MASTER

The willingness to implement a green roof by homeowners in The Netherlands

A stated choice experiment measuring the willingness to implement a green roof amongst homeowners in The Netherlands

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Award date:
2021

MASTER THESIS

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De Louw, R.

Year 2021

Colophon

Title

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Further information

ECTS:	45 EC
Public information:	Yes
Statement:	Thesis is in accordance with the rules of the TU/e Code of Scientific Integrity
Date:	17/05/2021

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Preface

In my master graduation project, I investigate the willingness to implement a green roof, based on the type of green roof and price per m² and how this can be stimulated by governmental policies. As a master student Urban Systems & Real Estate at the Eindhoven University of Technology, my interest lies in (re)developing real estate and modifying the urban space. I believe that all industries, including the real estate industry, should change more pro-environmentally in order to adapt to climate change and become more sustainable. In my opinion, an interesting opportunity lies in implementing green roofs. It is an opportunity that starts to be more dominant in recent years, but is not yet massively implemented. My curiosity lies in how green roofs can be made attractive enough to be implemented. The target group of this research are homeowners, real estate developers, green roof related companies and governmental organisations.

The process of writing this graduation project has taught me that it is interesting to create an in-depth look at how people create willingness to strive for a certain product. Generally conducting research has taught important steps to create scientific research. Moreover, research has taught me the major possibilities that are offered by research and possibilities that can be created as a result of research. Research is the basis for innovation in the broadest sense, in terms of knowledge as well as products. This can be vital in becoming more sustainably just. Lastly, research can create practical solutions for existing problems, which create a more convenient way of life.

Gladly, I want to thank my three supervisors. Stephan Maussen as my main supervisor, Robert van Dongen as my second supervisor and Theo Arentze as my third supervisor. All three have contributed to a better research by supplying the opportunity for discussion and offering feedback. Especially considering that the whole graduation project was executed in the Covid-19 period, which increased the difficulty of keeping in contact and created a new situation from which we all had to adapt.

Summary

Climate change causes consequences in The Netherlands such as floods, air pollution, heat waves and droughts. Possibilities mitigating these effects of climate change are vital in order to preserve the safety and well-being of the population. The consequences of climate change are increasingly noticeable in urban environments suffering relatively more from air pollution, heat stress and high peak runoffs. It is key to improve the liveability of urban environments to improve the well-being and safety of urban residents. Especially, as The Netherlands has a high population density, with 74% of inhabitants living in city environments, with urbanisation still on the rise. The use of green is one of the instruments to mitigate climate change. Only, space is scarce, which means that creating green on the ground is not as easy and rather costly. Creating green on rooftops, which are normally not used, is an interesting solution.

The objective of this research is to measure the willingness of homeowners to implement green roofs, determined by preferences regarding the type of green roof, the price per m² and governmental policies for stimulation. This research contributes to scientific literature in a couple different ways: firstly, it will contribute to scientific literature regarding the preference of homeowners in The Netherlands between an extensive- or intensive green roof. Secondly, it contributes to literature about the preference of price for green roofs in The Netherlands. Thirdly, it extends the literature about the effectiveness of governmental policies on the willingness to implement a green roof. Lastly, it extends to literature regarding using Defra's 4E model to influence pro-environmental behaviour and using the Defra's 4E model to influence the Theory of Planned Behaviour. Practically, this research could firstly lead to insights that can help improve pro-environmental behaviour by implementing green roofs. Furthermore, this research increases the knowingness of green roofs and advantages of green roofs in general. Lastly, it could provide insights for developers and help governmental organisations in stimulating pro-environmental means like green roofs.

From literature review emerged that the type of green roof can be distinguished between extensive green roofs and intensive green roofs, which differs in aesthetics, functionality and maintenance. Extensive green roofs are vegetative layer on roofs, not usable for people, with a low level of maintenance, whereas intensive green roofs are rooftop gardens, usable for people with a higher level of maintenance. Implementing green roofs can have several benefits: lower energy use, lower inside temperature, increasing biodiversity, less floods, improving air quality, protective effect on roof construction, increasing productivity of solar panels and lowered outside temperature. Therefore, implementing green roofs could positively influence the local microclimate.

According to the Theory of Planned Behaviour, the attitude, subjective norm and perceived behavioural control should be positive in order to increase the likelihood that homeowners choose a certain behaviour. The attitude subjective norm and perceived behavioural control can be influenced by governmental policies from the Defra 4E model. The four different policies distinguished are: engaging policies, enabling policies, encouraging policies and exemplifying policies. Engaging policies are able to change the subjective norm and perceived behavioural control, effective on homeowners with a high willingness to act. Enabling policies are able to change the attitude and perceived behavioural control for homeowners with a high- and low willingness to act. Encouraging policies are able to change the attitude and perceived behavioural control and are most effective on homeowners with a low willingness to act.

Exemplifying policies are able to change the subjective norm and perceived behavioural control, most effective on homeowners with a low willingness to act.

Regarding methods, this research will be a quantitative research with an experimental research design. Furthermore, the research will be an explorative research with cross-sectional data. The questionnaire is formed into a stated choice experiment that includes 32 choice alternatives combined with close-ended questions about demographic characteristics, experience of the local microclimate and ranking advantages of green roofs. Data is collected door to door as well as via interest groups on Facebook, email and LinkedIn. Data gathering resulted in 159 fully completed surveys, usable for analysis. Data is analysed using the Multinomial Logit Model (MNL), based on the random utility theory and the Lancaster characteristics theory of value. Utility shows the preference of variables relative to the reference variables. Preferences translate into a willingness to implement a green roof. In order to measure the most realistic utility of variables, main effects and interaction effects will be included. Four variables are defined: the type of green roof[1], the price per m^2[2] and governmental policy 1[3] and governmental policy 2[4].

Results show that 94% of the homeowners graded their local microclimate as average or higher. Homeowners tend to see lower energy use, lower inside temperature and increasing biodiversity as the most important advantages of green roofs. Less floods and improving air quality are ranked as average advantages, whereas the protective effect on roof construction, increasing productivity of solar panels and lowered outside temperature are seen as the least important advantages.

The results of the MNL analysis confirm the objective of this research: that the willingness to implement a green roof for homeowners in The Netherlands is (partly) determined by the type of green roof, the price per m^2 and governmental policies. Preferences vary between variables. The price per m^2 has the biggest influence on homeowners, where the preferred price is the lowest price of €30 per m^2. The type of green roof has the second biggest influence on the willingness to implement a green roof, where an extensive green roof is preferred over an intensive green roof. The third biggest influence are governmental policies, where the willingness to implement a green roof, is positively influenced by a combination of engaging- and encouraging policies.

Demographic groups value the type of green roof, the price per m^2 and governmental policies differently. Large differences exist between men and women, in which men have a higher willingness to implement a green roof in general. Moreover, homeowners from different age categories tend to look differently towards implementing green roofs, where the youngest age category looks more positive towards implementing a green roof in general. Also, homeowners with different levels of education tend to value the type of green roof, the price per m^2 and/or governmental policies differently. Homeowners with a practical education deviate negatively when a relatively high price of €90 per m^2 is combined with engaging policies. Lastly, homeowners with an income of 5000 or more, tend to deviate on the willingness to implement a green roof, from other income groups in terms of the preference of price combined with a type of green roof. Not only demographic groups, but also the experience group that grades the local microclimate as high, values the willingness to implement a green roof differently from other experience groups.

In general the most effective governmental policies are a combination of engaging- and encouraging policies that jointly have the ability to change the attitude, subjective norm and perceived behavioural control. Changing the subjective norm and perceived behavioural control of engaging policies is most effective on homeowners with a high willingness to act and changing attitudes and perceived behavioural control by encouraging policies is most effective on homeowners with a low willingness to act. Differences exist about the preferences of governmental policies between demographic groups.

The governmental policies of Defra's 4E model to increase pro-environmental behaviour are in accordance with the Theory of Planned Behaviour. Limitations to the study are the low rho-square, caused by the high heterogeneity in the sample, sample size and a sampling bias.

Recommendations are to aim for extensive green roofs. The lower the price per m², the more attractive homeowners find the implementation of a green roof. Governmental policies should focus on a combination of subsidies, certification and participation. It could be interesting to target different demographics groups in different personalised ways to make it more effective:

- Men have a higher willingness to implement a green roof relative to women. It is therefore recommended to focus on men to increase the implementation of green roofs.
- It is recommended to focus on the recommendations of the main model when focussing on income levels.
- It is recommended to focus on relatively young homeowners until the age of 45 years old as these are more willing to implement a green roof.
- It is recommended to focus on homeowners with a practical education. This is a relatively large group in society, which can be very well stimulated to implement a green roof.
- It is recommended to follow recommendations of the main model in case of the perception of the local microclimate of homeowners.

Recommendations for future research would be to focus on homeowners with underrepresented demographic characteristics in this study. Moreover, it could be interesting to conduct an explorative research towards other incentives for demographic groups that relatively have a low willingness to implement a green roof. Furthermore, it could be interesting to focus on the willingness to implement green roofs by (social) housing corporations or landlords and focus on the actual (or revealed) willingness to implement a green roof.

Chapter I - Introduction

This chapter will define the main problem, the goal of this research and give an insight into the motives and main concepts of this research. Moreover, it introduces the gap in scientific literature and research questions designed to address the problem.

1.1 Problem definition

Climate change causes consequences in The Netherlands such as floods, air pollution, heat waves and droughts. Possibilities mitigating these effects of climate change are vital in order to preserve the safety and well-being of the population. The effect of climate change are increasingly noticeable in urban environments suffering more from air pollution, heat stress and high peak runoffs. It is key to improve the liveability of urban environments to improve the well-being and safety of urban residents (Rosenzweig et al. ,2015). Especially, considering The Netherlands has a high population density, with 74% of inhabitants living in city environments, with urbanisation still on the rise (PBL, 2015). The high population density in The Netherlands makes it increasingly important to mitigate consequences regarding climate change with measures in the built environment. The use of green is one of the instruments to mitigate climate change (Hoffman, 2009). Only, space is scarce, which means that creating green on the ground is not easy and rather costly. Creating green on rooftops, which are normally not used, are an interesting solution to investigate as a mitigation for consequences of climate change in urban areas in The Netherlands (Rooftoprevolution, n.d.).

1.2 Scope

Roofs are mostly private property. Therefore, governments are not able to implement green roofs easily on a large scale. This research aims on homeowners. Homeowners have to be willing to cooperate and willing to implement green roofs on a big scale. Every homeowner has their own degree of willingness to implement a green roof. The willingness can be influenced by aesthetics, price and governmental policies for stimulation. Since every country has their own demographic, economic and governmental situation, one dense populated country is chosen: The Netherlands.

1.3 Research gap

This research fills a gap in scientific literature by measuring the preferences of homeowners in terms of the type of green roof, the preference of price per m² and the effectiveness of governmental policies in The Netherlands.

Preferences regarding the type of green roof are already examined in scientific literature. Existing literature focuses on different countries than The Netherlands. Psychological distance, optimism bias and the dislike of the solution, can influence environmental psychology and possibly create differences between geographic locations (Steg & De Groot, 2018). Moreover, existing literature focuses solely on extensive green roofs and types of vegetation for extensive green roofs or focuses on preferences of types of vegetation. However, intensive green roofs exist, which have other functionalities and levels of maintenance than extensive green roofs (White & Gatersleben, 2011; Lee et al., 2014; fernandez-Canero, 2013; Jungels et al., 2013).

The preferences of price for green roofs are investigated multiple times. These studies were conducted in Portugal and China. The economic situation of these countries differ from the situation in The Netherlands. For this reason results of these studies may not be representative for The Netherlands. This is the reason why this research will add to scientific literature regarding the preference of price for green roofs in The Netherlands (Abrahamse, 2019; Teotonio et al., 2020; Zalejska- Jonsson, 2014; (Zalejska- Jonsson et al., 2020; Zhang, 2019).

This research also contributes to literature regarding effectiveness of governmental policies in The Netherlands for stimulating the implementation of green roofs. Existing literature states that the subsidy policy in Amsterdam is an 'initial step towards green roof development' and advises to look at more successful locations in other countries to compare policies. More research regarding governmental stimulation for green roofs is thus needed in The Netherlands in order to improve stimulation (Messina et al., 2015).

Moreover, the Theory of Planned Behaviour is used as a framework to determine choice behaviour. The application of this theory is combined with Defra's 4E model, that influences the Theory of Planned Behaviour by governmental stimulation. Defra sees the Theory of Planned Behaviour as a model to help understand the underlying factors which influence behaviour (Defra, n.d.). However, this study uses Defra's 4E model as a construct to influence the Theory of Planned Behaviour. It contributes to literature regarding using Defra's 4E model to influence choice behaviour under the construct of the Theory of Planned Behaviour.

Furthermore, Defra's 4E model is designed for the United Kingdom where it is used as a framework for stimulation of pro-environmental behaviour by governmental policies (Defra, 2008). It is also used multiple times outside the UK regarding analysing sustainable choice behaviour (Tom Jones et al., 2008; Van Poeck, 2010; Shahid, 2015; Valkering et al., 2014). This research applies Defra's 4E model as a framework to stimulate implementing green roofs, and thus pro-environmental choice behaviour, in The Netherlands. Moreover, it contributes to the practical use of Defra's 4E model.

Lastly, this research combines the type of green roof, price per m² and governmental policies. The research investigates a more realistic and complete consideration of homeowners, relative to other studies only measuring aesthetic preferences, the preference of price or types of governmental policies. It measures the relationship between the preference of price and the type of green roof, the type of green roof and governmental policies and the between the preference of price and the effectiveness of different types of governmental policies. This adds to literature of the stated willingness to implement a green roof.

Practically, conducting this research could lead to knowledge regarding the attractiveness of green roofs in terms of the type of green roof, the price per m² and effective means of governmental stimulation. Moreover, it could offer an insight in variations in choice behaviour between different demographic groups and experience groups. The knowledge that is gained, can be used as a mean to stimulate the implementation of green roofs and to use tailored means of governmental stimulation to increase pro-environmental behaviour. Also, the increased knowingness of homeowners about green roofs could have an encouraging effect on the implementation of green roofs. Furthermore, Real Estate developers could use it as inspiration to align their development projects with the wishes of the customer. Lastly, governmental organisations can use the gained information to adapt their tender procedure, concerning new development projects and renovations. Gaining this information possibly result into meaningful insights that can be used to increase the mitigation of climate change consequences and improve local microclimates of homeowners.

1.4 Goal of the research

The goal of this research is to discover preferences of homeowners in The Netherlands regarding the type of green roof, the preference of price per m² and the effectiveness of different governmental policies. In order to discover the willingness to implement a green roof. Another goal of the research is to be able to derive differences, if existent, in these preferences between demographic groups and between groups that experience their local microclimate differently. Lastly, the research is designed to provide answers regarding the homeowners' experience of the local microclimate and the ranking of importance of advantages of green roofs.

1.5 Research questions

In order to be able to investigate the willingness to implement a green roof based on preferences regarding the type of green roof, the preference of price and governmental policies, the following main research question is composed:

What is the willingness to implement a green roof for homeowners in The Netherlands, determined by the type of green roof and price per m² and how can these homeowners be stimulated by governmental policies?

The main research question is supported by the following sub-questions:

- What is the perception of homeowners regarding their local microclimate and what do people find important advantages of green roofs?
- How is the willingness to implement a green roof influenced by the type of green roof, price and policies?
- What is the relation between demographic- and experience groups (i.e. level of education, level of income, age, gender, perception of local microclimate) on the willingness to implement a green roof?
- Which types (and combinations) of governmental policies are most effective and what is their relation to the attitude, subjective norm and perceived behavioural control?

1.6 Overview

This quantitative research has an experimental research design. Furthermore, this research will be explorative with cross-sectional data. The research will first elaborate upon existing literature and create a literature review. Hereafter, the research design will be explained, which includes the conceptual model, an explanation of the stated choice experiment, an explanation of the design of the questionnaire will be given and data collection will be described. In the following chapter results of the questionnaire will be presented, followed by conclusion and discussion and lastly recommendations.

Chapter II – Literature review

This chapter will discuss literature regarding climate change, building constructs related to nature, the effect of vegetation on climate change, green roofs and benefits of green roofs, chances, drivers and bottlenecks of green roofs, the Theory of Planned Behaviour as a theoretical construct, and Defra's 4E model as a guide for governmental stimulation.

2.1 Climate change and the urban environment

Climate change is partly anthropogenic. Climate change has an impact on people, animals and ecosystems by destabilizing ecosystems creating problems such as displacement, disease and extinction (Steg & de Groot, 2018). Climate change has led to an increase in global temperature of 0.85 degrees Celsius in the period from 1880 until 2012. Furthermore, ongoing emissions, possibly cause that temperature levels rise towards 1.5 degrees Celsius compared to the period between 1850 and 1900 (UN, n.d.). Cities are currently the catalysator of climate change, being responsible for approximately 70% of the emission of greenhouse gas emissions. Cities currently house 50% of the world's population and this percentage will potentially grow to 70% in 2050. In The Netherlands 74% of the inhabitants already live in city environments in 2015 (PBL, 2015). Moreover, the cities will also face the biggest part of the consequences of climate change (UN, n.d.).

Besides the (local) climate, the urban ecology is affected. Urban ecosystems are key in adaptation and mitigation of problems generated by climate change. Urban ecosystems can decrease the urban heat island, improve air quality, decrease temperature and decrease the occurrence of floods. Currently climate change and urbanization are more likely to make these urban ecosystems more vulnerable by affecting biodiversity hotspots, urban species and critical ecosystem services (EPA, 2008). Rosenzweig et al. (2015, p.12), state that 'investing in urban ecosystems and green infrastructure can provide cost-effective, nature-based solutions for adapting to climate change while also creating opportunities to increase social equity, green economies and sustainable urban development'. Several benefits of improving urban ecosystems are: improving quality of life, human health and social well-being. Human health is affected by weather-related hazards such as: storms, floods, heat extremes and landslides. These climate change related hazards are likely to increase the morbidity and mortality rate in urban areas. Moreover, chronic health conditions, such as heat related diseases and infectious diseases will increase. Furthermore, 'the public's health in cities is highly sensitive to the ways in which climate extremes disrupt buildings, transportation, waste management, water supply and drainage systems, electricity and fuel supplies. If buildings tend to heat up quite fast due to solar radiation, human health can be affected by overheating. Droughts could lead to shortage in water supply' (Rosenzweig et al., 2015, p.14).

2.1.1 Air quality

The air people breathe consists of a variety of parts, of which some are hazardous and others unharmful. The quality of the air people breathe depends on the amount of hazardous parts the air contains which in turn depends on the level of industrialization and population density. This usually means that air quality in city environments is mostly lower than in more rural areas. The most important hazardous toxics in the air are: Particulate matter (PM10), Nitrogen oxides (NOx), Ozon (O3) and Volatile Organic Compounds (VOS). Improving air quality is key for human kind and ecosystems, because it can be harmful for human health. The best way to achieve improved air quality is to reduce the emission of hazardous toxics. However, emission of hazardous toxics will continue for quite some time, which means other solutions should be considered in order to filter hazardous toxins out of the air, such as the use of vegetation in urban areas (RIVM, 2011).

2.1.2 Temperature

Climate change creates more extremes in weather types, such as extreme heat. Urban areas are seen as vulnerable areas concerning the climate, as well as catalysts of this extreme heat. The city works as a catalyst for extreme heat in the form of the 'Urban Heat Island (UHI)': urbanization is associated with higher surface and air temperatures compared to surrounding areas, also called the urban heat island. Reason for this is the presence of heat absorbing materials, reduced amount of evaporation due to a lack of vegetation and the production of waste heat (Rosenzweig et al., 2014). Buildings have the biggest influence on the UHI (UN, 2018).

Local microclimate

The UHI is dependent on local microclimates. A Microclimate is a local atmospheric zone where the climate differs from the surrounding areas. Microclimates exist, for example, near bodies of water which may cool the local atmosphere, or in heavily urban areas where brick, concrete and asphalt absorb the sun's energy, heat up and reradiate that heat to the air: the resulting urban heat island is a kind of microclimate. A local climate is the climate of a small area such as a moorland or city - a mesoclimate- falling between a microclimate and a macro climate. A microclimate is the average temperature in a small area and a local climate is the average temperature in a large area (Evan, 2014). It is key for cities to adapt to future city climates, to be able to foresee urban microclimates and most importantly try to influence these future urban microclimates. All in order to keep the city liveable in the more extreme weather conditions faced due to climate change. Important is to design 'in accordance with the environment and the climate', also called 'Urban Climate-Sensitive Design'. Urban climate-sensitive design is a type of design in which the design takes into account the elements of the local microclimate, such as sun, wind, temperature and water. This design is created in order to benefit from the existing urban microclimate, as well as mitigating its already affected conditions (Marchettini et al., 2014, p. 623-625).

According to the United Nations (UN, 2018), it is still possible to mitigate climate change and with it the urban heat island (UHI). Mitigating is possible by technological measures, as well as changes in behaviour of human kind and let the mean temperature not above two degrees Celsius compared with pre-industrial level. The UN adds that major institutional and technological change is needed to stay under this threshold.

2.1.3 Water

According to the United Nations (n.d.), due to climate change more heavy rains and longer droughts will occur. Cities in coastal areas will face more risk of high waters and cyclones, cities near rivers face more risks concerning floods and cities overall will face high peak rain runoffs and heat stress related to the urban heat island with a lack of vegetation (UNU, 2015).

2.2 Nature inclusive building as solution

A sustainable solution should be found in order to counteract the rising problems, but what exactly can be understood by the word sustainability? According to Steg & De Groot (2018), Sustainability is seen as a relationship that exists between people and their environments that is in balance. Next to environmental sustainability also social- and economic sustainability are important. Environmental sustainability can be found in gas, electricity and water consumption, as well as CO2 emissions and land use. Economic sustainability is determined by factors like production values, inflation rates and purchasing power. Social sustainability is measured by determinants like average lifetime, unemployment rates, service accessibility, public health, individual income level and individual health status.

Improvement of infrastructure, actions focusing on the reduction of the emission of greenhouse gases in urban environments can lead to a decrease in health related costs and bring direct local benefits. These benefits are related to reduced air pollution in the local climate and also improved access to green space and the possibility of active transport (Rosenzweig et al., 2015). Reduction in greenhouse gases should be considered to mitigate climate change by reducing the emission of greenhouse gases (Steg & De Groot, (2019). This adaptation can be accelerated by decreasing the vulnerability as well as increasing the resilience.

In the construction industry, with the increase of ecological and sustainable motives, a new concept arose fulfilling this desire: nature inclusive building. Nature inclusive building contributes to the conservation of protected- and non-protected species. Furthermore, it adds to a pleasant environment, a possibility to experience nature in the city and because of that, it contributes to the well-being and health benefits of humankind. Moreover, nature inclusive building is seen as an attractive way to create a more climate adaptive built environment (Den Haag, 2019). Green in cities does not only change the direct environment, but also contributes to the indirect environment. For example, green on walls and roofs cleans the air in the city, supplies oxygen, buffers rain water and cools the built environment in times of warm periods. However, costs for installation and maintenance often are for the inhabitants, which has a negative effect on stimulation for measurements regarding nature inclusive building (Den Haag, 2019). According to bouwnatuurinclusief (2019) values of real estate are higher in green surroundings with an added value of 4 to 8%.

2.3 Green roofs

Not only vegetation on the streets, but also green roofs can contribute to the improvement of the air quality in cities (RIVM, 2011). Moreover, vegetation is able to reduce the urban heat island effect and to mitigate water peak run-off. One option to create vegetation in urban areas, is to implement green roofs. The implementation of green roofs is a possible practical solution, which comprehends with the trend of nature inclusive building (Bouwnatuurinclusief, 2019). Different forms of green roofs exist, each having different benefits, specifications. Moreover, different chances, drivers and bottlenecks exist regarding green roofs.

2.3.1 Extensive and intensive green roofs

Green roofs are vegetative layers on roofs. A distinction can be made between extensive green roofs and intensive green roofs, which both have different specifications. Extensive green roofs have a tendency to be simpler, including lower ground covering plants with a growing medium of in between five (5) and ten (10) centimetres (EPA, 2008). Moreover, extensive green roofs need less structural support, because of the relatively light weight (EPA, 2008). The weight is according to Optigrün (n.d.), 120 kg/m² or more depending on the type of layers. Lastly, extensive green roofs need less maintenance. For extensive sedum roofs, maintenance consists of a roof inspection twice a year, where weeds should be removed and the sewer should be controlled for blockages. Moreover, the roof should be fertilized twice a year in very dry circumstances and should be watered. Watering is normally not necessary for this type of green roof (Sempergreen, n.d.). Additionally, intensive green roofs exist that are often more complex like a totally accessible rooftop park. These intensive green roofs are heavier and thus require more structural support. An intensive green roof could weigh up to 700 kg/m², which makes it more important to have a good working irrigation and drainage system, to avoid overpressure on the construction (Zandcompleet, n.d.). Furthermore, intensive green roofs require a higher initial investment as well as more intensive maintenance. In case of an intensive green roof, more maintenance is necessary. Plants need to be watered, fertilized and pruned, just like a normal garden (zandcompleet, n.d.).

The initial investment costs of green roofs are typically also higher than the use of more traditional roofs (EPA, 2008). The lifespan of green roofs, before important repairs or replacements are needed, is estimated at 90 years. This lifespan is based on green roofs that already exist for more than 90 years in Berlin, Germany (Porsche & Köhler, 2013).

2.3.2 Benefits

Green roofs have several (environmental) benefits, which are explained below.

