; 793)	8.91*** (df = 5; 793)	1.82 (df = 5;793)
VIF	1.10	1.10	1.10	1.10	1.10
Breusch-Pagan	X^2= 1.79	X^2 = 63.25***	X^2 = 17.43***	X^2 = 1.93	X^2 = 4.68*

Note: †p = < .1, *p = < .05, **p = <.01, ***p = <.001

Table 7. Robustness checks model 2 simple regression model with interaction

	Dependent variable:				
	Car travel	Plane travel	Meat consumption	Water saving	Energy conservation
Interaction education x discounting	.006 (.019)	-.027† (.016)	-.020 (.019)	.037 (.023)	.023 (.036)
Education	-.011 (.085)	.308*** (.072)	-.266** (.086)	-.034 (.105)	-.035 (.159)
Temporal discounting	.019* (.010)	-.012 (.008)	.019† (.010)	.007 (.012)	-.021 (.018)
Gender	.089 (.089)	-.177* (.076)	.521*** (.090)	.151 (.110)	.009 (.167)
Age	-.007** (.002)	-.015*** (.002)	-.001 (.002)	-.018*** (.003)	-.012** (.005)
Income	.170* (.067)	.388*** (.057)	-.182** (.067)	-.257** (.082)	-.002 (.124)
Intercept	1.008† (.528)	-.359 (.447)	5.556*** (.532)	6.010*** (.652)	3.019** (.985)
Observations	800	800	799	799	799
R-squared	.0262	.1381	.0560	.0561	.0119
Adjusted R-squared	.0188	.1315	.0489	.0490	.0044
F Statistic	3.55* (df = 6; 793)	21.17*** (df = 6; 793)	7.83*** (df = 6; 792)	7.85*** (df = 6; 792)	1.59 (df = 4; 794)
VIF	1.09	1.09	1.09	1.09	1.09
Breusch-Pagan	X^2 = 1.70	X^2 = 62.02***	X^2 = 17.93***	X^2 = 1.41	X^2 = 5.35*

Note: †p = < .1, *p = < .05, **p = <.01, ***p = <.001

Table 8. Robustness checks 2SLS regression model

	Dependent variable:				
	Car travel	Plane travel	Meat consumption	Water saving	Energy conservation
Education	-.014	.320***	-.257**	-.045	-.048
	(.084)	(.074)	(.085)	(.104)	(.158)
Temporal discounting	.022*	-.017*	.014	-.003	-.012
	(.010)	(.007)	(.010)	(.013)	(.019)
Gender	.089	-.180*	.519***	.159	.009
	(.090)	(.078)	(.090)	(.110)	(.166)
Age	-.007**	-.015***	-.001	-.017***	-.012**
	(.002)	(.002)	(.002)	(.003)	(.005)
Income	.171**	.387***	-.183**	-.269**	.002
	(.067)	(.058)	(.067)	(.082)	(.124)
Intercept	.996†	-.350	5.569***	6.111***	2.977**
	(.526)	(.460)	(.530)	(.651)	(.983)
Observations	800	800	799	799	799
R-squared	.0260	.1347	.0546	.0520	.0111
Wald X^2	21.61***	121.86***	44.64***	44.78***	8.27
Durbin-Watson	X^2 = .33	X^2 = 1.58	X^2 = .77	X^2 = 5.12*	X^2 =1.14
Hausman-Wu	F(1,793) = .32	F(1,793) = 1.62	F(1,792) = .77	F(1,792) = 5.11*	F(1,792) = 1.13

Note: †p = < .1, *p = < .05, **p = <.01, ***p = <.001

Results indicate there to be endogeneity for sustainable behaviour proxy water saving. Hence, gross income has been excluded from the models presented in this paper for the proxy water saving.