Improved air quality
Green roofs are capable of counteracting air pollution, which occurs both directly as indirectly. Directly it could lead to reduction of air pollutants in the air (Berardi et al., 2014). Indirectly, green roofs create a reduction of energy use for providing cooling and heating. Due to this, green roofs reduce air pollution and greenhouse gas emissions related to energy production (EPA, 2008).

Outside and inside temperature effect
Two systems that create the cooling effect of vegetation in urban climates can be distinguished: shading and evapotranspiration. Shading is created by overhanging leaves and branches, which reduce the amount of solar radiation that reaches the area below it. The amount of solar radiation coming through varies based on the type of plant, but generally fluctuates between the 10 and 30% in summertime. In winter it fluctuates between the 10 and 80%. The wider range is caused by the existence of evergreen vegetation, which also keeps its leaves in winter. The cooling effect in degrees Celsius could vary between the 11 and 25 degrees reduction. Evapotranspiration consists of two mechanisms: evaporation and transpiration. Transpiration is the mechanism in which vegetation absorbs water from the ground and then emits it through their leaves. The second mechanism is evaporation, which is the process of converting water from a liquid to gas. This mechanism happens in the soil, as well as on the leaves of the vegetation. The two processes together represent evapotranspiration, which could lead to a reduction in temperature. That’s why, a grass field can be 1 to 2 degrees Celsius cooler than a pavement in the same conditions (EPA, 2008).

On a micro-level, green roofs are able to decrease the surface temperature by 7,3 degrees Celsius and the air temperature by 0.5 degrees Celsius. In case of a large-scale application it could lead to a reduction of outside air temperature by 0.3 to 3 degrees Celsius (EPA, 2008). Green roofs not only have a cooling effect on the outdoor temperature, Additionally, the indoor air temperature can be decreased by a green roof. Green roofs reduce indoor mean temperature of residential buildings with up to 2 degrees Celsius (Ahmadi et al., 2015).

Water retention

The lack of vegetation increases the probability of high peak run-offs due to a lack of infiltration possibilities for water caused by the amount of paving (Sanders, 1986). Vegetation could increase infiltration possibilities and thereby hold water and decrease droughts. The capacity of vegetation to hold water also reduces high peak run-offs (EPA, 2008). Green roofs are also able to retain water and thereby prevent high peaks in water runoff. Similar to other greenspace and natural surfaces, green roofs absorb water and prevent direct runoff. This decrease in runoff could lead to less floods and less overflow of the sewer (EPA, 2008). Vijayaraghavan (2016), conducted a study on the University of Manchester campus. The results of the study show that a green roof retains an average runoff of 65,7%, whereas the neighbouring paved roof retained 33,6% of the runoff water.

Lower energy use

Green roofs could reduce power consumption from air conditioning, while remaining the same indoor air temperature (Yang et al., 2015). Ahmadi et al. (2015) state that in winter times, green roofs are able to reduce heat loss, which leads to less use of energy for heating. Cooling energy demand can be reduced by green roofs. However, energy savings concerning green roofs are dependent on the local climate, building characteristics and roof characteristics (Yang et al. 2015).

Increasing productivity solar panels

Furthermore, green roofs increase the productivity of solar panels on roofs (Rooftop revolution, n.d.). The combination of green roofs and solar panels is also called a Biosolar Roof Project. The reason for the increase in productivity of solar panels, is the decrease in temperature in the microclimate around the solar panels. Solar panels tend to lose efficiency when it is too hot and work most efficiently around the 25 degrees Celsius (Livingroofs, 2017).

Protective effect on the roof construction

Moreover, green roofs protect the building structure. Buildings are exposed to the different types of weather, which could lead to a (partial) destruction of materials. The contraction and expansion shift of materials that leads to these (partial) destructions are caused by frost and thaw, as well as UV exposure (Sheweka & Mohamed, 2012).

Biodiversity

At last, if the urban environment can be modified in a more green space with natural gardening, green roofs, parcs fit for its surroundings and a better ecological connection between the rural- and urban areas, biodiversity could thrive in urban areas (Farjon et al., 2018).

2.3.3 Chances, drivers and bottlenecks

Chances for green roofs

The situation in The Netherlands concerning the implementation of green roofs consists of individual- and neighbourhood initiatives. Larger programs are started in order to improve the total amount of green roofs. For example, in Rotterdam a program for green roofs was started in 2005, in 2015 this project contributed to 200.000m² green roof (Rooftop revolution, n.d.). Rotterdam itself currently has 360.000m² meters of green roofs (Rotterdamenergiebesparing, 2019). The amount of green roofs in Rotterdam is thus increasing. However, Rotterdam has around 14.5 million m² of flat roofs, of which 1 million in the inner city (Remmers, 2017). This shows that despite the big amount of absolute square meters in increase in green roofs, there is still a lot of space for improvement. More opportunities are possible, as shown by Rooftoprevolution (2020), who made a rooftop map of opportunities for the city of Nijmegen. In the city of Nijmegen one third of the roofs can be used for the implementation of green roofs. The implementation of green roofs on all these flat roofs, would create an increase of 300.000m² meters of green roof.

Conventional roofs

Porsche & Köhler (2013), who conducted a research about the differences in lifecycle costs between conventional roofs and green roofs determined Bitumen roofs and gravel roofs as potential substitutes for roofs suitable for the concept of green roofs. Other roof types are EPDM roof and PVC. However both can also be used as a bottom layer for a green roof (mijn-dakdekker, n.d.).

Costs and maintenance of green roofs and conventional roofs

The costs for the installation of a green roof are estimated between 66 and 110 euros per m², which depends on the type of roof and fluctuating installation costs. The costs of a green roof calculated over a lifespan of 60 years lay 10-14% higher than a conventional roof, estimated by calculating the Net Present Value (Castleton et al. 2010). Porsche & Köhler (2013) estimated life cycle costs of several types of roofs in Germany. A distinction was made between bitumen roofs, gravel roofs, extensive green roofs with PVC-products, extensive green roofs without PVC-products, Intensive green roofs with PVC-products, Intensive green roofs without PVC-products. The PVC layer creates a waterproofing layer, but it also causes problems in production and recycling. From their research about lifecycle costs of the different types of roofs, the following table with lifecycle costs was derived and translated from dollars per m² to euros per m².

Table 1 - Lifecycle costs of different types of roofs (Porsche & Köhler, 2013)

Type of roof	Construction costs in €/m²	Repairs intervals in years	Renovation after...years	Renovation costs (€) during lifespan per m² (90 years)	Sum (€/m²)
Bitumen roof	35	Every 10 years	After 15 years	215	250
Gravel roof	45	Every 15 years	After 15-20 years	180	225
Extensive green roof without PVC	80	-	Temporally only occasional renovation work	35	115
Extensive green roof with PVC	75	-	Temporally only occasional renovation work	35	110
Intensive green roof without PVC	340	-	Temporally only occasional renovation work	Max. 340 (same as construction costs)	680
Intensive green roof with PVC	300	-	Temporally only occasional renovation work	Max. 300 (same as construction costs)	600

More recently Wageningen University bundled a reader with several organisations, in which costs regarding extensive green roofs is estimated on €59/m² green roof and when in need of extra structural reinforcement €35/m² should be added. Costs for intensive green roofs are estimated at €98/m² and €65/m² for structural reinforcement (Star, 2009). Important to note from the figure 'lifecycle costs of different types of roofs', is that the initial construction costs of green roofs are higher than costs for conventional roofs. However, looking at the last column including the sum of costs, extensive green roofs are less costly than a conventional roof. Intensive green roofs are more expansive still, but also have an added value relative to extensive green roofs and conventional roofs, since the roof space can be utilised.

EPDM costs between €60 and €80 per m² with a lifespan of 30-50 years, whereas PVC costs €50 to €70 per m² with a lifespan of 15-40 years (mijn-dakdekker, n.d.).

Preferences, drivers and bottlenecks of homeowners

homeowners are vital in the decision making process that could lead to an implementation of green roofs. It is important to look at the implementation of green roofs from the perspective of homeowners. Drivers as well as bottlenecks are identified on fora, one to one conversations and scientific literature. White & Gatersleben (2011) examined preferences of homeowners in the United Kingdom considering a green roof focusing on the type of vegetation. Homeowners tend to find turf, sedum and brown roofs not to be differentiated from a normal roof, concerning aesthetics and restoration. Other 'right' types of vegetation tend not only to have environmental benefits, but also psychological benefits due to the aesthetic and restorative value it creates. Lee et al. (2014), conducted a research about living roof preference amongst 274 Australian office workers. Lee et al. (2014, p.152), state that 'living roofs with tall, green, grassy vegetation were highly preferred, flowers increased living roof preference, plant diversity increased preference overall, but decreased preference for most preferred vegetation, psychological restoration was associated with the most preferred living roof'. Drivers for homeowners to implement a green roof are: the aesthetic look, the increase in biodiversity, the increase in water retention, the indoor insulation it offers to the dwelling, the durability of the roof compared to more conventional roofs, the lowering outdoor air temperature (Ecologieforum, 2015). Jungels et al. (2013, p.13), who conducted research on 'attitudes and aesthetic reactions toward green roofs in the Northeastern United States', contribute to this by stating that 'overall attitudes and aesthetic reactions to green roofs are positive'. Whereas negative reactions are mostly related to messiness. Moreover, stoloniferous grass is less appreciated than sedum or mixed perennial vegetation. Fernandez-Canero et al. (2013), discovered in their study about public attitudes and preferences in Southern Spain, that the most important benefit for the respondents was the reduction in air pollution. According to Zalejska-Jonsson (2014, p.55), 'customers are willing to pay a premium for features they understand and can see the potential of, in terms of energy consumption, for example'. This is contributed by Abrahamse (2019, p.65), who states that people are not only focussed on self-interest. 'Money is an important driver in energy conservation, but not for everybody and not for every behaviour'. However, customers scepticism could cause the preference of price to shrink and the perception of investment risk to rise. Therefore, important in the process are environmental education, information quality and practical denotation of building environmental assessment for customers (Zalejska-Jonsson, 2014).

In general an important bottleneck regarding pro-environmental behaviour is a lack of awareness regarding environmental problems (Musad et al., 2016). Other bottlenecks, regarding green roofs, for homeowners are the price, the unorthodox look, the durability of the roof construction, lack of knowledge of experts, the isolation of the indoor temperature works better from the heath from outside than keeping the warmth inside. However, in The Netherlands most of the time it is more needed to keep the warmth inside (Ecologieforum, 2015). Fernandez-Canero et al. (2013), identified possible allergy problems as the potentially biggest bottleneck regarding green roofs. White & Gatersleben (2011), identified in their study that concerns rise about the maintenance and installation of green roofs and influence the willingness to implement a green roof in their dwelling. Suggestions to overcome these complications are: create a list of suppliers, installers and maintainers. Moreover, the effect of education, about green roofs, on preference ratings should be examined. Zalejska-Jonsson (2014) adds to this, that homeowners preference of price for buildings with an environmental certificate lowers, because the homeowners do not believe this environmental certification translates into higher value. Possible solutions could be to take building environmental performance into consideration in the valuation process. Moreover, a lack of information and the different meanings of rating systems could cause confusion about the benefits that comprehend with the rating systems, which could influence the preference of price negatively (Judge et al., 2019).

2.4 Theory of Planned Behaviour

In order to predict choice behaviour of homeowners on green roofs, a theoretical construct is necessary. The theoretical construct offers guidance to define and understand a certain choice behaviour. This research makes use of the Theory of Planned Behaviour to understand human choice behaviour.

Human caused-, or anthropogenic-, climate change, causes the psychologist discipline to think about environmental problems. When are people willing to implement? The psychology regarding choice behaviour can be explained by the following theoretical framework: Theory of Planned Behaviour. This theory predicts behaviour by the hand of three pillars: (1) the attitude towards the act of behaviour, (2) subjective norm and (3) the perceived behavioural control (Judge et al., 2019). Attitude, subjective norms and perceived behavioural control all have a positive effect on adaptation to climate change and pro-environmental behaviour (Musad, 2016).

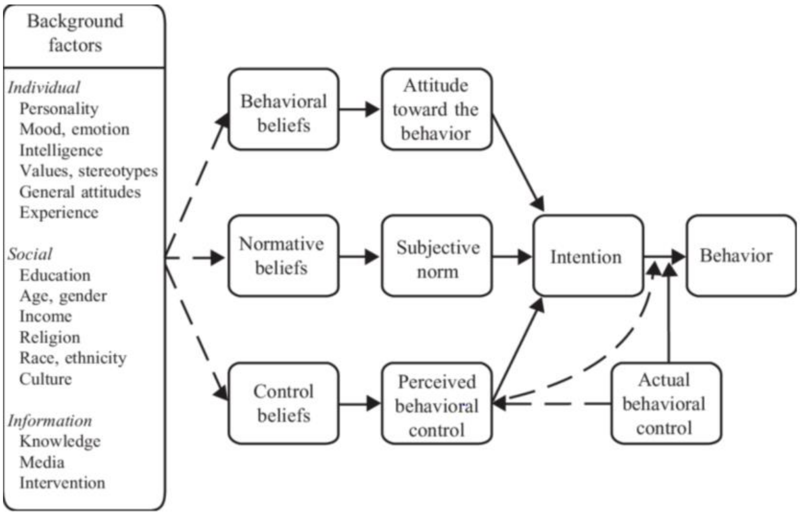


Figure 1 - Theory of Planned Behaviour (Ajzen & Fishbein, 2005)

Figure 1 shows a more complex schematic representation of the Theory of Planned Behaviour. The figure shows that the 'background factors' influence the behavioural- normal- and control beliefs, which in their turn lead to the three pillars of the Theory of Planned Behaviour: (1) attitude towards behaviour, (2) subjective norm and (3) perceived behavioural control. The three pillars lead on their behalf to an intention, which could generate a certain behaviour (Ajzen & fishbein, 2005). A person is most likely to do an act or behaviour if there is a positive attitude towards the act/behaviour, there are positive subjective norms and there is a high level of perceived behavioural control (Dreiling, 2015).

Paul et al. (2016), add another determinant to the Theory of Planned Behaviour concerning green product consumption: the environmental concern. The environmental concern is defined by Hu et al. (2010, p. 348) as: "the degree to which people are aware of problems regarding the environment and support efforts to solve them and or indicate the willingness to contribute personally to their solutions”. Several studies showed that people are willing to pay a small premium for green products. Furthermore, the study showed that the environmental concern is significant and positive for attitude, subjective norm, perceived behavioural control and the intention to purchase green products. This is contributed by Biel & Thogersen (2007), who state that social norms lead normally to cooperation and support in social dilemmas. Moreover, in large-scale dilemmas, like environmental problems, it will also sometimes lead to cooperation and support. In the next sub chapters, the attitude, subjective norm and perceived behavioural control are elaborated on.

2.4.1 Attitude

The attitude is part of the Theory of Planned Behaviour. It is seen as the evaluation of the individual concerning the behaviour, which is determined by underlying beliefs. Thereby ‘attitude is a function of a person’s salient behavioural beliefs’ (Smelser & Baltes, 2001, p.8511). Behavioural beliefs are ‘a person’s estimation of the likelihood (subjective probability) that performing a particular behaviour will lead to a certain outcome’ (Ajzen, 2011, p.221). The attitude of people is also defined as their feelings, values or beliefs (Howe, 2019). The more in favour a certain behaviour is evaluated upon, the stronger the intention to conduct the certain behaviour will be. Whether a behaviour is evaluated as favourable or unfavourable, depends on the belief of this particular person about the effects of a certain behaviour (Van Logchem, 2018). Attitudes towards conservation are depending on the costs. Reduction of costs, could cause reconsideration of negative attitudes regarding conservation. Moreover, attitudes can be influenced by formal- and non-formal education. The formal education level also positively influences the attitudes (Howe, 2009). However, human caused climate change is a global phenomenon, with different local outcomes. Since local impacts differ per location, the vulnerability of different individuals does too. There is a difference in how people understand climate change and whether climate change is assessed as a risk. In other words, what their attitude is towards climate change (Steg & De Groot, 2018). For example, developing countries are more vulnerable to climate change than developed countries. However, developed countries had a higher awareness level regarding environmental problems than developing countries (Musad et al., 2016). Furthermore, it is assessed if the public should mitigate or adapt to the problem. An important factor in the motivation to mitigate climate change is, the psychological distance to the impacts of climate change, which affects the perceived ‘threat and worry’ (Steg & De Groot, 2018). This is contributed by Biswas (2016), who states that the perceptual factor determines the preference of price for green products and by this the mitigation and adaptation towards climate change. The perceptual factor encompasses the degree of environmental responsibility of individuals, which is measured by “the probable causal effects of environmental deterioration measured upon individuals perceptions, beliefs and behavioural commitment”. Yau (2012), adds that the environmental attitude is important in consumers’ preference of price for green products, where the environmental attitude is a mental valuation of protection for the environment. The biggest predictor for the intention to buy green products, is attitude, followed by perceived behavioural control (Paul et al., 2016).

Blankenberg & Alhusen (2019), state that demographic factors can be of influence on pro environmental behaviour. Age, for example, has a negative relation with pro-environmental behaviour. However, the lowest point of pro-environmental behaviour is in the life cycle phase where people are starting a family. Starting a family brings constraints like money and time.

People below 30 years of age and people between 60 and 69 act more pro-environmental. Education increases pro environmental behaviour, since ‘educated people are also more aware and more concerned with social welfare’ (Blankenberg & Alhusen, 2019, p.6). Pro-environmental behaviour is more influenced by education than income, since education creates a higher awareness regarding environmental issues, which is correlated with pro-environmental behaviour. Income itself has no effect on pro environmental behaviour. However, higher GHG emissions due to a higher energy requirement are related to higher incomes. Higher incomes are also more likely to participate in for example green electricity programs and the preference of price for green products like green electricity also increases. Concerning gender, women have a significantly higher pro-environmental behaviour than men.

Although people might have a positive attitude towards the necessity to mitigate or adapt to climate change, an optimism bias could affect the vigor of people. An optimism bias can cause people to believe that negative impacts of climate change are more likely to occur somewhere else and by this decrease the feeling of being at risk. Furthermore, people could have an aversion from the solution, because there is a dislike about the solution despite assessment of the risk (Steg & De Groot, 2018).

2.4.2 Subjective norm

The subjective norm is part of the Theory of Planned Behaviour. It embodies the general tendency to which the decision maker thinks most related or important people will agree or disagree with the plan (LaMorte, 2019). The subjective norm is determined by normative beliefs, which is the estimation about the judgement of a reference group, such as friends, family co-workers, of a person (Ajzen, 2011). This is contributed by Ham et al. (2015, p.740), who add to this, that ‘subjective norms are determined by the perceived social pressure from others for an individual to behave in a certain manner and their motivation to comply with those people’s views’. Social norms are a guidance in social dilemmas, in which social norms mostly arise when actions of a certain actor create a negative effect for others (Biel & Thogersen, 2007). A social norm is the expectancy of how the person itself is supposed to act in a certain situation. These social norms could cause a certain behaviour, since people tend to do what others do or see as a good way to handle (Steg & De Groot, 2018). The stronger the subjective norm is, the stronger the intention of behaviour will be (Van Logchem, 2018). These social norms and own beliefs are a limiting factor concerning behaviour focussed on self-interest. A relevant example of these are the pro-environmental activities (Steg & De Groot, 2018).

This is contributed by Van Lange et al. (2018, p.269), who state that climate change infuses several social dilemmas: ‘social conflicts between self-interests and collective interests and temporal conflicts between short-term interests and future interests’. These social dilemmas are difficult since generally the human mind is focussed on short-term and self-interest (Van Lange et al., 2018). Steg & De Groot (2018), add to this that self-interest occurs when the payoff for acting in self-interest is higher than the payoff for acting in collective interest. This type is also called defection. However, there is also a situation where the payoff to act collectively has a higher payoff than acting in self-interest, which is called cooperation. Further explained. This occurs when everybody acts selfishly that causes negative outcomes to accumulate. The accumulation of negative outcomes causes that all individuals were better off by not choosing selfishly. There are several types of social dilemmas: Large-scale dilemmas, resource dilemmas and public good dilemmas. However, motives on social dilemmas are not only infused by maximizing their own interest. The greed of people is held back by the wish to use the resource efficiently and they have a fair allocation of the resource (Steg & De Groot, 2018). Other social dilemmas can be found nationwide, on the continent or the globe. These social domains are heterogeneous, with people in need for policies regarding climate change and people less in need for policies. There is an uncertainty in the amount of environmental impacts and the importance of climate change (Van Lange et al., 2018).

Enabling cooperation in social dilemmas

There is a complex system regarding the activation of subjective norms, in other words cooperation in social dilemmas, which is displayed in a schematic manner below.

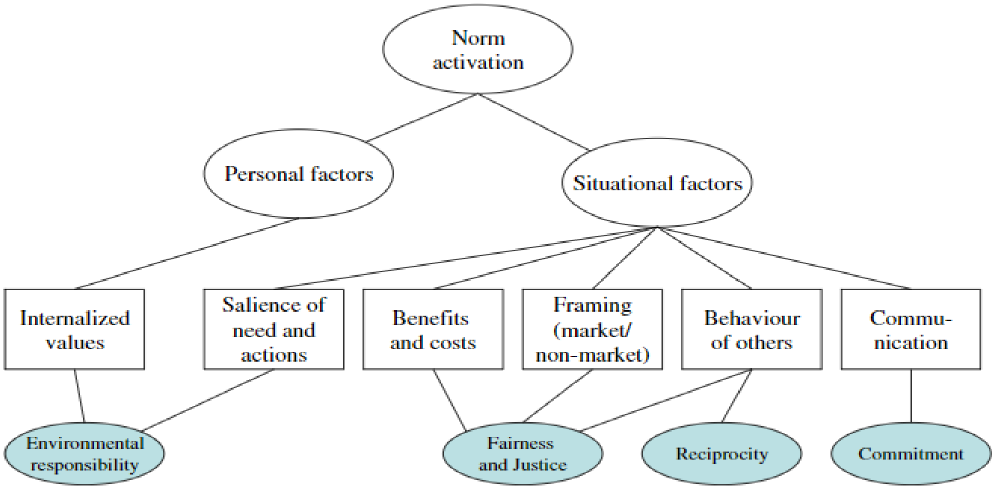


Figure 2, Influential factors for norm activation in social dilemmas (Biel & Thogersen, 2006)

As can be seen in figure 2, Norm activation is determined by personal- and situational factors. The motivation of personal factors are seen as a felt obligation, whereas situational factors are related to cooperation. Personal factors are determined by 'internalized values', which are values of the individual itself. Situational factors are determined by 'salience of need and actions, benefits and costs, framing (market and non-market), behaviour of others and communication' (Biel & Thogersen, 2006). This is contributed by Steg & De Groot (2018), who state that better decisions are made, when there was communication beforehand. Moreover, cooperation increases with 45% when there has been face-to-face communication. Communication is most importantly when used in small collectives. Musad (2016), add that it is key to have effective communication with residents of communities in order to be able to mitigate and adapt to changing conditions. Moreover, it is important that people feel that their actions regarding cooperation are vital to maintain or create a common resource, also known as response-efficacy. Steg & De Groot (2018), also add some other influential factors concerning cooperation:

- Group size: the degree of cooperation increases when group size decreases.
- Environmental uncertainty: the degree of cooperation depends on the knowledge of the group members regarding the size of the common resource. A lack of knowledge will increase the environmental uncertainty, which possibly creates a higher request of the common resource.

- Social uncertainty: the uncertainty about the choices in social dilemmas of others in the group. A lack of knowledge of how others would act, creates a less cooperative environment.

2.4.3 Perceived behavioural control

Perceived behavioural control is part of the Theory of Planned Behaviour. Perceived behavioural control is defined as how difficult people experience to conduct a certain behaviour (Barlett, 2019). The perception of difficulty is dependent on ‘all the situational factors and facilities that enable consumers to behave pro-environmentally, from the existence of resources (time, money, and knowledge), opportunities or facilitating conditions to perform the behaviour.’ (Octav-Ionut, 2015, p.270). Perceived behavioural control consists of two components: self-efficacy, someone’s belief in its own ability and controllability, the strong will to believe in a behaviour (Kraft et al., 2005). But, also cooperation by other people. A positive collective efficacy leads to a higher self-efficacy, which then leads to a higher personal intention to act (Jugert et al., 2016). According to Paul et al. (2016), perceived behavioural control is influenced by the perceived difficulty. When there is a high perceived difficulty about the behaviour, the less the behaviour will be shown. When there is a higher perceived behavioural control, the intention to have a certain behaviour will be bigger (Van Logchem, 2018). Means to reduce the perceived difficulty, are clear communication about the availability of green products, mode of acquisitions, enhancing the variety of green products. The underlying goal is to create a bigger belief amongst possible consumers, that there is a big variety of products and it is convenient for consumers to buy. Moreover, the perceived behavioural control can be strengthened by creating informative commercials, that show the performance of green products, to increase the initial trial behaviour (Paul et al., 2016).

2.5 Stimulating behaviour through governmental policies

The transition towards a more sustainable society is a public matter, in which not only institutional experts, but the whole society, plays a role (Van Poeck, 2010). The Theory of Planned Behaviour explains behaviour as a result of the attitude, subjective norm and perceived behavioural control. ‘Such models help understand specific behaviours, by identifying the underlying factors which influence them’. The 4E model then provides a tool to ‘ensure a mix of interventions’ in order to promote a sustainable way of living (Defra, n.d., p.29). Defra’s 4E model is a model of the UK Department for Environment, Food and Rural Affairs (Defra) and is widely used as a theoretical construct for the transition to support pro-environmental behaviour and create a more sustainable way of living (Tom Jones et al., 2008; Van Poeck, 2010; Shahid, 2015; Valkering et al., 2014). Defra invested ‘substantially in a significant social research programme to build a robust evidence base on understanding and influencing sustainable behaviour. This has involved working collaboratively across government and with other organisations such as academia and civil society' (Eppel et al., 2013, p.40-41).

Eppel et al. (2013), state that change occurs with Defra’s triangle of change in which governmental policies, business and civil society play a role in accomplishing change. Public matters, such as climate change, do not purely consist of facts or indications that lead to an appropriate response. The adequate response is not about individual change, but about a change in society where the ecological destruction is internalised. Education in this field asks for a political completion (Van Poeck, 2010). Whether people are conducting a behavioural change depends on the willingness and the ability of these people to conduct this change in behaviour (DEFRA, 2008). Governmental policies are means to create a behavioural change towards pro-environmental behaviour. Defra translates governmental policies into four categories in the 4E's model. To accomplish behavioural change, according to the Defra's 4E's model, means are:

1. *Engaging*

Engagement creates the importance to set people into motion in the transition process by setting the whole community in motion. An important role in this engagement is education and sensitization. Examples are: Community action, co-production, forums, personal contacts, media campaigns, usage of networks, education, sensitization (Defra, 2008). The subjective norm is the normative belief about what referent groups think of a behaviour, which consists of other's opinions whether another person should conduct a behaviour (Ajzen, 2011). Social uncertainty and environmental uncertainty are of big influence on the subjective norm of people (Steg & De Groot, 2018).This is supported by Eppel et al. (2013), who state that it is important to create a social norm and marks the importance that people's actions are positively justified. Engaging policies is a type of strategy to change the subjective norm. Since engaging governmental policies, are focussed on actions related to co-production, community action, personal contacts and networks. These are means to decrease the social uncertainty and stimulate cooperation (Steg & De Groot, 2018). Moreover, do engaging policies result in cooperation by other people, which could increase the perceived behavioural control (Ajzen, 2011).

2. *Encouraging*

Encouraging implies that pro-environmental behaviour and choices are stimulated by governmental policies. Examples can be price indices, such as subsidies, certification or favourable loans. The other way around non-sustainable choices can be discouraged by means like taxes, permits, acknowledgements and deniance. External costs should thereby be internalised (Defra, 2008). Encouraging policies, such as subsidies and favourable loans could lead to the necessary means (money) to conduct a certain behaviour and thereby increase the perceived behavioural control (Ajzen, 2011). Moreover, the subsidies and certification could lead to a different perspective regarding the salient behavioural belief, since it could reduce the costs by installation or by creating a higher valuation on real estate. Reduction of costs, could cause reconsideration of negative attitudes (Howe, 2009).

3. *Enabling*

Enabling stands for the ability of people to make sustainable choices. Sustainable choices should thereby be available, straightforward and naturally, whereas non-sustainable choices should be averted. Examples are: to remove barriers, provide information, provide facilities, provide alternatives, provide education and skills, provide capacity (Defra, 2008). Enabling is a type of governmental policy strategy, which could create change in the salient behavioural beliefs by formal- and non-formal education, and thereby change the attitude towards a behaviour (Howe, 2009). Moreover, enabling policies affect control beliefs and the perceived behavioural control by offering information and education that offer the required skills and abilities (Ajzen, 2011).

4. *Exemplifying*

Exemplifying focuses on the capability of the government to lead by example. The government can make a big difference as a big consumer, to stimulate sustainable initiatives. Moreover, the government has an important signal function for civilians (Van Poeck, 2010). Examples are: leading by example and consistency in policies (Defra, 2008). Exemplification shows that an action is possible, which influences the collective efficacy of perceived behavioural control, which could influence the individual efficacy and increase the willingness to act (Jugert et al., 2016). Eppel et al. (2013), state that positive justification can be enforced by exemplification when the government acts in a sustainable way too and thereby change the normative beliefs and the subjective norm (Ajzen, 2011).

Table 2 shows the relation between the attitude, subjective norm and perceived behavioural control and engage, enable, encourage and exemplify schematically.

Table 2 – schematic display of Defra's 4E model and the Theory of Planned Behaviour

		Theory of Planned Behaviour		
Rank	*Type of policy*	*Attitude*	*Subjective norm*	*Perceived Behavioural control*
1	*Engaging*		*X*	*X*
2	*Enabling*	X		*X*
3	*Encouraging*	*X*		*X*
4	*Exemplifying*		*X*	*X*

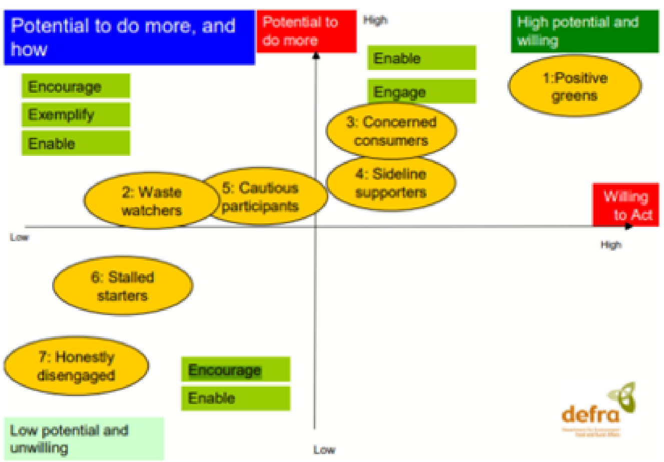


Figure 3 – Defra's 4E model and the willingness to act

The department of food and rural affairs (Defra, 2008), created a segmented strategy regarding changing towards pro-environmental behaviour. According to Defra (2008) the 4E's: encourage, exemplify, enable and engage should be used in different occasions and different types of people. This is shown in the diagram, where the potential to do more and the willingness to act is forged together in a diagram. As can be seen, 'encourage, exemplify and enable' can be used in situations with a high potential and a low willingness to act. People that are less willing to act, are more likely to be motivated by means like encouragement, exemplifying and enabling, since these groups still need to be convinced and motivated to strive towards more pro-environmental behaviour. The other way around, 'enable and engage', can be used in situations with a high potential to do more and a high willingness to act. Reason for this is that people that are already willing to act, need less support for motivation, but more support regarding the ability to conduct pro-environmental behaviour. In case of a low potential and a low willingness to act, 'encourage and enable' can be used as means to create behavioural change.

2.6 Conclusion

This chapter discusses literature regarding climate change and green roofs as practical solution to counteract consequences of climate change. Moreover, it discusses the theoretical construct for choice behaviour: Theory of Planned Behaviour and Defra's 4E model as means of governmental stimulation.

Climate change is a major problem in the contemporary world, with consequences as decreasing air quality, increasing temperature and increasing chances of floods. Vegetation has the capability to decrease air temperatures, purify the air and retain water from the hydro cycle and spread water runoff. Urban areas will likely suffer the most from climate change, but high land prices make it harder to implement green space at the ground level. However, opportunities lay on roof spaces with thousands of square meters per city centre unused. Vegetative layers on unused roofs, green roofs, can help counteract climate change by creating green space in the city in a relatively easy and cheap manner. Generally, two different types of green roofs are distinguished: extensive green roofs and intensive green roofs. Extensive green roofs cannot be utilized by humans, whereas intensive green roofs can. The major problem with implementation is that most roofs are in property of homeowners. In order to be able to create green roofs, homeowners have to be willing to implement a green roof on the roof of their dwelling. A willingness, or intention, to act by a certain behaviour, is determined by the attitude, subjective norm and perceived behavioural control. The attitude, subjective norm and perceived behavioural control can be determined by a certain price situation, but also functionality, aesthetics and/or maintenance level. Governmental policies could lead to a change in the attitude, subjective norm or perceived behavioural control and contribute in this way by convincing homeowners to be willing to implement a green roof. Governmental policies are divided into four different types: engage, enable, encourage and exemplify. Each governmental policy changes the attitude, subjective norm and/or perceived behavioural control in a different way. This research is conducted to find answers on what drives the willingness of homeowners in terms of type of roof, price per m² and governmental policies. The next chapter will discuss how this research will be conducted.

Chapter III - Research methodology

This research focuses on filling the gap regarding preferences of the type of green roof, preference of price and governmental policies in The Netherlands. It uses the Defra's 4E model as a construct for governmental stimulation regarding pro-environmental behaviour in accordance with the Theory of Planned Behaviour. This chapter discusses the conceptual model, followed be the theoretical background of the methodology. From the theoretical methodology, a design of the stated choice experiment is created. Furthermore, data preparation and data collection is elaborated upon.

3.1 Conceptual model

From the research question, the following conceptual model is derived:

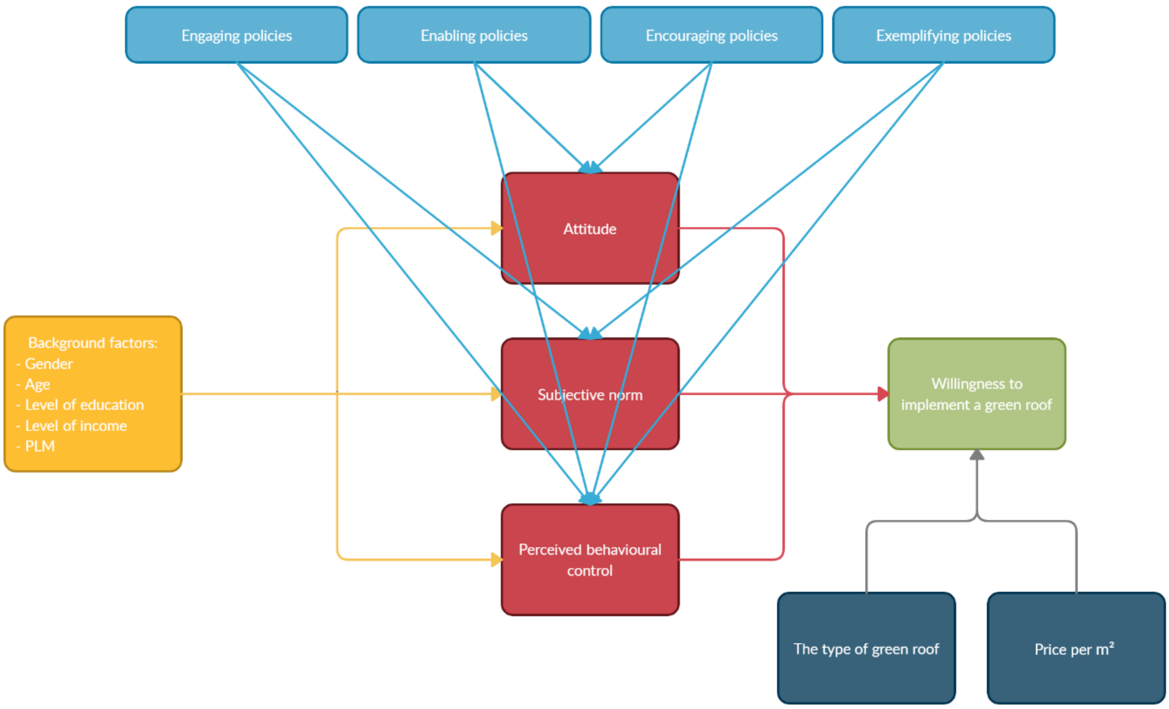


Figure 4 - conceptual model

The willingness to implement a green roof is determined by the type of green roof and the price per m² (dark blue). The type of green roof can be distinguished in an extensive green roof and intensive green roof. These types differ in aesthetics, functionality and maintenance. The price is evident in stimulating pro-environmental behaviour. Via the price per m², the preference of price for green roofs can be measured.

The independent variable in this research is 'background factors' (yellow). Background factors consist of demographic factors gender, age, level of education, the level of income and experience level, the perception of the local microclimate (PLM). Background factors could influence the dependent variables 'attitude', 'subjective norm' and 'perceived behavioural control' (red). From the attitude, subjective norm and perceived behavioural control flows the intention (green). The intention can be a willingness to implement a green roof or not to implement a green roof. Where a person is most likely to do an act or behaviour if there is a positive attitude towards the act/behaviour, there are positive subjective norms and there is a high level of perceived behavioural control (Dreiling, 2015).

However, the government has means to stimulate their inhabitants in pro-environmental behaviour. Governmental means to change people's behaviour more environmentally just are: engaging, enabling, encouraging and exemplifying. These different policies (light blue), have a different effect on the attitude, subjective norm and perceived behavioural control, from which the intention flows. The attitude, subjective norm and perceived behavioural control are constructs of the Theory of Planned Behaviour and are used in the same manner. As explained in the literature (chapter 2.5), engaging policies can influence the subjective norm and perceived behavioural control, and are most effective on people with a high willingness to act. Enabling policies can in their turn influence the attitude and perceived behavioural control and are effective on people with a low- and high willingness to act. Encouraging policies can have influence on the attitude and perceived behavioural control. Lastly, exemplifying policies can influence the subjective norm and perceived behavioural control. Both encouraging- and exemplifying policies are most effective on people with a low willingness to act. By influencing the attitude, subjective norm and/or perceived behavioural control, governmental policies can lead to a change in attitude, subjective norm and/or perceived behavioural control and by that a change in intention and thus a different willingness to implement a green roof.

3.2 Research design

3.2.1 Theoretical construct of the questionnaire

Quantitative research is based on a more analytical base, which supports researchers by hypotheses in numbers and calculations (Myers, 2000). "Quantitative research is expressed in numbers and graphs. It is used to test or confirm theories and assumptions. This type of research can be used to establish generalizable facts about a topic" (Streefkerk, 2019). Quantitative research is easier to gather large samples of data, since it is less time-consuming to hand out questionnaires relative to conducting interviews. Data gained by questionnaires creates primary data. This creates a possibility to design data specific to a research goal. Moreover, it offers more control over which methods and sampling is used (Scribbr, 2020). Quantitative research generally needs more respondents than qualitative research to be able to extract meaningful data. A higher number of respondents leads to a higher internal validity. The chance becomes smaller that participants cannot be compared due to a substantial difference in the experimental group. More respondents can also lead to a higher external validity, since a larger group of respondents possibly lead to a better reflection of the population. A better reflection of the population lead to a higher generalizable answer since there is a higher chance that the common assumptions are processed in the research. Moreover, conducting questionnaires at one moment in time, increases the internal validity. Lastly, in a questionnaire also questions like 'why' and 'how' can be asked, which can give more in depth answers (Streefkerk*, 2019). Furthermore, a distinction can be made between descriptive- and experimental research. Descriptive research is a research method in which data is collected about the study subject without interventions. Important note is that the validity of the research will be dependent on the sampling method. On the other hand, experimental research is based on intervening in the process and by that measure the outcome. The validity depends on the experimental design (Scribbr, 2020). An exploratory research is a research, which explores new insights in given data (McCombes, 2020). Cross-sectional data is data that consists of different demographic groups (Thomas, 2020).

Stated choice experiment

A stated choice experiment is a type of questionnaire where beforehand determined choice alternatives are created. The preference of the respondent about the choice alternatives is asked (Kemperman, 2019). A stated choice experiment creates the situation where a yes-bias can be averted. The yes-bias is caused by social pressure when somebody is asked about their willingness to implement. People tend to put a higher number than without this social pressure. Limitations of the method can be the high amount of choice alternatives, which causes respondents to get bored. Too many attributes could cause the respondents to focus on just a part of these attributes (Conservation Strategy Fund, 2016). Stated choice experiments' questionnaires need to be developed, tested and optimized in order to be successful and create validity in the research. The design process includes the identification of attributes and their relative levels, which can be conducted by qualitative research. This qualitative research could include literature review, observational fieldwork, interviews with clinicians, interviews with potential respondents and qualitative pilot tests (Kløjgaard et al., 2012). Hensher et al. (2012), have a critical note on stated choice experiments: the attribute range in stated choice experiments is funded on pilots, focus groups and experiences. The amount of relevance however cannot be truly discovered.

Practically, the creation of a stated choice experiment consists of a couple of steps:

1. identifying relevant attributes
2. identifying levels for each attribute
3. design experimental task
4. data collection
5. model estimation

It is recommended to use less than ten attributes in order to reduce drop out of respondents due to complexity. Then levels should be assigned in a manner that it corresponds with reality. Moreover, attribute levels should include the range of trade-off and competitive trade-off. The design of the experimental task will be based on experimental designs that provide orthogonality between levels and attributes. Differences exist between a full factorial design and a fractional factorial design. A full factorial design insists on combining all attribute levels in every combination, whereas a fractional factorial design consists of a subset of levels of attributes (Kemperman, 2019). A full factorial design creates the possibility to derive interaction effects from the analysis. Interaction effects rise when the utility of one variable depends on the value of another variable. 'Interaction effects indicate that a third variable influences the relationship between an independent and dependent variable. This type of effect makes the model more complex, but if the real world behaves this way, it is critical to incorporate it in your model' (Frost, 2020). In a design, a 'no-choice' option should be included since goods and or services are not always consumed and consumers have a choice to not buy a good or service (Henscher et al., 2015).

Theoretical background

Stated choice experiments, or discrete choice models, are based on two theories: the importance of characteristics is shown, via the Lancaster characteristics theory of value. Respondents face an unidentified demand that does influence their choice behaviour.

However, in choice modelling, the availability of the goods, or attributes, remain the same, but the levels of these attributes change. The choice behaviour is thus not focussed on the availability but on the levels of the attributes (Lancaster, 1966). The other theory is the random utility theory. The random utility theory declares that the alternative with the highest utility for the respondent, will be chosen (Manski, 1977). One of the base theories of discrete choice modeling is the random utility theory, but how does this work? Utility (U_{nsj}) consists of structural utility and random utility, where structural utility (V_{nsj}) is observable and random utility consists of unobservable determinants. This random utility is also called the error term (ε_{nsj}). Where $'nsj'$ stands for decision maker n in choice situation s will choose for alternative j. Utility can thus be explained as followed:

$$U_{nsj} = V_{nsj} + \varepsilon_{nsj}$$

However, discrete choice models possibly consist of multiple variables, which results in the following utility function for the structural utility:

$$V_{nsj} = \sum_{k=1}^{K} \beta_k x_{nsjk}.$$

The function above describes the structural utility as the sum of utility per main effect and interaction effect. Where the utility per main effect or interaction effect is measured by the coefficient (β) times the utility (X) (Henscher et al., 2015).

The coefficients of the variables that lead to utility for the choice alternative are depending on the relationship between the independent and the dependent variable. These coefficients are also called main effects. However, different levels of variables combined in a choice alternative could lead to an extra utility on top of the utility of the main effects, which is called an interaction effect. Interaction effects rise when the utility of one variable depends on the value of another variable. 'Interaction effects indicate that a third variable influences the relationship between an independent and dependent variable. This type of effect makes the model more complex, but if the real world behaves this way, it is critical to incorporate it in your model' (Frost, 2020). Important to note, is that the no-choice option also generates a utility when it is chosen by respondents (Henscher et al., 2015). If the Utility (U) of Alternative A is bigger than the utility (U) of Alternative B, the respondent is likely to choose Alternative A, since the alternative has the higher utility. The likelihood that a choice is chosen is represented by P_{nsj}. The choice situation can be expressed in the following formula:

$$P_{nsj} = Prob(\, V_{nsj} + \varepsilon_{nsj} > V_{nsi} + \varepsilon_{nsi}, \forall i \neq j)$$

(Henscher et al., 2015)

However, humans do not always make rational choices and thus not always choose the alternative with the highest utility (Samson, 2014). This will influence the applicability of the findings. Homeowners can always deviate from the outcomes of the research. The goodness of fit is measured by the McFaddens Rho-square. For exploratory research with cross-sectional data, the threshold for the Rho-square to be a good fit is typically 0.10 (Sarstedt & Mooi, 2014). However, for MNL analysis a good fit is suggested to be from 0.20 upwards.

3.2.2 Theoretical construct of Multinomial logit model (MNL)

A model to analyse discrete choice models is the multinomial logit model. The multinomial logit model is used when a dependent variable is predicted by more than two independent variables in choice modelling. An MNL generates the values of the coefficients (β) per level of the variable and the coefficients of the interaction effects in the model, from the analysed dataset. Whether choice alternative j is chosen is determined in the following formula:

$$\text{Prob (Alt } j \text{ is chosen)} = \frac{\exp(V_{nsj})}{\sum_{j=1}^{J} \exp(V_{nsj})}, j = 1, \ldots, J.$$

The coefficients of the reference categories are set to zero (0). The coefficients of the other levels of variables and interaction effects are important in determining the total utility of the different alternatives ($U_{nsj} = V_{nsj} + \varepsilon_{nsj}$). The total utility ($U_{nsj}$) explains the preference of a choice alternative j. A larger utility, or preference, translates into a higher chance that a certain choice alternative is implemented (Henscher et al., 2015).

The coefficients are determined per level of the variable, as a main effect, or between levels of variables as an interaction effect. Threshold for significance is <0.01, <0.05 or <0.1. The total utility is the relative preference of a choice alternative. When the total utility is higher, the degree of willingness to implement is likely also higher. People are more likely to choose choice alternatives with a higher utility than choice alternatives with a lower total utility. Therefore, the degree of utility can be seen as the degree of preference.

In order to be able to test the goodness of fit, a log likelihood should be calculated to find the rho-square (ρ^2). To identify the rho-square, the following formula applies:

$$\rho^2 = 1 - \frac{LL_{Estimated\ model}}{LL_{Base\ model}}.$$

The Log likelihood of the base model represents the average utility for each of the choice alternatives. 'If an estimated model does not improve the LL function in comparison to the base model, then additional parameters do not add to the predictive capability of the base model' (Henscher et al., 2015). Threshold for a good fit in MNL is determined at 0.2.

Table 3 - example of coefficients main effects and interaction effects

Rank	Choice	Coefficients	Standard Error	t-value	Sig. P-value
1	Hotdog	1	0.1	7.84	0.0000
2	Ice cream	1	0.1	7.78	0.0000
3	Mustard	0.5	0.1	7.78	0.0000
4	whipped cream	0.5	0.1	-6.75	0.0000
5	Hotdog + Mustard	0.25	0.1	4.57	0.0000
6	Hotdog + Whipped cream	-0.25	0.1	2.53	0.0114
7	Ice cream + Mustard	-0.1	0.01	3.33	0.0000
8	Ice cream + Whipped cream	0.1	0.01	5.39	0.0000

Table 2 shows an example of how MNL analysis with main- and interaction effects should be interpreted. Rank one to four are all main effects, whereas rank five to eight are all interaction effects. Column 'P-value' shows that all main effects and interaction effects are significant. The coefficients show the degree of utility the main effects and interaction effects add to the total utility. Main effects are an individual effect of the particular attribute on the total utility. Respondents generally dedicate a utility of one (1) to a hotdog and an ice cream (rank 1 & 2). Respondents generally dedicate a utility of 0.5 (rank 3 & 4) to the sauces mustard and whipped cream. However, if respondents get a hotdog with mustard, respondents create not only a utility of 1.5 (Main effects hotdog and mustard), but dedicate extra utility to a hotdog with mustard of 0.25 because it is an extra tasty combination, which brings the total utility of a hotdog with mustard on 1.75. Same goes for ice cream with whipped cream. However, when a hotdog is served with whipped cream respondents dedicate less utility to the total utility as a result of the interaction effect of rank 6 since it is a less tasty combination, with a total utility of 1.25. Same goes for ice cream with mustard in interaction effect in rank 8 (Forster, 2020).

3.2.3 Type of questionnaire

This research will be conducted as a quantitative research with an experimental research design. Variables will be manipulated in order to derive the willingness of homeowners to implement a green roof. The research is conducted to explore the main drivers of the willingness to implement and is therefore exploratory research (McCombes, 2020). Surveys will be spread randomly, in order to create a respondent group, which is representative for homeowners in The Netherlands and therefore increase the external validity (Streefkerk, 2020). The random selection of homeowners makes it a cross-section of homeowners in The Netherlands, with different education levels, income, age, gender and is therefore cross-sectional data (Thomas, 2020).

By using a stated choice experiment, different components of the subject can be weighed off against each other on preferences and the willingness to implement can be determined. A benefit of this method in measuring the stated willingness to implement, is that the yes-saying bias is averted. In this research a full factorial design will be created in order to create data that includes all possibilities of different alternatives. The use of a full factorial design enables the possibility to measure interaction effects. In the design, a ‘no-choice’ option will be included to give the opportunity to respondents to not choose an alternative.

However, due to normalisation a reference category per variable should be included, which are used as a reference category in the analysis.

3.2.4 Design stated choice experiment

An explanation of the questionnaire and choices of attributes is given in this part. The questionnaire itself will be given in the form of a stated choice experiment. However, also close-ended questions will be asked beforehand regarding demographic information, respondents’ current (economic) situation and the experience of the local microclimate. This information will help in mapping demographic influences on preference of type of green roof, price per m² and governmental policies in the respondent. Regarding demographics respondents are asked about their gender, age, education and income, as described in the conceptual model under background factors. More information regarding the questionnaire can be found in appendix IV.

Where demographic questions help to distinguish different demographic groups and their choice behaviour, experience questions are able to distinguish respondents and their choice behaviour, based on their experience levels. Experience levels are also part of the background factors in in the Theory of Planned Behaviour, as described in the conceptual model. Important regarding green roofs, is the experience of the local microclimate of homeowners. The perception of the local microclimate can be seen as an experience, which is part of the background factors in the Theory of Planned Behaviour (Ajzen & Fishbein, 2005). Green roofs can have a substantial effect on the local microclimate. Regarding the local microclimate, the following question was asked:

- Respondents are asked to grade the perception of their local microclimate, based on floods, temperature and air quality. The grading goes from one (low) to five (high). Answer options: one (lowest), two (low), three (average), four (high), five (highest).

Experience questions give insight into homeowners perception of a certain experience. Asking respondents to rank advantages of green roofs give meaningful insights in the relative importance of advantages and gives information to respondents about the different advantages of green roof.

- Respondents are asked to rank the advantages of green roofs from one (highest) to eight (lowest). Answer options: (1) lowered energy use, (2) lowered inside temperature, (3) lowered outside temperature, (4) improving air quality, (5) increasing biodiversity, (6) less floods, (7) protective effect on the roof construction and (8) higher productivity of solar panels.

The stated choice experiment includes eight questions, in which a choiceset is presented with two options and a ‘no choice-option’. The respondent is obliged to choose one of the three options. Every choice option consists of four attributes derived from the conceptual model: type of green roof, price per m², governmental policy 1 (engaging and enabling) and governmental policy 2 (encouraging and exemplifying). Below the attributes and levels are further operationalised:

- **The type of green roof**, consists of two types of green roofs (levels): extensive green roofs and intensive green roofs. These type of green roofs differ significantly in terms of aesthetics, functionality and maintenance. Extensive green roofs are vegetative layers on roofs, not usable for people, with low maintenance. Intensive green roofs are rooftop gardens, usable for people with higher maintenance levels. Earlier research already discovered that people have different attitudes on different types of vegetation (aesthetics) for green roofs. The two types of green roofs differ significantly in aesthetics and thus vegetation, which might have influence on the willingness towards implementing a green roof. This research will add existing differences in functionality and maintenance of the two types of green roofs and give a more complete view on the type of green roof. This more complete view will lead towards more realistic attitudes towards the preferences of these main types of green roofs and to the goal of measuring the willingness to implement a green roof.
- **The price per m²**, consists of four different price levels (€30; €60; €90; €120), and is included to measure the preference of price. Since prices of green roofs are mostly calculated in price per m², price per m² is used as attribute. In the literature review the price per m² is analysed for the different types of green roofs. price levels are divided into four equally divided prices. moreover, the prices are chosen in a way that the actual price is within the range of the different levels, so that the level of price per m² lies within the believability of respondents’ judgement regarding the actual price. Differences in price could affect homeowners’ willingness towards implementing a

green roof. By measuring the preference of price, the influence of homeowners' preference of price on the willingness to implement a green roof, can be measured. Measuring the preference of price will contribute to the goal of measuring the willingness to implement a green roof.

- **Policy 1** and **policy 2**, both consists of two levels. Policies are included since governmental policies are widely used to promote pro-environmental behaviour. Behaviour can be changed in accordance with the Theory of Planned Behaviour. By changing the attitude, subjective norm and/or the perceived behavioural control. The influence of governmental policies on the willingness to implement a green roof can be measured and give meaningful insights about governmental strategies regarding pro-environmental policies. Two policy attributes are chosen with two levels, which brings a total of four types of policies. The four policies are in accordance with Defra's 4E model, which focusses on promoting pro-environmental behaviour. Defra's 4E model consists of four policies: engaging, enabling encouraging and exemplifying. Engaging policies are participative policies focussing on neighbourhood projects and media campaigns. Enabling policies are policies that focus on supplying expert information and advice. Encouraging policies are policies that focus on subsidies and certification. Exemplifying policies are policies focussed on leading by example. According to Defra (2008), engaging policies are more effective on people with a high willingness to act, enabling policies on people with a low and high willingness to act and encouraging- and exemplifying policies on people with a low willingness to act. Governments do not necessarily use one policy, but can also use a combination of policies to promote pro-environmental behaviour. Therefore this research focuses not only on measuring the effectiveness of one policy, but also the effectiveness of a combination of policies, the four policies are divided between **policy 1** and **policy 2**. **Policy 1** consists of engaging- and enabling policies, that together can change the attitude, subjective norm and perceived behavioural control. **Policy 2** consists of encouraging- and exemplifying policies, who together can change the attitude, subjective norm and perceived behavioural control. By combining the different levels of **policy 1** and **policy 2**, the research goal to find an effective combination of governmental policies to stimulate the willingness to implement a green roof, can be examined for people with different levels of willingness to act.

Table 4 gives an overview of the different attributes and levels.

Table 4 - attributes and levels

Levels/ attribute	***Type of green roof***	***Price per m2***	***Policy1***	***Policy2***
0	Extensive	€ 30	Engage	Encourage
1	Intensive	€ 60	Enable	Exemplify
2	-	€ 90	-	-
3	-	€ 120	-	-

Table 5 - Example of a choice alternative

Attribute	**Choice 1**	**Choice 2**
Functionality, maintenance & aesthetics	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**  **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**  **Renovations in € per m² (over the lifespan):** 100 **Maintenance:** High
Price per m²	**30**	**120**
Policy 1	**Engaging**	**Enabling**
Policy 2	**Encouraging**	**Exemplifying**

Further explanation of the different attributes and levels can be found in Appendix II.

Design of choice experiment
The stated choice experiment is based on a full factorial design, including all different combinations of levels and different attributes. Using a full factorial design, enables the possibility to measure interaction effects between the different levels of attributes. In order to be able to create a full factorial design, all levels of one attribute should be combined with all levels of the other attributes. How this orthogonal design was created can be found in Appendix II. This design resulted in the following 32 different **alternatives** and the **no-choice option** (choice alternative 33), displayed in table 6.

Table 6 - overview alternatives

Alternative nr.	Type of green roof	Price per m2	Policy1	Policy2
1	Extensive	€ 30	Engage	Encourage
2	Extensive	€ 30	Enable	Encourage
3	Intensive	€ 30	Engage	Encourage
4	Intensive	€ 30	Enable	Encourage
5	Extensive	€ 60	Engage	Encourage
6	Extensive	€ 60	Enable	Encourage
7	Intensive	€ 60	Engage	Encourage
8	Intensive	€ 60	Enable	Encourage
9	Extensive	€ 90	Engage	Encourage
10	Extensive	€ 90	Enable	Encourage
11	Intensive	€ 90	Engage	Encourage
12	Intensive	€ 90	Enable	Encourage
13	Extensive	€ 120	Engage	Encourage
14	Extensive	€ 120	Enable	Encourage
15	Intensive	€ 120	Engage	Encourage
16	Intensive	€ 120	Enable	Encourage
17	Extensive	€ 30	Engage	Exemplify
18	Extensive	€ 30	Enable	Exemplify
19	Intensive	€ 30	Engage	Exemplify
20	Intensive	€ 30	Enable	Exemplify
21	Extensive	€ 60	Engage	Exemplify
22	Extensive	€ 60	Enable	Exemplify
23	Intensive	€ 60	Engage	Exemplify
24	Intensive	€ 60	Enable	Exemplify
25	Extensive	€ 90	Engage	Exemplify
26	Extensive	€ 90	Enable	Exemplify
27	Intensive	€ 90	Engage	Exemplify
28	Intensive	€ 90	Enable	Exemplify
29	Extensive	€ 120	Engage	Exemplify
30	Extensive	€ 120	Enable	Exemplify
31	Intensive	€ 120	Engage	Exemplify
32	Intensive	€ 120	Enable	Exemplify
33	No green roof	€ -	No Policy	No policy

Every questions consists three choice options: choice alternative nr.1, choice alternative nr.2 and the no-choice option, which means that fifteen questions cover all choice alternatives. Due to concerns regarding drop out of respondents, eight choice questions are asked. Beside the choice questions, seven demographic and experience questions are asked, which brings the total of questions per respondent at fifteen (15). In order to avert order bias, eight different versions were generated, which are allocated randomly by the software. Further details of the design of the choice experiment, can be found in Appendix II.

3.2.5 Data collection

In order to create a representative group for homeowners in The Netherlands with a high external validity, surveys are spread randomly (Streefkerk, 2020). The data is gathered via door to door notes in mailboxes and through social media platforms. The aim of the data collection is to generate a large response within different groups of homeowners. Therefore, accounts with a large reach on LinkedIn and Facebook are used. The approached accounts vary from focussing on homeowners and living related subjects, to advertising accounts. Group members partly consist of homeowners, which could contribute to a larger response. Furthermore, the survey with explanation was posted in online interest groups on Facebook of neighbourhoods in different cities. These neighbourhood groups include residents of the particular neighbourhood, which makes the group attractive to find homeowners. Also KnoopXL, a gathering of interested people in the development of the Central station region of Eindhoven, spread the survey to all people in the interest group. This interest group will likely consist partly of homeowners, which increases the amount of response. The choice for internet based data collection lies in the big reach the internet has, with the high amount of viewers that can be generated by one post. Due to this, it is less time consuming than in real life handing out surveys. However, also notes with QR-codes to the online survey were handed out in a corona proof manner in different areas of The Netherlands to generate a larger response. Seven different areas were targeted, handing out 300 notes, from which 31 responses are generated. Moreover, social relations were asked to spread the survey to increase response.

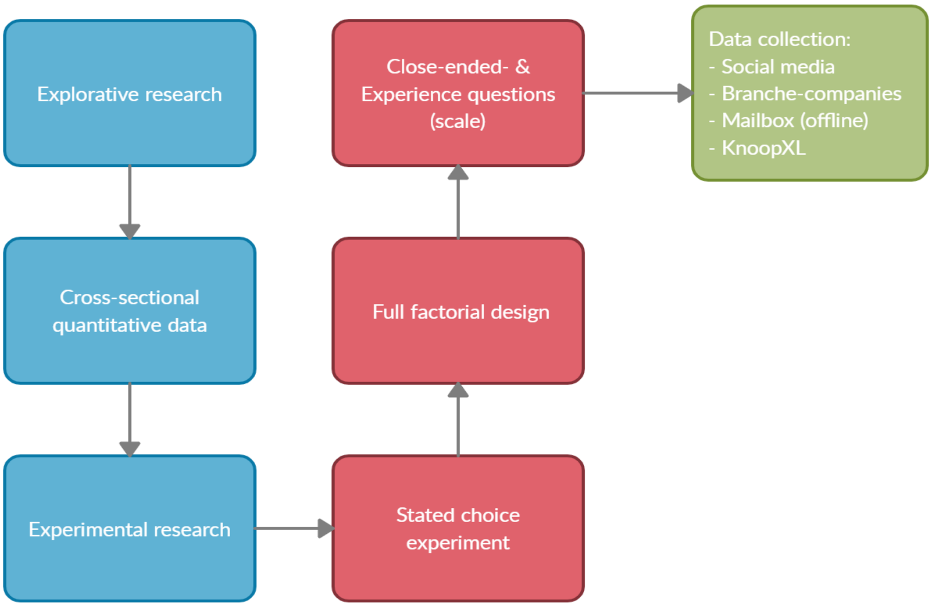


Figure 5 - schematic display of research design

3.3 Conclusion

This chapter discusses the research design. A conceptual model was derived from the literature review, which combines the Theory of Planned Behaviour, leading to a willingness to implement a green roof, with Defra's 4E model for stimulation by governmental policies. In this research design is determined that the research is an exploratory quantitative research that is experimental with cross-sectional data. As a questionnaire a stated choice experiment is used in combination with demographic and experience questions. The theoretical background of the stated choice experiment is based on the Lancaster characteristics theory of value and the random utility theory. In addition, the analysis of the multinomial logit model (MNL) is explained. Followed by the actual design of the choice experiment, which is presented and discussed including an example of the actual choice alternative. Data was collected via the internet as well as door to door. In the next chapter, data preparation and the results of descriptive statistics and the choice experiment are discussed.

Chapter IV - Analysis and Results

This chapter discusses data preparation, the analysis of gathered data in terms of descriptive statistics regarding the group of respondents, followed by results of the perception of the local microclimate, the ranking of advantages of green roofs. Furthermore, results of the main model of the stated choice experiment and results of the stated choice experiment relative to demographic factors and experience factors are discussed.

4.1 Data preparation

At first, the data is changed by filtering out the non-homeowners. All respondents that filled in that their house is not in their own property, are substracted. 159 respondents remained in the dataset usable for analysis. The remaining data is coded into dummy variables, which makes the data suitable for analysis. However, dummy coding of alternatives does not give a coding for the no-choice option. In order to include the ‘no choice’ in the coding scheme, a constant should be attached to the data (Henscher et al., 2015). The no choice option ‘Constant’ is also included in the analysis and will also be represented by a coefficient. It is coded by one (1) in the dataset when a green roof was chosen and as zero (0) when the no choice option was used. Moreover, a variable ‘Choice’ was added, which indicated whether a choice alternative was chosen (coded by 1) or not chosen (coded by 0). The variable choice will act as a dependent variable. For more information regarding coding, see Appendix III.

The levels of independent variables are represented by: Extensive; Intensive; Price30; Price60; Price90; Price120; Engage: Enable; Encourage; Exemplify and the utility of the reference categories in the ‘Constant’. The reference categories in this particular MNL are: Intensive; Price120; Enable; Exemplify. The levels of independent variables that are included in the MNL are: Constant; Extensive; Price30; Price60; Price90; Engage; Encourage. The levels of variables included in the MNL are thus measured, relative to the reference categories. The ‘Constant’ represents the utility value dedicated to the reference categories all together.

The values in the coding scheme of the no-choice option are all determined at zero, which means the no-choice option will have a utility of zero (0) and will serve as the reference point between choice alternatives with a positive utility and choice alternatives with a negative utility. The coefficient of the ‘Constant’ should be included in calculating utility ($\beta * X$), when a green roof is included in the chosen choice alternative, since the value of $X = 1$ in this situation. Therefore, the ‘Constant’ variable will be used as a zero point of the choice alternatives. Reason for this is, that all utility calculations for choice alternatives start at the utility of the ‘Constant’ variable, because all utilities are measured relative to the reference categories included in the model.

Regarding age, which was measured as a scale variable, age categories are created in order to be able to distinguish differences in choice behaviour between people from different age categories. The age categories are formed as followed:

- Age category 1: 1 - 30 years
- Age category 2: 31 - 45 years
- Age category 3: 46 - 60 years
- Age category 4: 61 - 75 years
- Age category 5: 76+

4.2 Descriptive statistics

Data was gathered between 26-11-2020 and 08-01-2021. A total of 231 respondents started the survey, from which 230 filled in the first part about demographics, perception of the local microclimate and advantages of green roofs. The second part of the survey, which included the choice experiment, was started by 170 respondents and fully filled in by 159 homeowners. The dropout mostly occurred after the first part of the two parts of questions. The surveys of the 159 homeowners fully filled in are taken into account in this research.

Table 7 - Frequencies and percentages descriptive statistics

Variable	*Level*	*Frequency*	*Percentage (%)*
Gender	*Men*	*68*	*43%*
	Women	*69*	*43%*
	would rather not say	*22*	*14%*
Education	*University*	*70*	*44%*
	Higher education	*63*	*40%*
	Practical education	*17*	*11%*
	Secondary school	*7*	*4%*
	would rather not say	*1*	*1%*
Income in euros	*0-1000*	*2*	*1%*
	1000-2500	*26*	*16%*
	2500-5000	*70*	*44%*
	5000 or more	*43*	*27%*
	would rather not say	*18*	*11%*
Age category	*1-30 years old*	*20*	*13%*
	31 to 45 years old	*45*	*28%*
	46 to 60 years old	*67*	*42%*
	61 to 75 years old	*22*	*14%*
	76+ years old	*5*	*3%*
Perception of local microclimate	*Grade 1 - lowest*	*1*	*1%*
	Grade 2 - Low	*9*	*6%*
	Grade 3 - Average	*61*	*38%*
	Grade 4 - High	*74*	*47%*
	Grade 5 - Highest	*14*	*9%*
Variables choice experiment	*No choice*	*276*	*22%*
	Extensive	*649*	*51%*
	Intensive	*347*	*27%*
	Price 30	*354*	*28%*
	Price 60	*276*	*22%*
	Price 90	*218*	*17%*
	Price 120	*148*	*12%*
	Engage	*495*	*39%*
	Enable	*501*	*39%*
	Encourage	*560*	*44%*
	Exemplify	*436*	*34%*

Figures 6, 7, 8 and 9 illustrate the important characteristics regarding demographics:

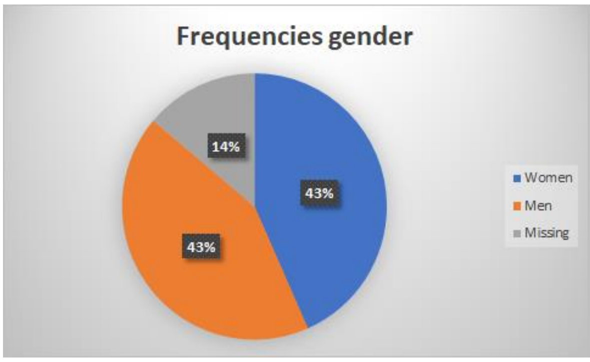


Figure 6 - Gender

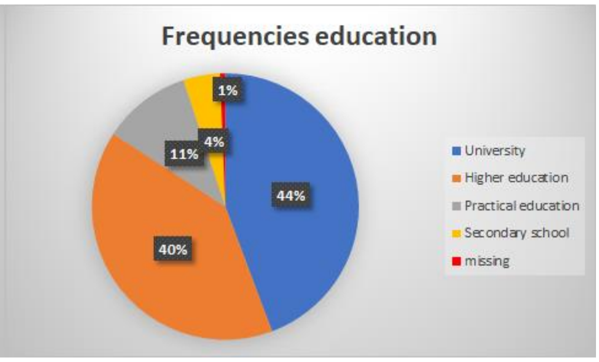


Figure 7 - Level of education

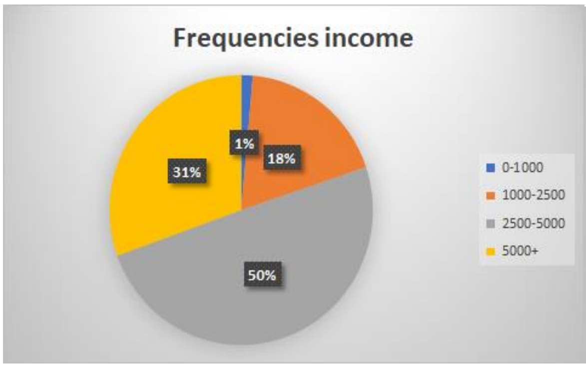


Figure 8 - Income levels

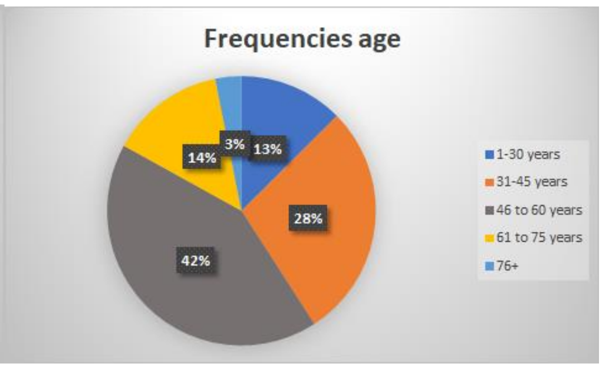


Figure 9 - Age

Figure 6 shows the frequencies of gender in the sample. The sample is equal between men and women in this research and is therefore true to nature in terms of gender in The Netherlands (CBS, 2021). Figure 7 shows the level of education in the sample. It occurs that 84% of the sample has a higher education or a university degree. Compared to Dutch society, where in 2017 22% had a higher education and 15% a university degree (Maslowksi, 2018). It seems that there is an overrepresentation of higher levels of education. Therefore, results of this research will be better applicable to people with a higher education or a university degree. Further research could therefore focus on lower levels of education. Moreover, figure 8 shows a relative high representation of higher income levels in the sample. The level of income of a household, who have their house in their own property is on average estimated at €38.000,- per year, which is €3167 per month (CBS, 2019). The income of respondents in the sample is estimated on approximately €4000,- per month. Results are thus more representative for homeowners with a higher than average income. Generally, when it comes to income, more homeowners have an average or high income when in property of a dwelling (Maslowski, 2018). Lastly, figure 9 shows the representation of age groups in the sample. The figure shows that the biggest age group in the experiment is 46-60 years old, followed by 31-45 years old, 61-75 years old, 1-30 years old and lastly 76+. The average age per respondent was estimated at 51 years old. However, in The Netherlands the average age of buying the first house is estimated at 39,5 years old. This partly declares why the group from 1-30 years old is relatively small. The groups with ages 31-45 years old and 46-60 years old are largest in the sample. However, this indicates an underrepresentation of older age groups in the sample, since most people that buy a house do not return to rent. On top of that there is a growing group of elderly people in The Netherlands, which would indicate an even bigger group of older homeowners (CBS, 2017).

4.3 Perception of the local microclimate

The perception of the local microclimate was questioned in the questionnaire. In figure 10 a visual representation is given of the frequencies regarding the perceived local microclimate (PLM).

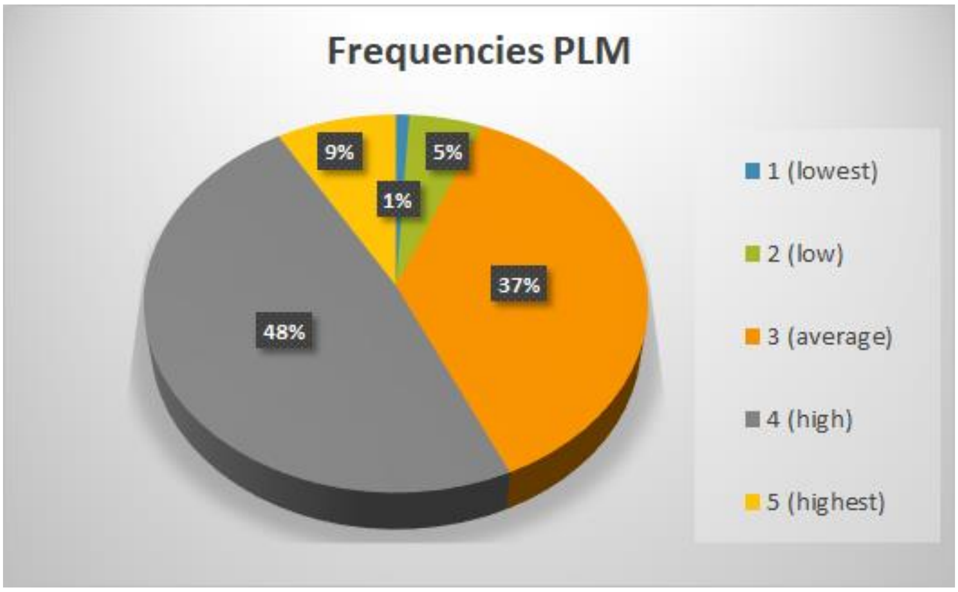


Figure 10 - frequencies of PLM

The pie chart in figure 10 shows that the biggest amount of respondents graded their PLM as high with level 4 (high). The second biggest amount of respondents graded their PLM as average (3). The third biggest amount of respondents graded their PLM as highest (5), followed by low (2) and lastly, lowest (1). 94% of the respondents graded their PLM as average or higher, which indicates that most respondents were quite satisfied with their PLM.

4.4 Ranked advantages of green roofs

The questionnaire offered a question that ranked advantages of green roofs. In figure 12 is displayed, how advantages of green roofs are ranked by the respondents. Advantages of green roofs, partly offer solutions for improving the local microclimate. Green roofs offer the following advantages with a direct effect on the local microclimate: ‘lower inside temperature’, ‘lower outside temperature’, ‘improving air quality’ and ‘less floods’ (Evan, 2014). Other advantages such as lower energy use, higher productivity of solar panels and protective effect on the roof construction could have a long term indirect effect, as they could all help reduce the carbon footprint on our planet (Castleton et al. 2010). The figure below shows for every rank the frequency of the times this particular advantage was chosen for the rank. The ranks go from one, most important, to eight, least important.

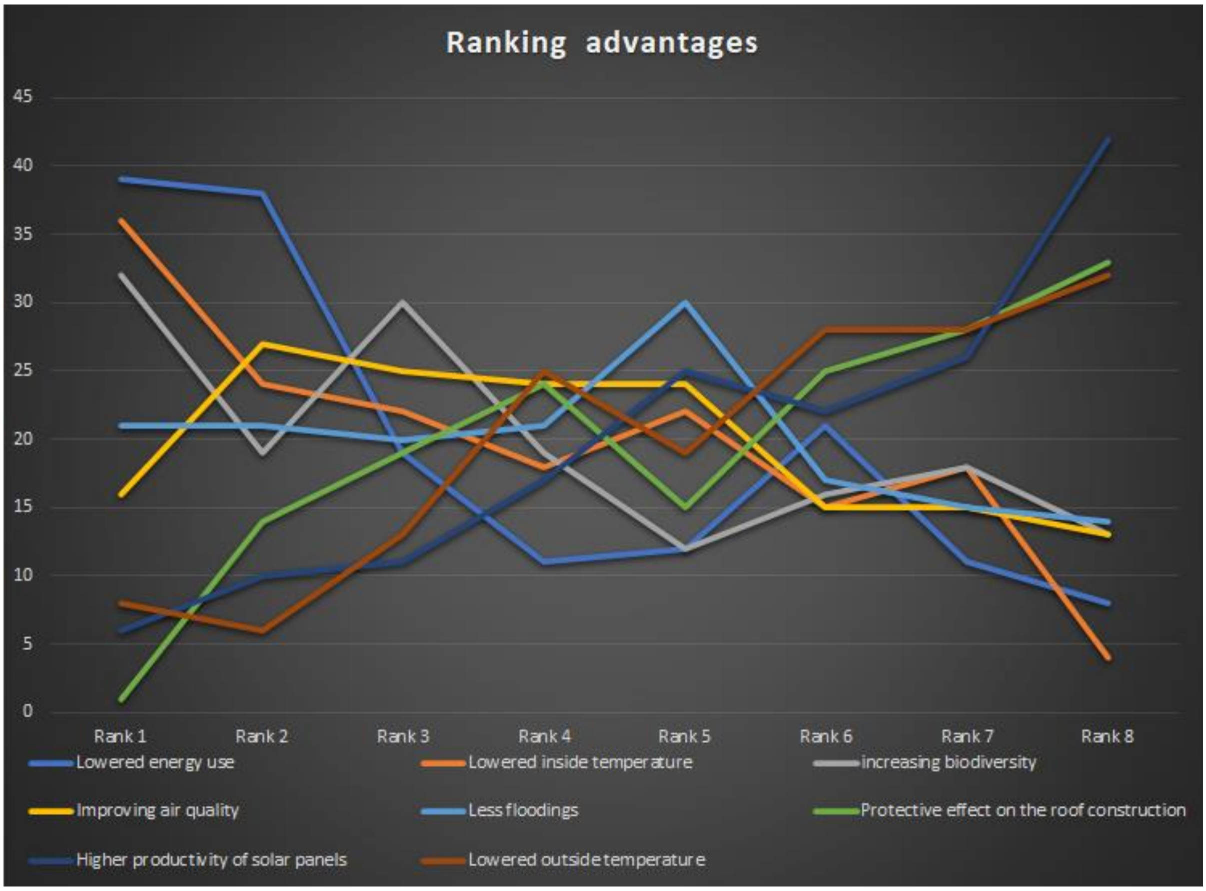


Figure 11 - ranking advantages green roofs

Figure 11 shows that the highest frequency regarding rank 1 is for advantage 'lower energy use'. This indicates that lower energy use is ranked as the most important advantage of green roofs, followed by lower inside temperature. This is contributed by the low frequencies at rank 8, relative to the other advantages. On the other hand, advantages 'increasing productivity of solar panels',' protective effect on the roof construction' and 'lowered outside temperature' represent the lowest frequencies at rank 1 and the highest frequencies at rank 8. This indicates that these advantages are perceived as the least important advantages of green roofs. Advantages 'increasing biodiversity', 'less floods' and 'improving air quality' are perceived as average advantages compared to the other advantages. This is contributed by their mid-level frequencies in figure 11. From these average advantages, 'increasing biodiversity' is ranked as most important, looking at the relatively high frequency at rank 1. However, at rank 7 and 8 'increasing biodiversity' scores similar to 'less floods' and 'improving air quality'. This indicates that there is a diversity in how people rank the advantage 'increasing biodiversity'. The figure shows that from the advantages with a direct effect, 'lower inside temperature' scores highest, followed by improving air quality, less flooding and lastly lowered outside temperature. The most important advantage of a direct improvement of the local microclimate is thus the decrease of the inside temperature in a house. This is followed by the improving effect on air quality, the lower occurrence of floods and the lower outside temperature. Regarding the indirect effects, lower energy use is ranked as the best advantage of green roofs, followed by protective effect on the roof construction and higher productivity of solar panels. However, one advantage of green roofs is not included in the direct and indirect effects on the local microclimate: increasing biodiversity. Biodiversity can be very local and will increase in case of implementing a green roof, but it will not contribute to a better local microclimate in terms of temperature, water retention or improving air quality. Nonetheless, respondents found it a relatively important advantage of green roofs according to the ranking.

4.5 The preferred type of green roof, price and governmental policies

This chapter will discuss results from the MNL analysis. In MNL analysis the utility is measured, which translates into preferences of the type of green roof, the price per m² and governmental policies. These preferences translate into a willingness to implement a green roof. An increase in the degree of preferences are able to increase the willingness to implement. This increases the chance of implementing a green roof. Decreasing preferences lead to a decreasing willingness to implement. This decreases the chance of implementing a green roof. In this chapter the results regarding the preferences for the main model and differences in preferences are addressed in the form of utility. Extra information regarding the MNL analysis can be found in appendix IV.

4.5.1 Main model

The dummy coded dataset, as described in the data preparation (4.1), is used. The main model is determined as the model over the whole dataset without making a distinction between demographic- or experience groups. MNL analysis is conducted using the variable 'Choice' as the dependent variable and 'Extensive', 'Price 30', 'Price 60', 'Price 90', 'Engage' and 'Encourage' as independent variables. All generated coefficients are measured relative to the reference categories as described in chapter 4.1. Table 8 represents the main model including all significant main effects and interaction effects. The coefficients in this table are ranked on the degree of influence of the coefficient on the utility. This is also a ranking of relative importance of the main effects and interaction effects of the model on determining the utility of a choice alternative.

Table 8 and figure 12 show the significant coefficients that influence the total utility homeowners dedicate to a choice alternative and by that influence willingness to implement a green roof, by homeowners, both positive and negative. They are put in order from the highest influence (left; up) to the lowest influence (right; down). The goodness of fit of the model, measured by the rho-square (ρ^2).

ρ^2=1-(1167.72411/-1397.4348)=0.164.

A good fit in MNL analysis is identified at threshold 0.20, which indicates that the model is estimated below a good fit. However, seven significant values are included in the model, displayed in table 8.

Table 8 – Significant coefficients main model

			Standard		Prob
Rank	*Choice*	*Coefficients*	*Error*	*t-value*	*p-value*
1	*Price30*	*1.134*	*0.145*	*7.840*	*0.000*
2	*Extensive*	*1.102*	*0.131*	*7.780*	*0.000*
3	*Price60*	*0.964*	*0.124*	*7.780*	*0.000*
4	*Constant*	*-0.767*	*0.114*	*-6.750*	*0.000*
5	*Extensive & Price 90*	*0.730*	*0.160*	*4.570*	*0.000*
6	*Extensive & Price 30*	*0.553*	*0.219*	*2.530*	*0.011*
7	*Engage & Encourage*	*0.523*	*0.097*	*5.390*	*0.000*

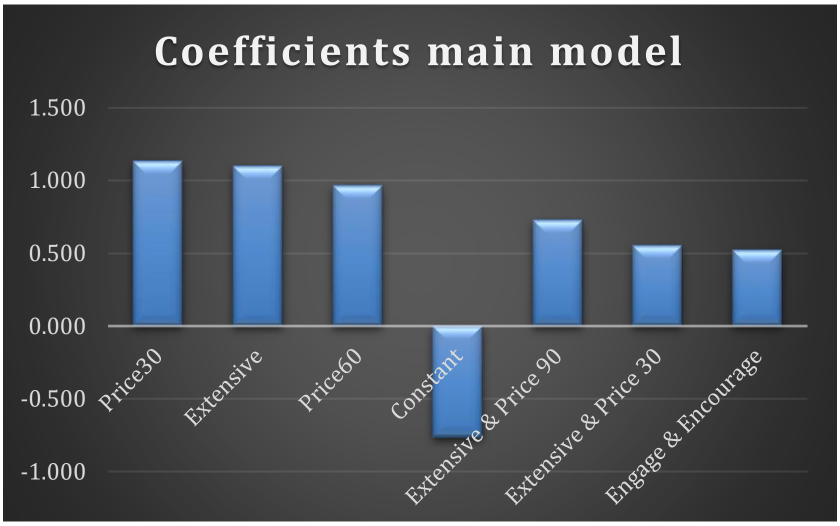


Figure 12 - coefficients main model

Price 30
'Price 30' is a main effect, which is measured relative to the reference category of 'Price 120'. 'Price 30' has the highest positive coefficient. This means that a price of €30 per m² has the largest positive influence on the total utility of the choice alternatives relative to the other price levels.

Extensive
'Extensive' is a main effect that represents the extensive green roof, relative to an intensive green roof. The coefficient is positive, which means respondents generally appreciate an extensive green roof over an intensive green roof. Extensive green roofs will have a positive influence on the total utility.

Price 60
'Price 60' is a main effect also measured relative to 'Price 120', which indicates the total utility homeowners dedicate to a choice alternative, when the price per m² is €60. The coefficient is positive, which indicates that respondents dedicate a higher utility towards choice alternatives that include a price of €60 per m² instead of €120 per m².

Constant
'Constant' represent the choice alternative that includes all the reference categories of all attributes, which is an intensive green roof with a price of €120 per m², enabling policies combined with exemplifying policies. The choice alternative that includes those attributes has a negative total utility (-0.77). Calculations of the total utilities of all choice alternatives, except for the no choice, include the (negative) coefficient of the reference categories as it is the 'zero point' of the utility calculations.

Extensive & Price 90
'Extensive & Price 90' is an interaction effect. 'Extensive & Price 90' represents the effect on the willingness when both an extensive type of green roof and a price of €90 per m² are included in the choice alternative. The coefficient is positive, which indicates that respondents create a higher utility to implement an extensive green roof of €90 per m². Price €90 as main

effects is not significant, which indicates that a price of €90 per m² is only attractive for homeowners, when it is combined with an extensive green roof.

Extensive & Price 30

'Extensive & Price 30' represents the interaction effect between 'Extensive' and 'Price 30'. The coefficient is positive. Similar to the example given in chapter III about hotdogs, ice cream, mustard and whipped cream. 'Extensive' and 'Price 30' also have positive coefficients as a main effect separately. An extensive green roof combined with a price of €30 per m² creates an extra appreciation of respondents relative to the main effects separately. Therefore, the total utility of the choice alternative increases even more than only with the utilities of the main effects in the form of this interaction effect.

Engage & Encourage

'Engage & Encourage' is an interaction effect that combines engaging- and encouraging policies. Engaging policies are able to change the subjective norm and the perceived behavioural control most effective on people with a high willingness to act. Encouraging policies are able to change attitude and perceived behavioural control most effective on people with a low willingness to act. The positive coefficient indicates that when both engaging policies and encouraging policies are included in a choice alternative, the total utility will increase. Respondents in general are thus in search for policies that can change the attitude, subjective norm and perceived behavioural control. The absence of main effects of engaging policies or encouraging policies indicate that only a combination of these two policies will lead to an increase in the total utility.

From the coefficients in table 9, the total utility per alternative was calculated. Below in table 9, all alternatives are specified regarding the levels of variables included in the alternative and are ranked relative to their total willingness. Alternatives with a negative total utility will likely not be chosen, whereas alternatives with a positive overall utility are likely to be chosen. The no-choice option, alternative 3 (No green roof), is set to zero, with a utility of zero, which is caused by coding as explained in Appendix III.

Table 9 - utilities per choice alternative

Rank	Alternative #	Type of green roof	Price	Policy 1	Policy 2	Total utility
1	1	Extensive	€ 30	Engage	Encourage	2,55
2	2	Extensive	€ 30	Enable	Encourage	2,02
3	17	Extensive	€ 30	Engage	Exemplify	2,02
4	18	Extensive	€ 30	Enable	Exemplify	2,02
5	5	Extensive	€ 60	Engage	Encourage	1,82
6	9	Extensive	€ 90	Engage	Encourage	1,59
7	6	Extensive	€ 60	Enable	Encourage	1,30
8	21	Extensive	€ 60	Engage	Exemplify	1,30
9	22	Extensive	€ 60	Enable	Exemplify	1,30
10	10	Extensive	€ 90	Enable	Encourage	1,06
11	25	Extensive	€ 90	Engage	Exemplify	1,06
12	26	Extensive	€ 90	Enable	Exemplify	1,06
13	3	Intensive	€ 30	Engage	Encourage	0,89
14	13	Extensive	€ 120	Engage	Encourage	0,86
15	7	Intensive	€ 60	Engage	Encourage	0,72
16	4	Intensive	€ 30	Enable	Encourage	0,37
17	19	Intensive	€ 30	Engage	Exemplify	0,37
18	20	Intensive	€ 30	Enable	Exemplify	0,37
19	14	Extensive	€ 120	Enable	Encourage	0,33
20	29	Extensive	€ 120	Engage	Exemplify	0,33
21	30	Extensive	€ 120	Enable	Exemplify	0,33
22	8	Intensive	€ 60	Enable	Encourage	0,20
23	23	Intensive	€ 60	Engage	Exemplify	0,20
24	24	Intensive	€ 60	Enable	Exemplify	0,20
25	33	No green roof	€ -	Nothing	Nothing	0,00
26	11	Intensive	€ 90	Engage	Encourage	-0,24
27	15	Intensive	€ 120	Engage	Encourage	-0,24
28	12	Intensive	€ 90	Enable	Encourage	-0,77
29	16	Intensive	€ 120	Enable	Encourage	-0,77
30	27	Intensive	€ 90	Engage	Exemplify	-0,77
31	28	Intensive	€ 90	Enable	Exemplify	-0,77
32	31	Intensive	€ 120	Engage	Exemplify	-0,77
33	32	Intensive	€ 120	Enable	Exemplify	-0,77

Table 9 shows that 24 alternatives have a positive utility. This means respondents dedicate a positive willingness to implement these choice alternatives that include a green roof. At rank 25 the no choice option is displayed. This indicates that the alternatives below rank 25 have a lower utility than to 'do nothing', which translates into a negative utility for these choice alternatives. Important to note, is that extensive green roofs are only included in choice alternatives with a positive total utility. This indicates a larger willingness to implement, and thereby a higher chance of implementation, for extensive green roofs. This shows that no matter the price or policies, an alternative with an extensive green roof has a positive willingness to implement. However, the degree of utility varies between the alternatives that include an extensive green roof. Regarding price, all choice alternatives that include levels €30 per m² and €60 per m², represent a positive total utility. However, the type of green roof and governmental policies can influence the degree of total utility. Price €90 and price €120 are both included in 50% of the alternatives with a positive total utility. Table 9 shows that alternatives with Price €90 and Price €120, only have a positive utility in combination with an extensive green roof. Table 9 shows that all policies are 75% included on choice alternatives with a positive total utility. The other 25% has a negative total utility. The choice alternatives with a negative total utility consist solely of intensive green roofs combined with price levels of 90 per m² and 120 per m² and all four different policies. This indicates that governmental policies do not determine whether the total utility is positive or negative, but only determine the degree to which the choice alternative has a positive- or negative total utility.

4.5.2 Differences in demographic- and experience groups

In the next chapter MNL analysis is conducted in order to derive differences in choice behaviour amongst different demographic characteristics and different experiences. Demographic characteristics are part of the background factors in the Theory of Planned Behaviour (Ajzen & Fishbein, 2005). Demographic- and experience groups used for analysis are: gender, income, education, age, perception of local microclimate. In order to be able to make a distinction between demographic characteristics, interaction-terms are created in order to be able to derive coefficients. For example for gender, this looks as in table 10. Where all values of men remain, the same whereas all values of women become zero. Therefore, it is possible to measure coefficients of utility regarding the choice alternative for men, relative to women.

Table 10 – coding interaction term example: gender interaction

Gender	Coding	Interaction with variables	Interaction
Men	1	1	1*1=1
Women	0	1	0*1=0

Since men are coded with one (1) the interaction term with a variable remains the same value as the variable was in the main model (if included in the alternative) with value one (1). Women are coded with zero (0) and the interaction term becomes zero (0) compared to one (1) in the main model. By creating the same interaction variables for the gender data (for example 'men - engage & encourage') and analysing this data together with the main model ('Engage & Encourage)', a coefficient table will occur, with the same interpretation as in the main model. However, when an interaction term of gender is significant, this means that on this variable men are responding differently compared to the main model with both men and women. Due to sample size, the following demographic- and experience groups are not included: Grade 1 and grade 2 (perception of the local microclimate); Age Category 5 (Age); Secondary school (education); 0-1000 (income). More information regarding the MNL analysis can be found in Appendix IV.

Table 11 – overall display of significant demographic- and experience groups effects

Rank	Choice	Coefficient	Standard Error	t-value	Prob p-value
1	*Price 30*	1.317	0.139	9.500	0.000
2	*PLM 4 - Extensive & Price 30*	1.287	0.292	4.400	0.000
3	*Age category 1 - Constant*	1.264	0.334	3.790	0.000
4	*PE - Price 90 & Engage*	-1.193	0.574	-2.080	0.038
5	*PE - Extensive & Engage*	1.105	0.398	2.780	0.006
6	*Price 60*	0.945	0.146	6.460	0.000
7	*Constant*	-0.890	0.183	-4.870	0.000
8	*Men - Price 60 & Engage*	-0.843	0.299	-2.820	0.005
9	*Extensive*	0.826	0.202	4.090	0.000
10	*Extensive & Price 90*	0.825	0.165	4.990	0.000
11	*Income 5000+ - Extensive & Price 30*	0.705	0.346	2.040	0.042
12	*Income 5000+ - Price 60*	0.692	0.231	3.000	0.003
13	*Age category 2 - Extensive & Encourage*	0.677	0.221	3.060	0.002
14	*Men - Price 30 & Encourage*	-0.658	0.252	-2.610	0.009
15	*Men - Engage & Encourage*	0.614	0.267	2.300	0.021
16	*Age category 1 - Engage & Encourage*	.596	0.329	1.810	0.070
17	*Men - Engage*	-0.562	0.214	-2.630	0.008
18	*PE - Encourage*	0.524	0.231	2.270	0.023
19	*Uni - Extensive & Engage*	0.507	0.210	2.410	0.016
20	*Men - Extensive*	-0.489	0.220	-2.230	0.026
21	*Men - Constant*	0.462	0.217	2.130	0.033
22	*HE - Extensive*	0.417	0.190	2.200	0.028
23	*Engage & Encourage*	0.342	0.150	2.290	0.022
24	*Age category 3 - Constant*	-0.33	0.155	-2.120	0.034

The goodness of fit of the model is estimated by the rho-square:

ρ^2=1-(1107.57077/-1397.4348)=0.207.

0.207 is above the threshold of 0.2, which indicates a good model fit. Table 12 displays the main- and interaction effects of demographic- and experience groups schematically. A positive effect is indicated by a plus (+) and a negative effect by a minus (-). More plusses or minuses, indicate that the effect is bigger on the particular group than the other group that is influenced by the main- or interaction effect.

Table 12 – Schematic display of effects by demographic- or experience groups

		Gender	Education			Income	Age Categories			PLM grade
Rank	Main- and interaction effects	Men	Uni	HE	PE	Income 5000+	AgeCat 1	AgeCat 2	AgeCat 3	PLM 4
1	*Extensive & Price 30*					+				++
2	*Constant*	+					++		-	
3	*Price 90 & Engage*				-					
4	*Extensive & Engage*		+		++					
5	*Price 60 & Engage*	-								
6	*Price 60*					+				
7	*Extensive & Encourage*							+		
8	*Price 30 & Encourage*	-								
9	*Engage & Encourage*	++								
10	*Engage*	-								
11	*Encourage*				+					
12	*Extensive*	-		+						

Table 13 displays main- and interaction effects that include at least one governmental policy. Only demographic- and experience groups with a main- or interaction effect that includes governmental policies are included in the table. The table shows per demographic group, whether the attitude (*ATT*), subjective norm (*SN*) and/or the perceived behavioural control (*PBC*) is changed for the particular main- or interaction effect. The plus indicates that the particular demographic group dedicates a positive utility to the main- or interaction effect, and the minus (-) indicates that the particular group dedicates a negative utility to the main- or interaction effect.

Table 13 – Schematic display of changes by the Theory of Planned Behaviour

		Gender	Education		Age Categories
Rank	Main- and interaction effects	Men	Uni	PE	AgeCat 2
1	Price 90 & Engage			SN, PBC (-)	
2	Extensive & Engage		SN, PBC (+)	SN, PBC (+)	
3	Price 60 & Engage	SN, PBC (-)			
4	Extensive & Encourage				ATT, PBC (+)
5	Price 30 & Encourage	ATT, PBC (+)			
6	Engage & Encourage	ATT, SN, PBC (+)			
7	Engage	SN, PBC (-)			
8	Encourage			ATT, PBC (+)	

Below results of differences in demographic- and experience groups, displayed in table 10 are explained.

Extensive & Price 30

'PLM 4 – Extensive & Price 30' represents the interaction effect between an extensive green roof and a price of €30 per m² for homeowners that grade their local microclimate as high (4), relative to homeowners that grade their local microclimate differently. 'Income 5000+ - Extensive & Price 30' represents the interaction effect between an extensive green roof and a price of €30 per m² for homeowners with an income of €5000 or more. This is relative to homeowners from another income level. The coefficient are positive, which indicates that homeowners that grade their local microclimate as high and homeowners with an income of €5000 or more dedicate more utility towards choice alternatives that include extensive green roofs and a price of €30 per m². However, homeowners that grade their local microclimate dedicate more utility to the interaction effect than homeowners with an income of €5000 or more.

Constant

Age Category 1 and men dedicate extra positive utility towards the constant variable. Age Category 3 dedicates a negative extra utility towards the constant variable. The constant represents the utility homeowners to the reference categories (Intensive; Price 120; Enable; Exemplify), relative to women or other age categories. The positive coefficient, indicate that homeowners from age category 1 and men dedicate more utility towards the choice alternative that includes the reference categories relative to homeowners from other age categories and women. The zero point of the total utility calculations is thus also higher, which indicates that homeowners from the age of 1 to 30 and men dedicate more utility to choice alternatives in general and therefore possibly choose less for the no-choice option. Homeowners from age of 46 to 60 dedicate less utility to the reference categories, which lowers the zero point and are more likely to choose the no-choice option.

Price 90 & Engage
'PE – Price 90 & Engage' represents the interaction effect between a price of €90 per m² and engaging policies for homeowners with a practical education. The coefficient is negative, which indicates that homeowners with a practical education dedicate less utility towards choice alternatives that include a price of €90 per m² and engaging policies, able to change the subjective norm and perceived behavioural control, relative to homeowners with another level of education.

Extensive & Engage
'PE – Extensive & Engage' is an interaction effect that belongs to homeowners with a practical education and 'Uni – Extensive & Engage' to homeowners with an education in university. The interaction effect represents the effect when an extensive green roof and engaging policies are both included in the choice alternative. The coefficients are positive, which indicates that homeowners with a practical education and education in university both dedicate a higher utility towards choice alternatives that include an extensive green roof and engaging policies, than the other education levels. Engaging policies are able to change the subjective norm and perceived behavioural control. Relatively, the coefficient of homeowners with a practical education is higher than the coefficient of homeowners with an education in university, which indicates that homeowners with a practical education dedicate an even higher utility towards choice alternatives that include extensive green roofs and engaging policies, relative to homeowners with an education in university.

Price 60 & Engage
'Men – Price 60 & Engage' represents the interaction effect between 'Price 60' and 'Engage' for men relative to women. The coefficient is negative. Men dedicate less utility to a choice alternative that includes both a price of €60 per m² and engaging policies, able to change the subjective norm and perceived behavioural control

Price 60
'Income 5000+ - Price 60' represents the main effect on the utility of a price of €60 per m² relative to a price of €120 per m², for homeowners with an income of €5000 or more relative to homeowners from the other income levels. The coefficient is positive, which indicates that homeowners with an income of €5000 or more dedicate more utility towards choice alternatives that include a price of €60 per m².

Extensive & Encourage
Age category two represents respondents within the age of 31 and 45. 'Age category 2 - Extensive & Encourage' represents an interaction effect between extensive green roofs and encouraging policies for homeowners of age category two. The coefficient is positive, which means that homeowners from age category 2 dedicate more utility to choice alternatives including an extensive green roof and encouraging policies, relative to homeowners from other age categories. Encouraging policies thereby are able to change the attitude and subjective norm and is most effective on people with a low willingness to act.

Engage & Encourage

'Men - Engage & Encourage' represents an interaction effect between engaging- and encouraging policies, where this value also represents the value men dedicate to the combination of these policies relative to women. The coefficient is positive, which indicates men dedicate more utility towards alternatives that include engaging- and encouraging policies, than women. In other words men dedicate more utility towards policies that are able to change the subjective norm and perceived behavioural control, effective on people with a high willingness to act, in combination with policies able to change attitudes and perceived behavioural control of people with a low willingness to act.

Engage

'Men - Engage' is a main effect measured relative to 'Enable' and has a negative coefficient. The coefficient is applicable on engaging policies that are able to change the subjective norm and perceived behavioural control. The negative coefficient indicates that men dedicate a negative utility towards engaging policies, relative to women. This decreases the total utility of the choice alternatives with engaging policies for men. The negative coefficient indicates that men are more in favour of enabling policies, that focus on supplying expert information and knowledge. Enabling policies are able to change the attitude and perceived behavioural control.

Encourage

'PE - Encourage' represents main effects for encouraging policies, relative to exemplifying policies regarding homeowners with a practical education, relative to homeowners with other types of education. The coefficient is positive, which indicates that homeowners with a practical education dedicate more utility towards choice alternatives that include encouraging policies than choice alternatives that include exemplifying policies, relative to homeowners with other levels of education. Encouraging policies are able to change attitudes and perceived behavioural control for people with a low willingness to act, whereas exemplifying policies are able to change the subjective norm and perceived behavioural control for people with a low willingness to act.

Extensive

'Men - Extensive' and 'HE - Extensive' are main effects, which measure the utility that men and homeowners with a higher education dedicate to extensive green roofs relative to intensive green roofs. Men dedicate a negative utility towards an extensive green roof and are more positive towards intensive green roofs, relative to women. Homeowners with a higher education dedicate extra positive utility towards extensive green roofs, relative to other education groups. This indicates a preference amongst homeowners with a higher education for an extensive green roof.

4.6 Conclusions of results

Homeowners in The Netherlands are quite satisfied with their urban local microclimate seen that 94% of the respondents grade their urban local microclimate as average or higher. Homeowners generally see lower energy use, lower inside temperature and increasing biodiversity as the most important advantages of green roofs. Less floods and improving air quality are ranked as average important advantages, whereas the protective effect on roof construction, increasing productivity of solar panels and lowered outside temperature are seen as the least important advantages.

The degree of utility can be translated into preference. The preferences together determine the degree of willingness to implement. An increase in preference translates into a higher willingness to implement and a bigger chance of the implementation of green roofs. In comparison a decrease in preferences, and thereby decreasing the willingness translates into a smaller chance of implementation.

In general, homeowners prefer an extensive type of green roof, dedicate the highest preference of price at a price per m² of €30,- (lowest price) and prefer a combination of engaging- and encouraging policies. Homeowners prefer an extensive green roof over an intensive green roof. Price preferences and preferences regarding different types of governmental policies have effect on the willingness to implement. However, the willingness to implement will always be positive when the type of roof is extensive. The chances of implementation of green roofs by homeowners are therefore higher for an extensive green roof, relative to an intensive green roof. The willingness to implement an intensive green roof is only positive when the price is €30 or €60 per m². Preferences regarding governmental policies have effect on the willingness to implement an intensive green roof, but the willingness to implement remains positive when these price levels are wielded. However, the willingness to implement an intensive green roof is lower than the willingness to implement an extensive green roof. This indicates a lower chance of implementation in case of an intensive green roof.

Preferences of homeowners regarding governmental policies is a combination of engaging- and encouraging policies. These policies focus on participation, subsidies and certification. Homeowners are therefore looking for policies that change the subjective norm and perceived behavioural control, relative to enabling policies, able to change the attitude and perceived behavioural control. Engaging policies are most effective on people with a high initial willingness to act and enabling policies on people with a low- and high willingness to act. Moreover, homeowners prefer encouraging policies that change the attitude and perceived behavioural control, relative to exemplifying policies able to change the subjective norm and perceived behavioural control. Encouraging- and exemplifying policies are most effective on people with a low initial willingness to act. A difference exist between increasing perceived behavioural control by engaging policies and encouraging policies. Engaging policies increase the perceived behavioural control by showing a possibility to implement a green roof. Encouraging policies increase the perceived behavioural control by supplying the necessary (monetary) means to implement a green roof. However, governmental policies only determine the degree of willingness to implement a green roof. Governmental policies are not able to switch the total utility and willingness to implement from negative to positive or positive to negative.

The willingness to implement a green roof differs between demographic characteristics, such as gender, education, income and age. In the Theory of Planned Behaviour these demographic characteristics are also called background factors. Men are measured relative to women. Men are willing towards the implementation of a green roof generally, relative to women. Men have a lower preference for engaging policies that are able to change the subjective norm and perceived behavioural control. Men prefer enabling policies that supply expert information to increase the attitude and perceived behavioural control. Men dedicate a lower preference to a price of €60 per m² in combination with engaging policies. At a price of €60 per m² men are not looking for policies able to change the subjective norm and perceived behavioural control. Men dedicate a higher preference, to a combination of engaging policies and encouraging policies. This combination of policies is able to change the attitude, subjective norm and perceived behavioural control. Moreover, men dedicate less preference towards encouraging policies, when the price per m² is €30,-. In case of a low price men are not searching for policies able to change the attitude and perceived behavioural control. Lastly, men do have a lower preference towards an extensive green roof than women.

Education also plays a role in the degree of willingness to implement a green roof. Higher educated homeowners dedicate extra preference to an extensive green, relative to other educational groups. Extensive green roofs therefore increase the chance of implementation. Practically educated homeowners dedicate extra preference to encouraging policies, relative to other educational groups. Homeowners with a practical education are searching for governmental stimulation that focuses on changing the attitude and perceived behavioural control. Moreover, practically educated homeowners dedicate less preference towards a combination of a price of €90 per m² and engaging policies. For a relatively high price, practically educated homeowners are not looking for policies able to change the subjective norm and perceived behavioural control. Homeowners with a universal degree or a practical education prefer a combination of an extensive green roof with engaging policies. Engaging policies focus on changing subjective norms as well as the perceived behavioural control and are most effective on people with a high initial willingness to act.

Concerning income, only homeowners with an income of €5000 or more deviate from the main model. Homeowners with an income of €5000 or more are more willing to implement a green roof at a price of €60 per m², relative to other income groups. Moreover, homeowners with an income of 5000 or more, prefer an extensive green roof in combination with a price of €30 per m². This increase in preference in both situations, increases the willingness to implement and translates into a bigger chance of the implementation of green roofs.

Age also partly determines the willingness to implement a green roof. Homeowners from 1-30 years old (cat. 1) are more willing to implement a green roof in general. Homeowners from age category one (cat. 1) prefer a combination of engaging policies and encouraging policies, more than other age categories. Homeowners from age category one prefer a combination between improving the attitude and perceived behavioural control and increasing the subjective norm and the perceived behavioural. homeowners from ages between 31 and 45 years old (cat. 2) prefer a combination of an extensive green roof with encouraging policies, able to change the attitude and perceived behavioural control. Homeowners from ages between 46 and 60 (cat. 3) generally stand less willing towards implementing a green roof in general.

Moreover, the perception of the local microclimate, also interpreted as a background effect, has influence on the willingness to implement a green roof. Homeowners that grade their local microclimate as high, prefer an extensive green roof with a price of €30 per m², relative to other experience groups.

Chapter V – General conclusion and discussion

This chapter will discuss findings and draw conclusions from the conducted research. As explained earlier, the degree of utility can be translated into the degree willingness to implement. In this chapter, willingness to implement will be used to draw conclusions.

5.1 Conclusion

Climate change is a major problem in the contemporary world and causes even bigger effects in urban environments. The implementation of green roofs in urban environments could have a major impact on local microclimates by advantages like improving air quality, increasing water retention, lowering the outside temperature and increasing biodiversity. Moreover, green roofs have several individual benefits for a household, such as a lower inside temperature, lower energy use, protective effect on the roof construction and increasing productivity of solar panels.

Homeowners tend to see lower energy use, lower inside temperature and increasing biodiversity as the most important advantages of green roofs. Less floods and improving air quality are ranked as average important advantages. The protective effect on roof construction, increasing productivity of solar panels and lowered outside temperature are seen as the least important advantages.

Despite the big amount of advantages, there is still a lot of free roof space that is not used for a green roof. This study was conducted in order to find answers regarding the willingness to implement green roofs. Therefore the following research question was proposed:

What is the willingness to implement a green roof for homeowners in The Netherlands, determined by the type of green roof and price per m² and how can these homeowners be stimulated by governmental policies?

A higher willingness to implement translates into a higher chance of implementing a green roof. A lower willingness translates into a smaller chance of implementation. The willingness to implement a green roof for homeowners in The Netherlands is in this research determined by the type of green roof, the price per m² and governmental policies. The price per m² has the biggest influence on homeowners, where the lowest price of €30 per m² has the highest preference. The type of green roof has the second biggest influence on the willingness to implement a green roof. This results indicate that an extensive green roof is preferred over an intensive green roof. Homeowners have in all cases a positive willingness to implement towards choice alternatives with an extensive green roof, no matter the price or included governmental policies. The chance of implementation is therefore highest in case of an extensive green roof. The third biggest influence are governmental policies. Regarding governmental policies a combination of engaging- and encouraging policies is preferred. The willingness to implement a green roof is positively influenced by this combination. This increases the chance of implementation. Although, governmental policies determine the degree of willingness to implement a green roof, policies are not able to switch the total utility and willingness to implement from negative to positive or positive to negative.

Results of demographic- and experience groups show that these groups value the type of green roof, the price per m^2 and governmental policies differently. Differences with the main model exist in the following demographic- and experience groups: gender, income, education, age and perception of the local microclimate.

In general the most effective governmental policies is a combination of engaging- and encouraging policies. These two policies are together able to change the attitude, subjective norm and perceived behavioural control. Changing the subjective norm and perceived behavioural control by engaging policies is most effective on homeowners with a high willingness to act. Engaging policies focus on participation in the neighbourhood. The ability of encouraging policies to change attitudes and the perceived behavioural is most effective on homeowners with a low willingness to act. Encouraging policies change the attitude and perceived behavioural control by offering subsidies and certification. Differences exist about the preferences of governmental policies between demographic- and experience groups. Men dedicate less preference to engaging policies solely, but dedicate extra preference towards a combination of engaging- and encouraging policies. For men it is thus very important that not only the subjective norm and perceived behavioural control are changed, but also the attitude. Men also dislike a combination of engaging policies and a price of €60 per m^2. Moreover men dedicate less preference to encouraging policies combined with a price of €30 per m^2. Homeowners with a practical education dedicate higher preference towards encouraging policies. Practically educated homeowners dedicate less preference to engaging policies, when the price is €90 per m^2. Practically educated homeowners and universal educated homeowners dedicate more preference towards engaging policies combined with an extensive green roof.

5.2 Discussion

5.2.1 Theory of Planned Behaviour and Defra’s 4E model

This research used the Defra’s 4E model as a construct to change towards more pro-environmental behaviour by changing the attitude, subjective norm and perceived behavioural control of the Theory of Planned Behaviour. When the attitude, subjective norm and perceived behavioural control are positive, people are likely to conduct a behaviour. By synthesis of literature regarding the Theory of Planned Behaviour and Defra’s 4E model it occurred that Defra’s 4E model is complementary to the Theory of Planned Behaviour. All four different policies are able to change the perceived behavioural control. Although, the four different policies have different influence on the attitude and subjective norm. Engaging- and exemplifying policies are able to change the subjective norm and perceived behavioural control. enabling- and encouraging policies are able to change the attitude and perceived behavioural control. A combination of engaging- and encouraging policies is significant in the main model. This means the willingness of homeowners to implement a green roof, the pro-environmental behaviour, is only influenced by governmental policies when the attitude, subjective norm and perceived behavioural control are changed. Using Defra’s 4E model as a construct to stimulate pro-environmental behaviour has proven to comprehend with the Theory of Planned Behaviour in literature. Outcomes of this research indicate that pro-environmental behaviour can be increased by governmental policies that are in accordance with Defra’s 4E model. The governmental policies of Defra’s 4E model are able to change the attitude, subjective norm and perceived behavioural control, in accordance with the Theory of

Planned Behaviour. This indicates that Defra's 4E model comprehends with increasing pro-environmental behaviour in accordance with the Theory of Planned Behaviour.

5.2.2 Model fit

A limitation to the research in the main model is the low rho-square of 0.164, which is below the threshold of 0.2. This does not indicates a good fit in MNL analysis. This is possibly caused by the high heterogeneity between different demographic groups and experience groups. As measures in the MNL model. The big variety in outcomes between these groups cause the low rho-square in the main model. This is contributed by the rho-square of 0.207 for the model that includes differences in demographic- and experience groups. In order to gain a better model fit, it can be helpful to use a mixed logit model. Mixed logit models offer more space for heterogeneity in the respondents group, which creates an increase in the rho-square and model fit. However, MNL analysis offered a multitude of significant results in the main model as well as the model analysed on demographic- and experience groups. The significant results indicate that this research offers meaningful insights regarding the willingness to implement green roofs.

5.2.3 Sample size

Sample size was reduced from 231 to 159 in order to be able to analyse choice data related to demographic- and experience data. The reduction is sample size could have affected the homogeneity of the choice experiment and therefore affected the model fit. The sample size was reduced after the first part of the two part questionnaire. Feedback on the questionnaire was the relatively long time it took to conduct the questionnaire. A shorter, less complex questionnaire could have improved the full response and thereby the model fit.

5.2.4 Sampling bias

Another limitation to the research is a sampling bias. This research has an overrepresentation of homeowners with a relatively high level of education and a relatively high income on average. Moreover, there is an underrepresentation of homeowners older than 60 years old. Study results are thus better applicable to homeowners with a relatively higher education, higher level of income and for homeowners until 60 years old. The over- and underrepresentation possibly have affected the model fit.

Chapter VI - Recommendations

This chapter discusses recommendations derived from conclusions based on results from the conducted research.

Recommendations that follow from this study: aim for green roofs as a counteract to climate change. Green roofs have influential benefits to create a better urban microclimate and the willingness to implement a green roof is relatively high amongst homeowners.

According to the main model, it is recommended to focus on extensive green roofs. Regarding price it is recommended to lower the price as much as possible. Furthermore, it is recommended to create policies that focus on participation, subsidies and certification.

It could be interesting to approach different demographics groups in different personalised ways to effectively increase the amount of green roofs implemented.

- Men have a higher willingness to implement a green roof relative to women. It is therefore recommended to focus on men to increase the implementation of green roofs.
- It is recommended to focus on the recommendations of the main model when focussing on income levels.
- It is recommended to focus on relatively young homeowners until the age of 45 years old as these are more willing to implement a green roof.
- It is recommended to focus on homeowners with a practical education. This is a relatively large group in society, which can be very well stimulated to implement a green roof.
- It is recommended to follow recommendations of the main model in case of the perception of the local microclimate of homeowners.

Recommendations for future studies would be to focus on homeowners with a lower income, lower education level and homeowners older than 60, due to the underrepresentation in this study. Also, it could be interesting to conduct an explorative research towards incentives for implementing green roofs amongst demographic groups that in general are less willing to implement a green roof. Moreover, future studies could focus on the willingness to implement green roofs by (social) housing corporations or landlords. This can be interesting since a lot of urban roof space is in the hands of housing corporations and landlords. Furthermore, this study estimates the stated willingness to implement a green roof. Another interesting recommendation for future studies would be to conduct a study focussing on the actual (or revealed) willingness to implement a green roof. This could contribute to scientific literature.

Chapter VII - Literature list

Abrahamse, W. (2019). Chapter 4 - Energy Conservation: For Money, or the Environment?, Editor(s): Wokje Abrahamse, Encouraging Pro-Environmental Behaviour, Academic Press, 2019, Pages 49-65, ISBN 9780128113592, https://doi.org/10.1016/B978-0-12-811359-2.00004-4.

Ajzen, I. (2011). Behavioural Interventions: Design andevaluationguidedbythe Theory of Planned Behaviour.

Ajzen, I. & Fishbein, M. (2005). The Influence of Attitudes on Behaviour.

Ahmadi H, Arabi R, Fatahi L. Thermal Behaviour of Green Roofs In Different Climates. Special Issue of Curr World Environ 2015;10(Special Issue May 2015). DOI:http://dx.doi.org/10.12944/CWE.10.Special-Issue1.110

Barlett, C.P. (2019). Chapter 5 - Social Psychology Theory Extensions,Editor(s): Christopher Paul Barlett, Predicting Cyberbullying, Academic Press, 2019, Pages 37-47, ISBN 9780128166536, https://doi.org/10.1016/B978-0-12-816653-6.00005-4.

Biel, A.,Thøgersen,J. (2007). Activation of social norms in social dilemmas: A review of the evidence and reflections on the implications for environmental behaviour, Journal of Economic Psychology, Volume 28, Issue 1, 2007, Pages 93-112, ISSN 0167-4870, https://doi.org/10.1016/j.joep.2006.03.003.

Biswas, A., & Roy, M. (2016). A study of consumers' willingness to pay for green products. *Journal of Advanced Management Science Vol*, *4*(3), 211-215.

Cambridge dictionary (n.d.). Support. Derived on 05/06/2020 from https://dictionary.cambridge.org/dictionary/english/support

Cambridge dictionary (n.d.). Goverment sponsored. Derived on 05/06/2020 from https://dictionary.cambridge.org/dictionary/english/government-sponsored?topoc=ruling-and-governing

Cambridge dictionary (n.d.). Motivation. Derived on 05/06/2020 from https://dictionary.cambridge.org/dictionary/english/Motivation

Cambridge dictionary (n.d.). Motivate. Derived on 05/06/2020 from https://dictionary.cambridge.org/dictionary/english/motivate

Cambridge dictionary (n.d.). Motivating. Derived on 05/06/2020 from https://dictionary.cambridge.org/dictionary/english/motivating

Castleton, H., Stovin, V., Beck, S., & Davison, J. (2010). Green roofs; building energy savings and the potential for retrofit. *Energy and buildings*, 42(10), 1582-1591

CBS (2019). Inkomensverdeling. Derived on 29-03-2021, from https://www.cbs.nl/nl-nl/visualisaties/inkomensverdeling

CBS (2017). Huizenkopers worden steeds ouder. Derived on 29-03-2021, from https://www.cbs.nl/nl-nl/nieuws/2017/10/huizenkopers-worden-steeds-ouder

Conner, M. (2001). Health behaviours. Derived on 02/11/2020, from https://www.sciencedirect.com/topics/psychology/theory-of-planned-behaviour

Conservation Strategy Fund, (2016). Valuation of Ecosystem Services: Choice Experiments. Derived on 13/04/2020, from https://www.youtube.com/watch?v=txScPIsxyCM&t=13s

Defra, (2008). A framework for pro-environmental behaviours. Derived on 14/07/2020, from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69277/pb13574-behaviours-report-080110.pdf

Defra, (n.d.). The sustainable lifestyle framework. Derived on 21/04/2021, from https://www.sustainabilityexchange.ac.uk/files/defra_sustainable_lifestyles_framework.pdf

Den Haag, (2019). De stad natuurlijk. Derived on 15-02-2020, from https://denhaag.raadsinformatie.nl/document/7525647/1/RIS302383_bijlage_Magazine_%27De_stad_natuurlijk_-_natuurinclusief_bouwen_in_Den_Haag%27

Dreiling, A. (2015). Theory of Planned Behaviour [Video]. Youtube. https://www.youtube.com/watch?v=nZsxuD3gExE

Ecologieforum, (2015). Groen dak info en tips gevraagd. Derived on 9 april 2020, from http://www.ecologieforum.eu/viewtopic.php?t=5321

Eppel, S., Sharp, V., & Davies, L. (2013). A review of Defra's approach to building an evidence base for influencing sustainable behaviour. *Resources, Conservation and Recycling*, *79*, 30-42.

European Commission. (2012). Policies to encourage sustainable consumption.

Evan, H. (2014). Local climate and microclimate. Derived on 11/11/2020, from http://biogenetitech.weebly.com/what-is-local-climate--microclimate.html

Fernandez-Cañero, R., Emilsson, T., Fernandez-Barba,C., Ángel Herrera Machuca, M. Green roof systems: A study of public attitudes and preferences in southern Spain, Journal of Environmental Management, Volume 128, 2013, Pages 106-115, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2013.04.052.

Frost, J. (2020). Understanding interaction-effects in statistics. Derived on 08-02-2021, from https://statisticsbyjim.com/regression/interaction-effects/

Groenbovenalles (n.d.). Overzichtskaart | Subsidies groene daken en gevels. Derived on 01-05-2020, from https://www.groenbovenalles.nl/stimuleringsmaatregelen/overzichtskaart

Ham, M., Jeger, M., & Frajman Ivković, A., (2015). The role of subjective norms in forming the intention to purchase green food, Economic Research-Ekonomska Istraživanja, 28:1, 738-748, DOI: 10.1080/1331677X.2015.1083875

Hensher, D. A., Rose, J. M., & Greene, W. H. (2012). Inferring attribute non-attendance from stated choice data: implications for willingness to pay estimates and a warning for stated choice experiment design. *Transportation*, *39*(2), 235-245.

Hensher, D. A., Rose, J. M., & Greene, W. H. (2015). *Applied Choice Analysis* (2 ed.). Cambridge, UK: Cambridge University Press.

Hu, H. H., Parsa, H. G., & Self, J. (2010). The dynamics of green restaurant patronage. *Cornell Hospitality Quarterly*, *51*(3), 344-362.

Ivanovic, A., Munshey, M., Bosetti, L. (2015). Climate change and the City. Derived on 07-03-2020, from https://unu.edu/publications/articles/climate-change-and-the-city.html#info

Jeremy Jungels, Donald A. Rakow, Shorna Broussard Allred, Sonja M. Skelly, Attitudes and aesthetic reactions toward green roofs in the Northeastern United States, Landscape and Urban Planning, Volume 117, 2013, Pages 13-21, ISSN 0169-2046, https://doi.org/10.1016/j.landurbplan.2013.04.013.

Jones, P. T., & De Meyere, V. (2009). Terra reversa. De transitie naar rechtvaardige duurzaamheid. Utrecht: Uitgeverij Van Arkel.

Judge, M., Warren-Myers, G., & Paladino, A. (2019). Using the Theory of Planned Behaviour to predict intentions to purchase sustainable housing. *Journal of cleaner production*, *215*, 259-267.

Jugert, P., Greenaway, K. H., Barth, M., Büchner, R., Eisentraut, S., & Fritsche, I. (2016). Collective efficacy increases pro-environmental intentions through increasing self-efficacy. *Journal of Environmental Psychology*, *48*, 12-23.

Kaplan,S., Gruber,J., Reinthaler,M., Klauenberg,J.,Intentions to introduce electric vehicles in the commercial sector: A model based on the Theory of Planned Behaviour,Research in Transportation Economics,Volume 55,2016,Pages 12-19,ISSN 0739-8859,https://doi.org/10.1016/j.retrec.2016.04.006.

Kemperman, A. (2019). Week 5 - Discrete choice models SCE 12-03-19. Retrieved from canvas.

Kessling, K., Cohen, A., Jasso, J. (2017). Feasibility of combining solar panels and green roofs on the activities and recreation center. Derived on 07-05-2020, from https://icap.sustainability.illinois.edu/files/projectupdate/4207/Solar%20with%20Green%20Roof%20design.pdf

Klassen, A. C., Creswell, J., Clark, V. L. P., Smith, K. C., & Meissner, H. I. (2012). Best practices in mixed methods for quality of life research. *Quality of Life Research*, *21*(3), 377-380.

Kløjgaard, M. E., Bech, M., & Søgaard, R. (2012). Designing a stated choice experiment: the value of a qualitative process. *Journal of Choice Modelling*, *5*(2), 1-18.

Koltai, A. (2017). Difference between motivation and stimulation. derived on 18-06-2020, from https://www.myenglishteacher.eu/blog/difference-between-motivation-and-stimulation/#:~:text=Possibly%20the%20main%20difference%20between,something%20else%20inspires%20you%20to.

Kraft, P., Rise, J., Sutton, S., & Røysamb, E. (2005). Perceived difficulty in the Theory of Planned Behaviour: Perceived behavioural control or affective attitude?. *British journal of social psychology*, *44*(3), 479-496.

LaMorte, W. (2019). The Theory of Planned Behaviour. Derived on 15/05/2020, from http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehaviouralChangeTheories/BehaviouralChangeTheories3.html

Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of political economy*, *74*(2), 132-157.

Lange, Paul & Joireman, Jeff & Milinski, Manfred. (2018). Climate Change: What Psychology Can Offer in Terms of Insights and Solutions. Current Directions in Psychological Science. 27. 096372141775394. 10.1177/0963721417753945.

Livingroofs, (2017). Green roofs and solar power - biosolar roofs are smart green infrastructure. Derived on 07-05-2020, from https://livingroofs.org/green-roofs-solar-power/

Manski, C. F. (1977). The structure of random utility models. *Theory and decision*, *8*(3), 229.

Maslowski, R. (2018). SCP - De sociale staat van Nederland 2018 - Onderwijs. Derived on 29-03-2021, from https://digitaal.scp.nl/ssn2018/onderwijs/

Middleton, F., (2020). The four types of validity. Derived on 12/02/2020, from https://www.scribbr.com/methodology/types-of-validity/

Middleton*, F., (2020). Types of reliability and how to measure them. Derived on 12/02/2020, from https://www.scribbr.com/methodology/types-of-reliability/

McCombes, S., (2020). How to do survey research. Derived on 11/03/2020, from https://www.scribbr.com/methodology/survey-research/

McCombes, S., (2020). How to write a research methodology. Derived on 12/02/2020, from https://www.scribbr.com/dissertation/methodology/

McCombes, S., (2020). The main types of research compared. Derived on 11/04/2021, from https://www.scribbr.com/methodology/types-of-research/

McCombes, S., (2019). Understanding different sampling methods. Derived on 15/02/2020, from https://www.scribbr.com/methodology/sampling-methods/

Messina, R., Van Mens, L., Nobel, C. (2015). Green roofs in Amsterdam a policy assessment. Derived on 27/04/2021, from https://www.uu.nl/sites/default/files/rebo-ucwosl_assessment_paper_gr_amsterdam.pdf

Mijn-dakdekker. (n.d.). Dakbedekking plat dak: mogelijkheden & prijs. Derived on 25/06/2020, from https://www.mijn-dakdekker.nl/dakbedekking-plat-dak

Myers, M., (2000) Qualitative Research and the Generalizability Question: Standing Firm with Proteus. The Qualitative Report, 4, 3-4.

Octav-Ionut, M. (2015). Applying the Theory of Planned Behaviour in Predicting Pro- environmental Behaviour: The Case of Energy Conservation. Acta Universitatis Danubius. Œconomica. 11. 15-32.

Paul, J., Modi, A., & Patel, J. (2016). Predicting green product consumption using Theory of Planned Behaviour and reasoned action. *Journal of retailing and consumer services*, *29*, 123-134.

PBL, (2015). De stad verbeeld. Derived on 15/04/2020, from https://www.pbl.nl/sites/default/files/downloads/PBL_2015_De_stad_verbeeld_1744.pdf

Porsche, U., & Köhler, M. (2013). Life cycle costs of green roofs. *World Climate & Energy Event*.

Remmers, M. (2017). NOS nieuws - Het platte dak wordt steeds groener in Rotterdam. Derived on 20-04-2020, from https://nos.nl/artikel/2200732-het-platte-dak-wordt-steeds-groener-in-rotterdam.html

RIVM. (2011). Het effect van vegetatie op de luchtkwaliteit. Derived on 04/03/2020, from https://www.rivm.nl/bibliotheek/rapporten/680705019.pdf

Rooftop revolution, (n.d.). Groendaken - rooftop revolution. Derived on 11-03-2020, from https://www.atlasnatuurlijkkapitaal.nl/praktijkvoorbeelden/groendaken

Rooftop revolution, (2020). Nijmeegse kansen in kaart gebracht. Derived on 09-04-2020, from https://www.rooftoprevolution.nl/nijmeegse-kansen-in-kaart-gebracht/

Rosenzweig C., W. Solecki, P. Romero-Lankao, S. Mehrotra, S. Dhakal, T. Bowman and S. Ali Ibrahim. 2015. ARC3.2 Summary for City Leaders. Urban Climate Change Research Network. Columbia University. New York.

Samson, A. (2014). Behavioural Economics Guide 2014. Derived on 09-02-2021, from https://www.behaviouraleconomics.com/resources/introduction-behavioural-economics/

Sanders, R. A. (1986). Urban vegetation impacts on the hydrology of Dayton, Ohio. *Urban Ecology*, *9*(3-4), 361-376.

Sasttedt, M., & Mooi, E. (2014). A Concise Guide to Market Research: The Process Data and Methods Using IBM Statistics.

Scribbr., (2020), An introduction to research methods. Derived on 15-02-2019, from https://www.scribbr.com/category/methodology/

Sempergreen (n.d.). Onderhoud van uw groendak. Derived on 24/06/2020, from https://www.sempergreen.com/nl/oplossingen/groene-daken/onderhoud#:~:text=Jaarlijks%20onderhoud%20Sedumdak&text=Inspecteer%20het%20Sedumdak%20minimaal%202,ter%20bescherming%20van%20de%20biodiversiteit.

Sempergreen (n.d.). Onderhoudsinstructie biodiversdak. Derived on 24/06/2020, from https://www.sempergreen.com/uploads/downloads/Downloads_SG_NL/Onderhoudsinstructie_biodiversdak.pdf

Shahid, N. (2015). *Pro-Environmental behaviour and implementation of environmental interventions in Pakistan* (Master's thesis, NTNU).

Singh, N., & Gupta, K. (2013). Environmental attitude and ecological behaviour of Indian consumers. *Social Responsibility Journal*.

Smelser, N. J., & Baltes, P. B. (Eds.). (2001). *International encyclopedia of the social & behavioural sciences* (Vol. 11). Amsterdam: Elsevier.

Souza, Cássia & Souza, Samuel & Secco, Deonir & Miguel Lenz anderson & Siqueira, Jair. (2018). Green roofs and their contribution for the reduction of room temperature in buildings in Cascavel-State Paraná/green roofs and energy efficiency. Acta Scientiarum. Technology. 40. 35267. 10.4025/actascitechnol.v40i1.35267.

Star, A. (2009). Het upgraden van het riool tot een groendak. Derived on 02/11/2020, from https://edepot.wur.nl/51424

Steg, L., van den Berg, A. E., & de Groot, J. I. (2018). Environmental Psychology: History, Scope and Methods. *Environmental psychology: An introduction*, 1-11.

Sterner, T. (2003). *Policy instruments for environmental and natural resource management*. Resources for the Future.

Streefkerk, R., (2019). Qualitative vs. quantitative research, derived on 12/02/2019, from https://www.scribbr.com/methodology/qualitative-quantitative-research/

Streefkerk*, R., (2019). Internal vs external validity. Derived on 12/02/2020, from https://www.scribbr.com/methodology/internal-vs-external-validity/

Streefkerk, R., (2020). Internal vs external validity. Derived on 11/04/2021, from https://www.scribbr.com/methodology/internal-vs-external-validity/

Teotonio, I., Oliveira Cruz, C., Matos Silva, C., & Morais, J. (2020). Investing in Sustainable Built Environments: The Willingness to Pay for Green Roofs and Green Walls. *Sustainability*, *12*(8), 3210.

Thomas, L. (2020). What is a cross-sectional study? Derived on 11/04/2021, from https://www.scribbr.com/methodology/cross-sectional-study/#:~:text=In%20a%20cross%2Dsectional%20study,an%20extended%20period%20of%20time.&text=They%20can%20provide%20useful%20insights,identify%20correlations%20for%20further%20research.

Thomas, L. (2020). What is a longitudinal study. Derived on 11-06-2020, from https://www.scribbr.com/methodology/longitudinal-study/

Tonglet, M., Phillips, P. S., & Read, A. D. (2004). Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth, UK. *Resources, conservation and recycling*, *41*(3), 191-214.

United Nations, (n.d.). Climate change, derived on 04/02/2020, from https://www.un.org/sustainabledevelopment/climate-change/

U.S. Environmental Protection Agency (EPA). 2008. "Green Roofs." In: Reducing Urban Heat Islands: Compendium of Strategies. Draft. https://www.epa.gov/heat-islands/heat-island-compendium

U.S. Environmental Protection Agency. 2008. "Trees and Vegetation." In: Reducing Urban Heat Islands: Compendium of Strategies. Draft. https://www.epa.gov/heat-islands/heat-island-compendium

U.S. Environmental Protection Agency (EPA). 2019. “Our Nation’s Air”. Derived on 14/05/2020, from https://gispub.epa.gov/air/trendsreport/2019/#air_pollution

K. Vijayaraghavan, Green roofs: A critical review on the role of components, benefits, limitations and trends, Renewable and Sustainable Energy Reviews, Volume 57, 2016, Pages 740-752, ISSN 1364-0321, https://doi.org/10.1016/j.rser.2015.12.119.

Valkering, P., Laes, E., Kessels, K., Uyterlinde, M., & Straver, K. (2014). How to engage end-users in smart energy behaviour?. In EPJ Web of Conferences (Vol. 79, p. 04003). EDP Sciences.

Van Logchem, D. (2018). Operatie beleidsinstrumenten. Derived on 09/07/2020, from https://dspace.library.uu.nl/bitstream/handle/1874/389221/Masterscriptie%20-%20David%20van%20Logchem.pdf?sequence=1&isAllowed=

Van Poeck, K. (2010). Leren veranderen. *Oikos*, *54*(3), 41-49.

Wansheng Yang, Zhangyuan Wang, Junjie Cui, Zishang Zhu, Xudong Zhao, Comparative study of the thermal performance of the novel green (planting) roofs against other existing roofs, Sustainable Cities and Society,Volume 16, 2015, Pages 1-12, ISSN 2210-6707,https://doi.org/10.1016/j.scs.2015.01.002.

White, E. V., & Gatersleben, B. (2011). Greenery on residential buildings: Does it affect preferences and perceptions of beauty?. *Journal of environmental psychology*, *31*(1), 89-98.

Wikidiff (n.d.). Stimulate motivate. Derived on 18-06-2020, from https://wikidiff.com/stimulate/motivate

Wikidiff (n.d.). Motivate support. derived on 18-06-2020, from https://wikidiff.com/motivate/support#:~:text=As%20verbs%20the%20difference%20between,senseid)to%20keep%20from%20falling.

Yang, J., Yu, Q., Gong, P. (2018). Quantifying air pollution removal by green roofs in Chicago, Atmospheric Environment, Volume 42, Issue 31, 2008, Pages 7266-7273, ISSN 1352-2310, https://doi.org/10.1016/j.atmosenv.2008.07.003.

Yang, W., Wang, Z., Cui, J., Zhu, Z., & Zhao, X. (2015). Comparative study of the thermal performance of the novel green (planting) roofs against other existing roofs. Sustainable Cities and Society, 16, 1-12.

Yau, Y. (2012). Willingness to pay and preferences for green housing attributes in Hong Kong. *Journal of Green Building*, *7*(2), 137-152.

Zalejska-Jonsson, A. (2014). Stated WTP and rational WTP: Willingness to pay for green apartments in Sweden, Sustainable Cities and Society, Volume 13, 2014, Pages 46-56, ISSN 2210-6707, https://doi.org/10.1016/j.scs.2014.04.007.

Zalejska-Jonsson, A., Wilkinson, S. J., & Wahlund, R. (2020). Willingness to Pay for Green Infrastructure in Residential Development—A Consumer Perspective. *Atmosphere*, *11*(2), 152.

Zandcompleet (n.d.). Exensief groendak of intensief groendak, wat is het verschil. derived on 24/06/2020, from https://www.zandcompleet.nl/zandblogs/extensief-groendak-of-intensief-groendak-wat-is-het-verschil/

Zhang, X. (2019). *Public preferences for ecosystem services of small urban green infrastructures in Guangzhou, China*.

Chapter VIII - Appendices

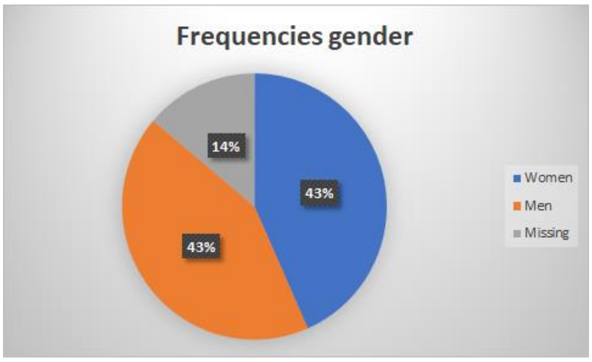
Appendix I - Descriptive statistics

Data was gathered between 26-11-2020 and 08-01-2021. A total of 231 respondents started the survey, from which 230 filled in the first part about demographics, perception of the local microclimate and advantages of green roofs. The second part of the survey, which included the choice experiment, was started by 170 respondents and fully filled in by 159 homeowners. The dropout mostly occurred after the first part of the two parts of questions. The surveys of the 159 homeowners fully filled in are taken into account in this research.

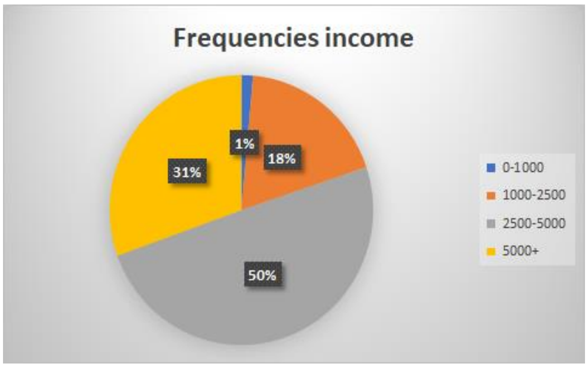
Table 7 - Frequencies and percentages descriptive statistics

Variable	Level	Frequency	Percentage (%)
Gender	Men	68	43%
	Women	69	43%
	would rather not say	22	14%
Education	University	70	44%
	Higher education	63	40%
	Practical education	17	11%
	Secondary school	7	4%
	would rather not say	1	1%
Income in euros	0-1000	2	1%
	1000-2500	26	16%
	2500-5000	70	44%
	5000 or more	43	27%
	would rather not say	18	11%
Age category	1-30 years old	20	13%
	31 to 45 years old	45	28%
	46 to 60 years old	67	42%
	61 to 75 years old	22	14%
	76+ years old	5	3%
Perception of local microclimate	Grade 1 - lowest	1	1%
	Grade 2 - Low	9	6%
	Grade 3 - Average	61	38%
	Grade 4 - High	74	47%
	Grade 5 - Highest	14	9%
Variables choice experiment	No choice	276	22%
	Extensive	649	51%
	Intensive	347	27%
	Price 30	354	28%
	Price 60	276	22%
	Price 90	218	17%
	Price 120	148	12%
	Engage	495	39%
	Enable	501	39%
	Encourage	560	44%
	Exemplify	436	34%

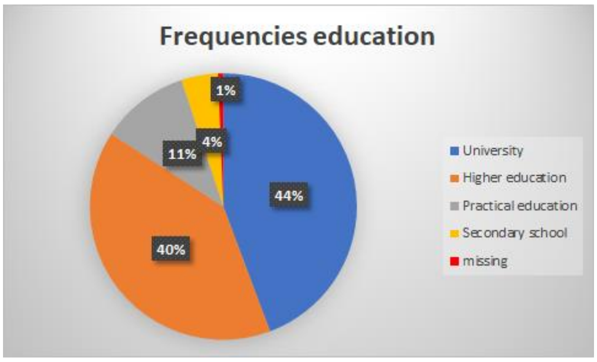
Gender:



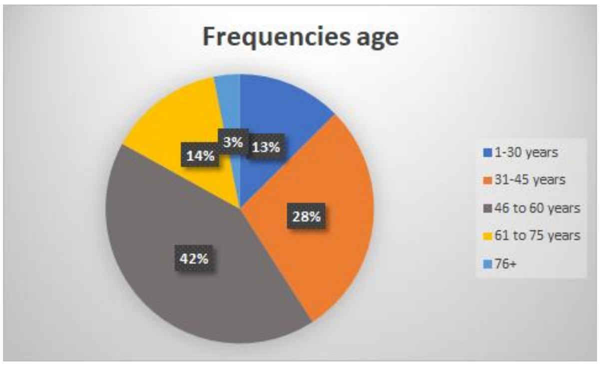
Income:



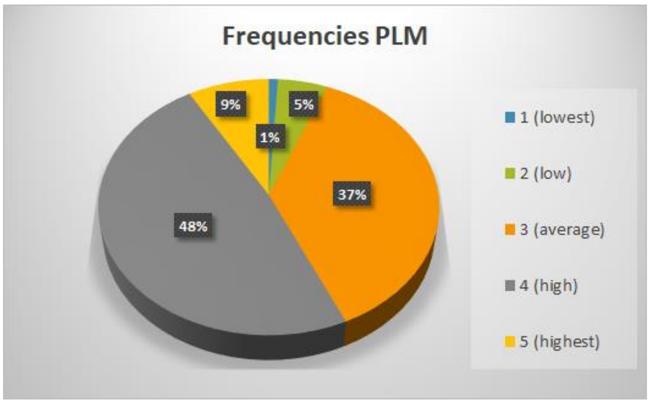
Level of education:



Age:



Perception of local microclimate

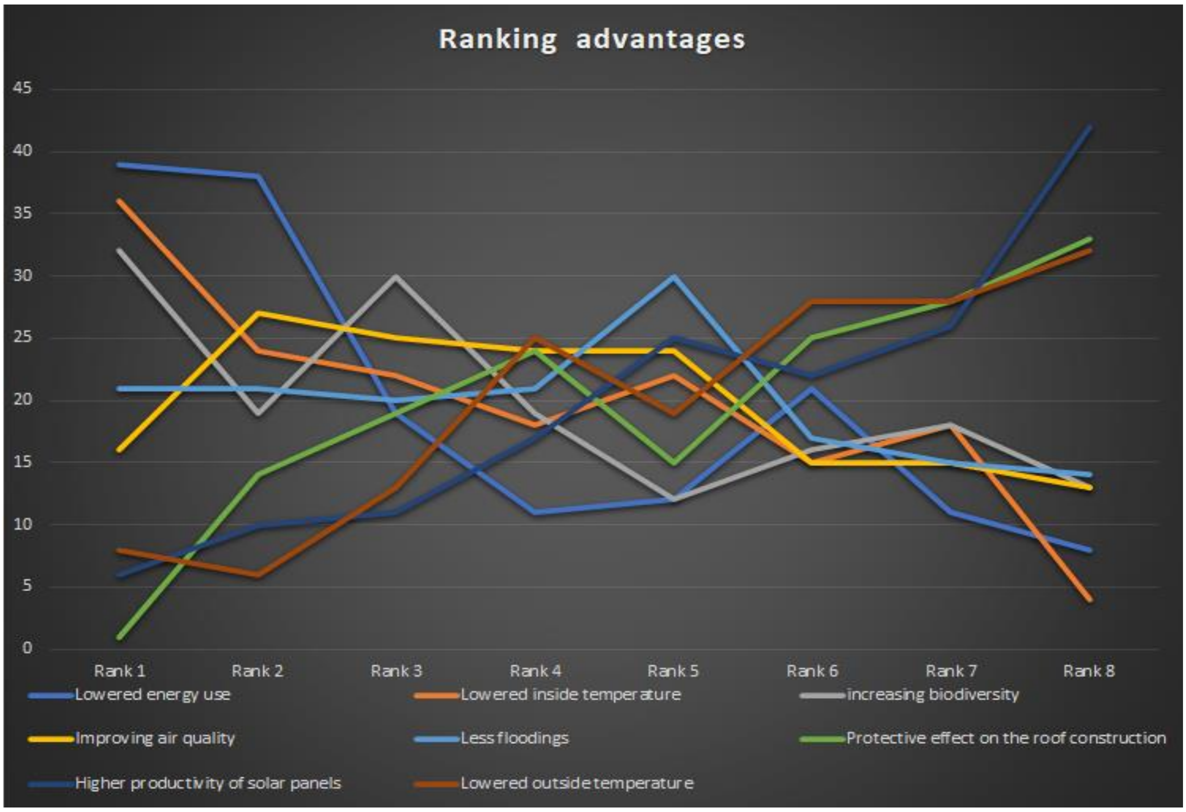


Ranking advantages:

Frequency table advantages per rank:

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8
Lowered energy use	39	38	19	11	12	21	11	8
Lowered inside temperature	36	24	22	18	22	15	18	4
increasing biodiversity	32	19	30	19	12	16	18	13
Improving air quality	16	27	25	24	24	15	15	13
Less floodings	21	21	20	21	30	17	15	14
Protective effect on the roof construction	1	14	19	24	15	25	28	33
Higher productivity of solar panels	6	10	11	17	25	22	26	42
Lowered outside temperature	8	6	13	25	19	28	28	32

Figure:



Appendix II - Design choice experiment

Attributes & levels

Levels/attribute	Typeofgreenroof	Price	Policy1	Policy2
0	Extensive	€30	Engage	Encourage
1	Intensive	€60	Enable	Exemplify
2	-	€90	-	-
3	-	€120	-	-

Table 1 - attributes and levels

Attribute operationalisation

Attribute 1 – Typeofgreenroof

Level 1:

Extensive green roof: is a vegetative layer on a roof and is not usable for people. Vegetation mostly includes sedum plants or grasses and small flowers. Maintenance is low and consists of: roof inspection twice a year; remove weeds; controlling sewer for blockages; fertilized (all twice a year); watered (only when dry); biodiverse mowed every year.

An example of an extensive sedum roof:

Level 2

Intensive green roof: is complex and could even be a totally accessible rooftop park/garden. The space is usable for people, like in a normal garden. A big variety of plants and trees can be used. Maintenance is more complex and consists of the following. An intensive roof should be: watered; fertilized, pruned; like a normal garden, which on average is once a month.

An example of an intensive green roof:

Attribute 2 – Price

The price consists of five different levels:

1	€30
2	€60
3	€90
4	€120

In the stated choice experiment the price levels are divided into four equally divided prices. The prices are chosen in a way that the original price is within the range of the different levels.

Attribute 3 – Policy 1

Policy 1 consists of three different levels, two types of policies: engage and enable. 'Engage' as well as 'enable' are, according to Defra (2008) mostly policies effective on people with a high willingness to undertake action, regarding the matter.

Level 1 - engaging

Neighbourhood projects & media campaigns (Engaging): Neighbourhood projects in which neighbourhood members together help in implementing green roofs, in which possibilities to use one another's knowledge and contacts to create a successful neighbourhood project. **Media campaigns** will supply information about green roofs, via the media.

Level 2 – enabling

Advice & information evenings (Enabling): An expert in green roofs will be present to ask **advice** for no costs in return. Supply clear information about pros and cons of green roofs and organise **information evenings** to spread information about the process of implementing a green roof.

Attribute 4 – policy 2

Policy 2 consists of three different levels of which two types of policies: Encouraging and Exemplification. 'Encouraging' and 'exemplification' are mostly effective policies on people with a low willingness to undertake action, regarding the matter.

Level 1 – encouraging

Subsidy & certification (Encouragement): Subsidies are given that reach 20 to 30 per m² green roof with a maximum of 50% on the total investment. Moreover, a **certificate** is given to every green roof, which works like energy labelling. The certification could cause a rise of the value of the dwelling.

Level 2 – exemplification

Government gives good example (Exemplification): the government implements green roofs at governmental buildings and includes it in building procedures for governmental infused projects.

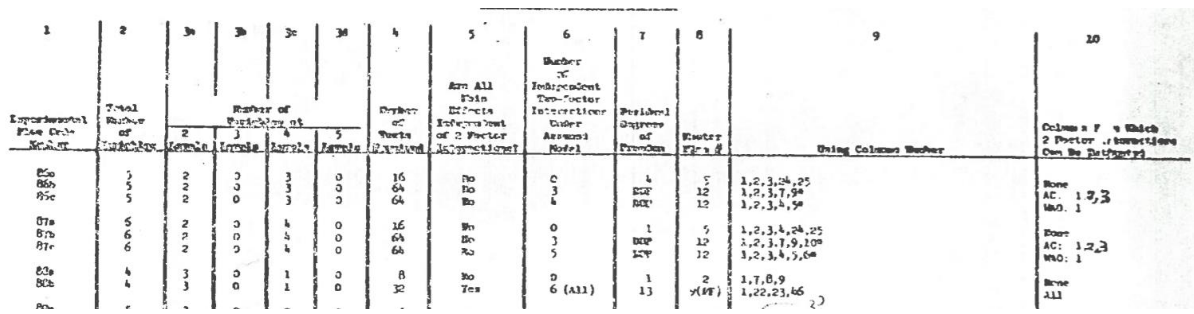
Orthogonal design

Before determining, which orthogonal design should be used, the attributes and levels should be defined:

Levels/attribute	**Typeofgreenroof**	**Price**	**Policy1**	**Policy2**
0	Extensive	€30	Engage	Encourage
1	Intensive	€60	Enable	Exemplify
2	-	€90	-	
3	-	€120	-	-

Via a pdf containing predefined orthogonal designs (see screenshot below), design 88B was selected. 88B is suitable for an alternative with four (4) attributes in total. From this total, one attribute has four (4) levels and three attributes of the alternative have two (2) levels. This design is suitable for this research, since all interaction effects can be measured in it. Moreover, only 16 different alternatives are generated, which makes it highly effective.

However originally the attributes policy1 and policy2 consisted of 3 levels, from which 'none' is deleted. The 'None'-option would give the possibility to look at a policy type individually. In the new design only the combinations can be measured. The other option would have been to keep the 'none' option and make the other level the following way: 'engage & enable', which are types of policies focussing on people willing to cooperate and 'encourage & exemplify', which are types of policies focussing on people not willing to cooperate. However, the thing you are then measuring is the willingness of people to cooperate and not the effectiveness of the four different policies. In the current situation it is possible to see, which combinations of policies are effective (engaging & encouraging; engaging & exemplifying; enabling & encouraging; enabling & exemplifying). Moreover, practically this seemed a good choice to me, since the government is already using multiple policies. For example there is a website with extra information about green roofs from the government, as well as subsidies. It is thus really relevant which combination of policies is most effective.



1	2	3a	3b	3c	3d	4	5	6	7	8	9	10
Experimental Plan Code Number	Total Number of Variables	Number of Variables at 2 Levels	3 Levels	4 Levels	5 Levels	Number of Tests Required	Are All Main Effects Independent of 2 Factor Interactions?	Number of Independent Two-Factor Interactions Under Assumed Model	Residual Degrees of Freedom	Master Plan #	Using Column Number	Columns For Which 2 Factor Interactions Can Be Estimated
85a	5	2	0	3	0	16	No	0	4	5	1,2,3,24,25	None
85b	5	2	0	3	0	64	No	3	[illegible]	12	1,2,3,7,9*	AC. 1,2,3
85c	5	2	0	3	0	64	No	4	[illegible]	12	1,2,3,4,5*	WAO. 1
87a	6	2	0	4	0	16	No	0	1	5	1,2,3,4,24,25	None
87b	6	2	0	4	0	64	No	3	[illegible]	12	1,2,3,7,9,10*	AC: 1,2,3
87c	6	2	0	4	0	64	No	5	[illegible]	12	1,2,3,4,5,6*	WAO: 1
88a	4	3	0	1	0	8	No	0	1	2	1,7,8,9	None
88b	4	3	0	1	0	32	Yes	6 (All)	13	4(MF)	1,22,23,46	All

88B refers to masterplan 5 in the excel spreadsheet with the masterplans and points columns 1, 22, 23 & 46 as columns that should be used to create the orthogonal design.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	1	1	2	3	1	1	1	1	0	1	1	2	1	1	1	1	1	0	0	0	0	1
4	0	2	2	3	1	2	2	2	2	0	2	2	1	1	2	2	2	2	0	0	0	1	0
5	0	3	3	1	2	3	3	3	3	0	1	1	1	2	1	1	1	1	0	0	0	1	1
6	1	0	1	1	1	1	0	3	2	1	0	1	1	1	1	0	1	2	0	1	1	0	0
7	1	1	0	3	2	0	1	2	3	1	1	0	1	2	0	1	2	1	0	1	1	0	1
8	1	2	3	2	0	3	2	1	0	1	2	1	2	0	1	2	1	0	0	1	1	1	0
9	1	3	2	0	3	2	3	0	1	1	1	2	0	1	2	1	0	1	0	1	1	1	1
10	2	0	2	2	2	3	1	0	2	2	0	2	2	2	1	1	0	2	1	0	1	0	0
11	2	1	3	0	1	2	0	1	3	2	1	1	0	1	2	0	1	1	1	0	1	0	1
12	2	2	0	1	3	1	3	2	0	2	2	0	1	1	1	1	2	0	1	0	1	1	0
13	2	3	1	3	0	0	2	3	1	2	1	1	1	0	0	2	1	1	1	0	1	1	1
14	3	0	3	3	3	2	1	3	0	1	0	1	1	1	2	1	1	0	1	1	0	0	0
15	3	1	2	1	0	3	0	2	1	1	1	2	1	0	1	0	2	1	1	1	0	0	1
16	3	2	1	0	2	0	3	1	2	1	2	1	0	2	0	1	1	2	1	1	0	1	0
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21	0	3	1	0	1	3	1	2	0	0	1	1	0	1	1	1	2	0	0	0	0	1	1
22	1	0	3	0	2	1	2	2	1	1	0	1	0	2	1	2	2	1	0	1	1	0	0
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32	3	2	3	1	1	0	1	0	1	1	2	1	1	1	0	1	0	1	1	1	0	1	0
33	3	3	2	3	2	1	0	1	0	1	1	2	1	2	1	0	1	0	1	1	0	1	1

	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW
1	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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30	0	0	1	1	1	0	1	0	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0	0	1
31	1	0	0	0	0	0	0	1	1	0	1	1	0	1	0	1	1	1	0	1	0	1	1	0	0	1
32	1	1	1	0	0	1	1	0	1	1	0	0	0	0	1	1	0	0	0	0	1	1	1	0	0	1
33	0	1	0	1	1	1	0	1	0	1	0	1	1	0	0	0	0	1	1	0	0	0	1	0	0	1

Above masterplan 5 is displayed, with columns 1 (yellow), 22 (red), 23 (green) & 25 (blue) highlighted. All columns represent one attribute of the alternative. To be clear about which column is dedicated to which attribute, the following scheme was made:

Attribute	Typeofgreenroof	Price	Policy1	Policy2
Column nr.	22	1	23	46

This resulted in the following list of alternatives:

Alternative nr.	Typeofgreenroof	Price	Policy1	Policy2
1	0	0	0	0
2	0	0	1	0
3	1	0	0	0
4	1	0	1	0
5	0	1	0	0
6	0	1	1	0
7	1	1	0	0
8	1	1	1	0
9	0	2	0	0
10	0	2	1	0
11	1	2	0	0
12	1	2	1	0
13	0	3	0	0
14	0	3	1	0
15	1	3	0	0
16	1	3	1	0
17	0	0	0	1
18	0	0	1	1
19	1	0	0	1
20	1	0	1	1
21	0	1	0	1
22	0	1	1	1
23	1	1	0	1

24	1	1	1	1
25	0	2	0	1
26	0	2	1	1
27	1	2	0	1
28	1	2	1	1
29	0	3	0	1
30	0	3	1	1
31	1	3	0	1
32	1	3	1	1

Table 2 - Alternatives

Levels of attributes in table 1 were dedicated to the values in table 2, which resulted in the following alternatives. However, also the no-choice option is added as alternative 33:

Alternative nr.	Type of green roof	Price per m2	Policy1	Policy2
1	Extensive	€ 30	Engage	Encourage
2	Extensive	€ 30	Enable	Encourage
3	Intensive	€ 30	Engage	Encourage
4	Intensive	€ 30	Enable	Encourage
5	Extensive	€ 60	Engage	Encourage
6	Extensive	€ 60	Enable	Encourage
7	Intensive	€ 60	Engage	Encourage
8	Intensive	€ 60	Enable	Encourage
9	Extensive	€ 90	Engage	Encourage
10	Extensive	€ 90	Enable	Encourage
11	Intensive	€ 90	Engage	Encourage
12	Intensive	€ 90	Enable	Encourage
13	Extensive	€ 120	Engage	Encourage
14	Extensive	€ 120	Enable	Encourage
15	Intensive	€ 120	Engage	Encourage
16	Intensive	€ 120	Enable	Encourage
17	Extensive	€ 30	Engage	Exemplify
18	Extensive	€ 30	Enable	Exemplify
19	Intensive	€ 30	Engage	Exemplify
20	Intensive	€ 30	Enable	Exemplify
21	Extensive	€ 60	Engage	Exemplify
22	Extensive	€ 60	Enable	Exemplify
23	Intensive	€ 60	Engage	Exemplify
24	Intensive	€ 60	Enable	Exemplify
25	Extensive	€ 90	Engage	Exemplify
26	Extensive	€ 90	Enable	Exemplify
27	Intensive	€ 90	Engage	Exemplify
28	Intensive	€ 90	Enable	Exemplify
29	Extensive	€ 120	Engage	Exemplify
30	Extensive	€ 120	Enable	Exemplify
31	Intensive	€ 120	Engage	Exemplify
32	Intensive	€ 120	Enable	Exemplify
33	No green roof	€ -	No Policy	No policy

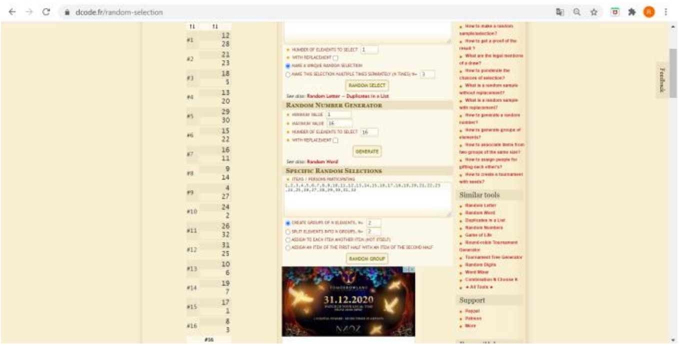
Random matching two alternatives

Via the website dcode.fr two alternatives are matched randomly. This way there will be 16 questions, that include two alternatives as a choice option. Also the choice option none is added, for people who are not satisfied with both alternatives.

Version 1:

#1	12	28
#2	21	23
#3	18	5
#4	13	20
#5	29	30
#6	15	22
#7	16	11
#8	9	14
#9	4	27

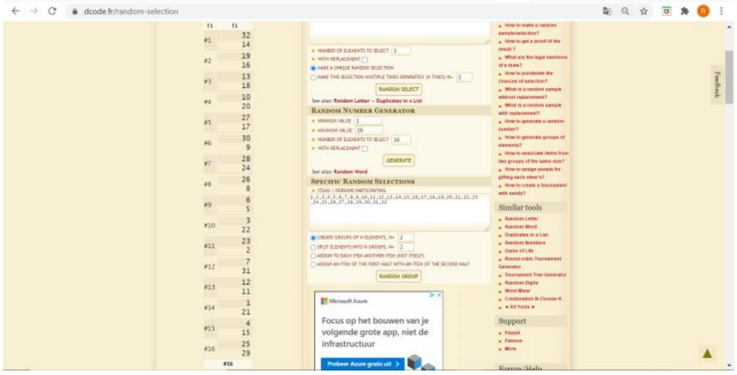
#10	24	2
#11	26	32
#12	31	25
#13	10	6
#14	19	7
#15	17	1
#16	8	3



(dcode.fr/random-selection)

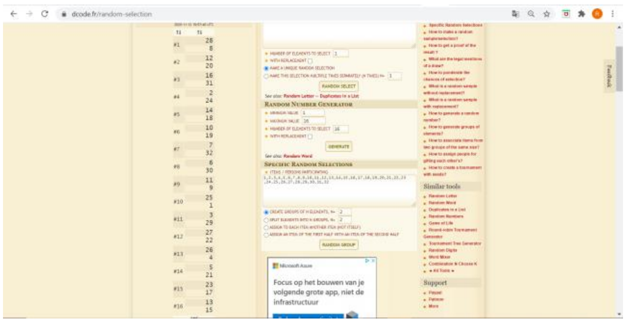
Version 2

#1	32	14
#2	19	16
#3	13	18
#4	10	20
#5	27	17
#6	30	9
#7	28	24
#8	26	8
#9	6	5
#10	3	22
#11	23	2
#12	7	31
#13	12	11
#14	1	21
#15	4	15
#16	25	29



Version 3

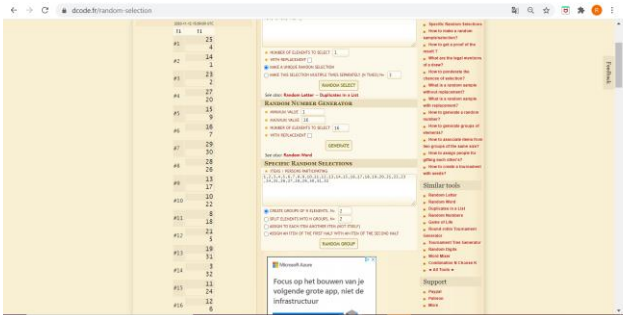
#1	28	8
#2	12	20
#3	16	31
#4	2	24
#5	14	18
#6	10	19
#7	7	32
#8	6	30
#9	11	9
#10	25	1
#11	3	29
#12	27	22
#13	26	4
#14	5	21
#15	23	17
#16	13	15



Version 4

#1	25	4
#2	14	1
#3	23	2
#4	27	20

#5	15	9
#6	16	7
#7	29	30
#8	28	26
#9	13	17
#10	10	22
#11	8	18
#12	21	5
#13	19	31
#14	3	32
#15	11	24
#16	12	6



Limesurvey

In Limesurvey the four different versions are split up in order to keep the survey short. Every version is divided into two parts. To give an oversight, the following scheme is made:

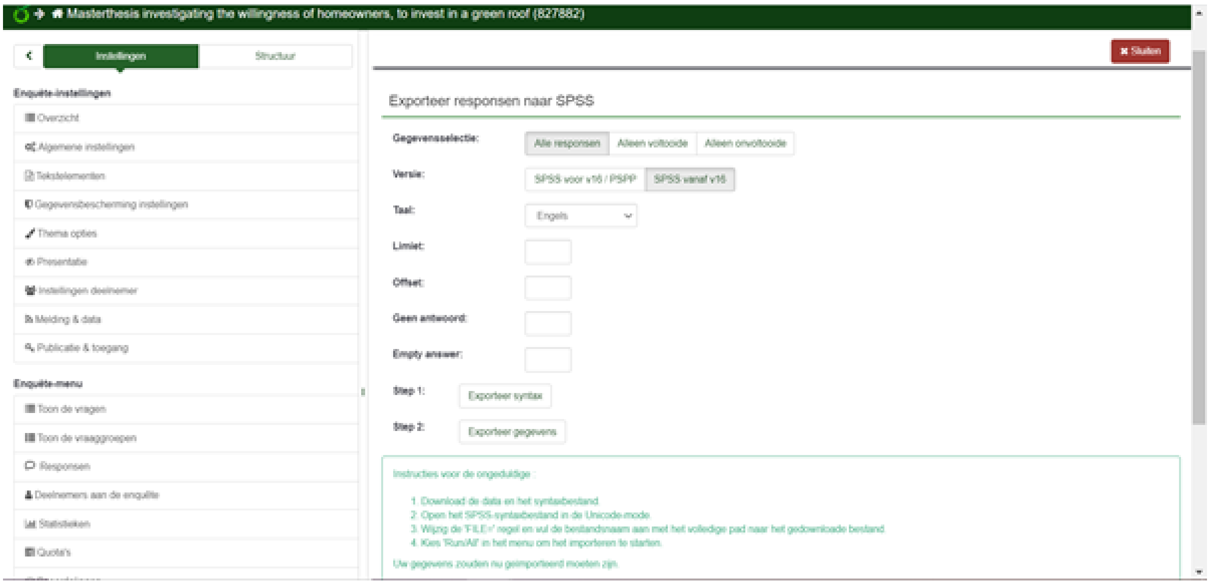
Version	Question numbers	Limesurvey question group	Question nr. In Limesurvey
1	1 to 8	Stated choice experiment (version1/part1)	1 to 8
1	9 to 16	Stated choice experiment (version1/part2)	9 to 16
2	1 to 8	Stated choice experiment (version2/part1)	17 to 24
2	9 to 16	Stated choice experiment (version2/part2)	25 to 32
3	1 to 8	Stated choice experiment (version3/part1)	33 to 40
3	9 to 16	Stated choice experiment (version3/part2)	41 to 48

4	1 to 8	Stated choice experiment (version4/part1)	49 to 56
4	9 to 16	Stated choice experiment (version4/part2)	57 to 64

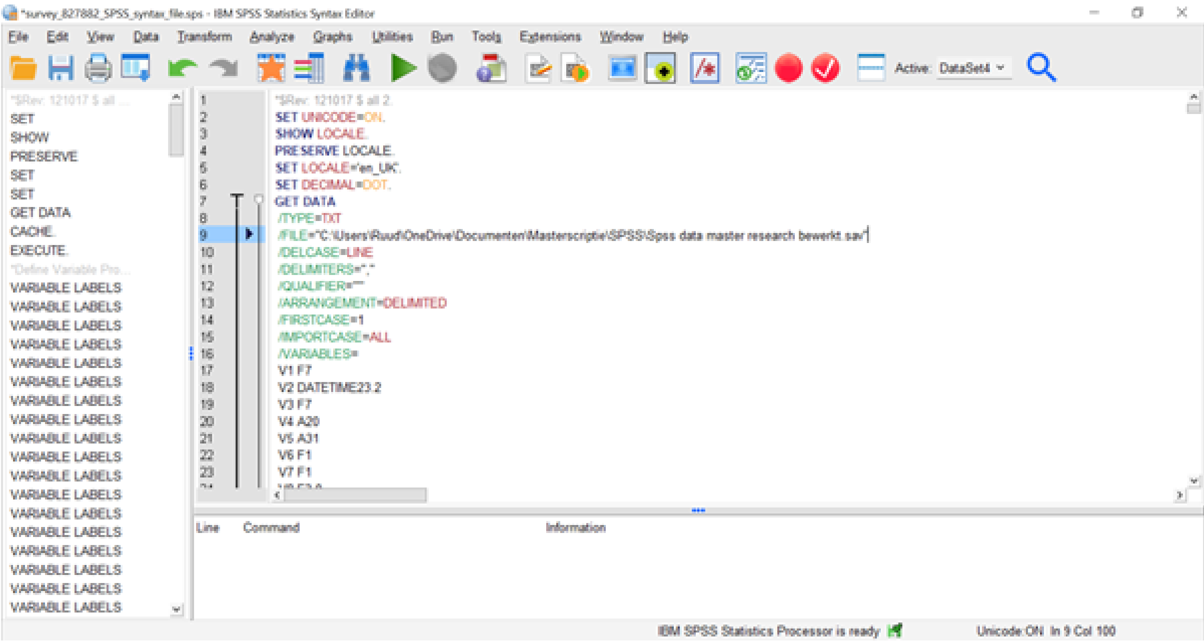
Appendix III - Data preparation

Appendix data preparation

Data was exported from limesurvey to SPSS:



The location of the file was correctly filled in order to retrieve data:



Attribute table

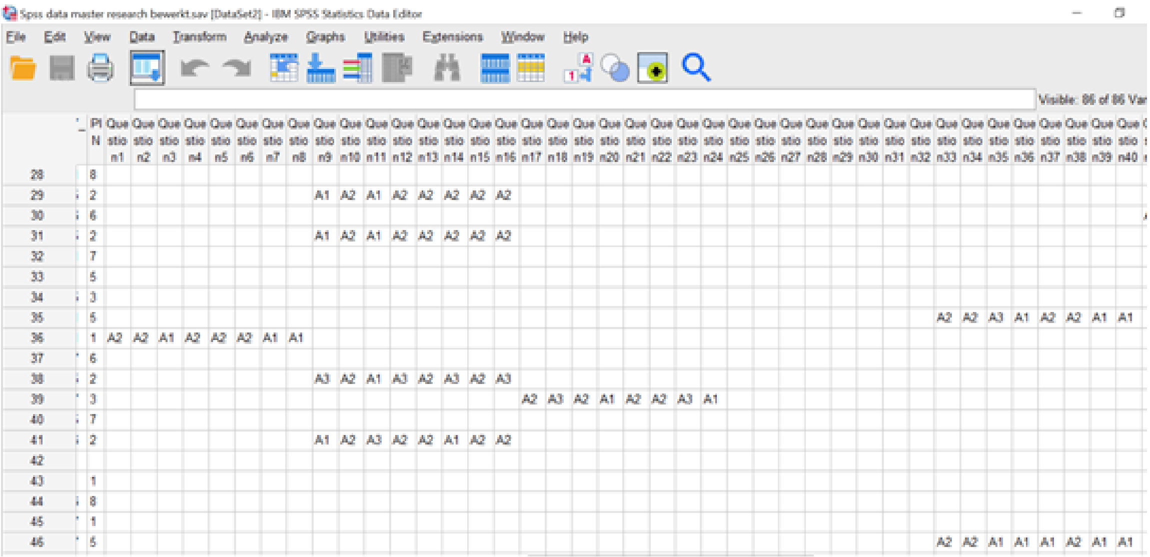
Levels/attribute	**Typeofgreenroof**	**Price**	**Policy1**	**Policy2**
0	Extensive	€30	Engage	Encourage
1	Intensive	€60	Enable	Exemplify
2	-	€90	-	
3	-	€120	-	-

Alternatives

Alternative nr.	Typeofgreenroof	Price	Policy1	Policy2
1	0	0	0	0
2	0	0	1	0
3	1	0	0	0
4	1	0	1	0
5	0	1	0	0
6	0	1	1	0
7	1	1	0	0
8	1	1	1	0
9	0	2	0	0
10	0	2	1	0

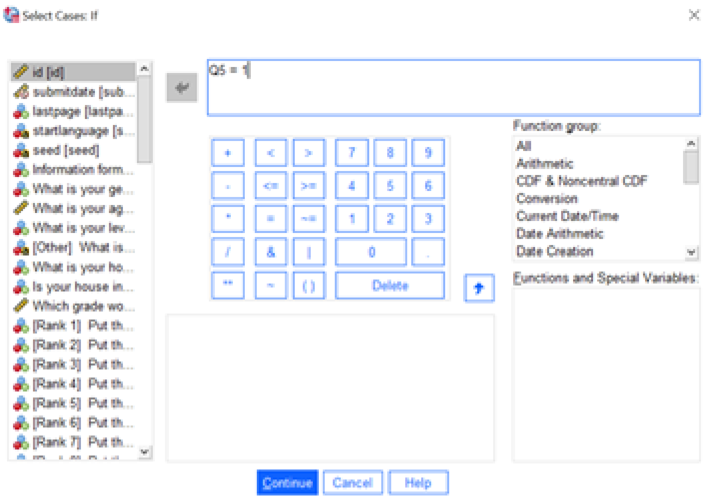
11	1	2	0	0
12	1	2	1	0
13	0	3	0	0
14	0	3	1	0
15	1	3	0	0
16	1	3	1	0
17	0	0	0	1
18	0	0	1	1
19	1	0	0	1
20	1	0	1	1
21	0	1	0	1
22	0	1	1	1
23	1	1	0	1
24	1	1	1	1
25	0	2	0	1
26	0	2	1	1
27	1	2	0	1
28	1	2	1	1
29	0	3	0	1
30	0	3	1	1
31	1	3	0	1
32	1	3	1	1

Data regarding the choice experiment that was derived from limesurvey was coded as followed:

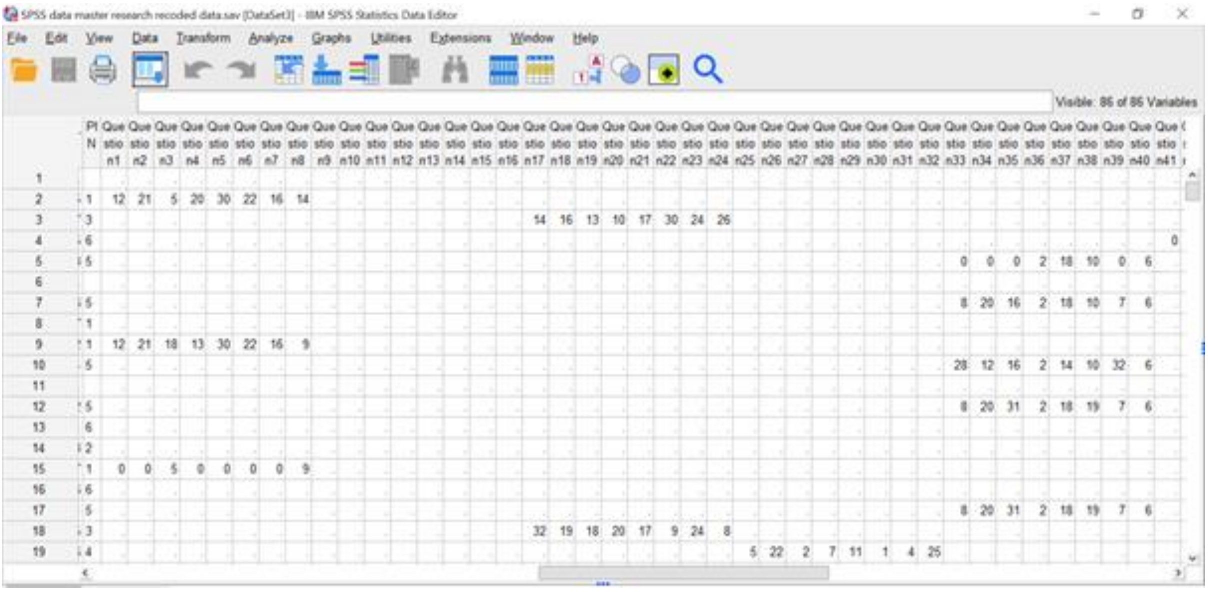


Where A1=choice option 1, A2=choice option 2 and A3=no choice option. In the left column PIN, the version is shown.

Next, respondents were deleted when the question ‘do you have a house in your own property?’ was answered with ‘No’. This was conducted by select cases, using the IF statisfied function coded as 1 (respondents that have their house in own property) delete unselected cases. This is illustrated below:



By knowing the version and the answer options, all A1's, A2's and A3's, were recoded to alternative numbers, as shown below:



The recoded datafile was exported to Excel

In excel the data was transformed from horizontal to vertical:

A	B	C
Responde	Question nr.	Alternativ
2	1	4
	2	2
	3	26
	4	25
	5	6
	6	7
	7	1
	8	3
3	1	11
	2	1
	3	3
	4	22
	5	4
	6	5
	7	17
	8	13
4	1	4
	2	2
	3	26
	4	25
	5	6
	6	7

Since it is a choice experiment only profiles that are chosen, can be weighed off to profiles (or alternatives) that were not chosen. Therefore, the column 'choice' is added in the choice experiment. Moreover, the alternatives that were not chosen relative to the chosen alternative is included:

Qno	Choice	Profile
1	1	12
1	0	28
1	0	33
2	1	21
2	0	23
2	0	33
3	1	5
3	0	18
3	0	33
4	1	20
4	0	13
4	0	33
5	1	30
5	0	29
5	0	33
6	1	22
6	0	15
6	0	33
7	1	16
7	0	11
7	0	33
8	1	14
8	0	9
8	0	33

As you see in the figure, there are three possibilities of profiles per question (Qno). Only one out of three is chosen (coded by 1 in the 'choice' column).

Constant (or no choice):

In order to be able to code the 'no choice' option, a constant was added. The constant is zero (0) for the no choice option and one (1) for the alternatives that include a green roof. Benefit of coding the no-choice to zero is that when the no-choice option, where no changes are made with the situation before, is chosen, a utility of zero is calculated. Since it is zero, it can serve as a reference point in the analysis in terms of finding alternatives with a positive utility and a negative utility (Henscher et al., 2015).

Dummycoding:

Dummycoding was conducted for both the choice experiment and the questions that were asked in advance and were coded as followed:

Gender	0=women 1=man
Age	-
Type of education	0=other 1=university/higher education/practical education/secondary school
Income	0=would rather not say 1=0-1000/1000-2500/2500-5000/5000 or more
Perception local microclimate	0=Lowest 1=low/average/high/highest

Ext	1=extensive green roof 0=no extensive green roof
Int	1=intensive green roof 0=no intensive green roof
Price per m²	0= other price 1=30; 60; 90; 120 (4 variables)
Engage	1=engage 0=no engage
Enable	1= enable 0=no enable
Encourage	1=encourage 0=no encourage

Exemplify	1=exemplify 0=no exemplify
Choice	1= Yes 0=No
Constant/No green roof	1=choice alternative with green roof 0=no choice option

Regarding the choice experiment, dummy coding was conducted in order to make the data analysable. By using an extra tab in the excel document, dummy coding of every alternative was conducted:

Alt.nr./Att	Constant (	Extensive	Intensive	€ 30	€ 60	€ 90	€ 120	Engage	Enable	Encourage	Exemplify
1	1	1	0	1	0	0	0	1	0	1	0
2	1	1	0	1	0	0	0	0	1	1	0
3	1	0	1	1	0	0	0	1	0	1	0
4	1	0	1	1	0	0	0	0	1	1	0
5	1	1	0	0	1	0	0	1	0	1	0
6	1	1	0	0	1	0	0	0	1	1	0
7	1	0	1	0	1	0	0	1	0	1	0
8	1	0	1	0	1	0	0	0	1	1	0
9	1	1	0	0	0	1	0	1	0	1	0
10	1	1	0	0	0	1	0	0	1	1	0
11	1	0	1	0	0	1	0	1	0	1	0
12	1	0	1	0	0	1	0	0	1	1	0
13	1	1	0	0	0	0	1	1	0	1	0
14	1	1	0	0	0	0	1	0	1	1	0
15	1	0	1	0	0	0	1	1	0	1	0
16	1	0	1	0	0	0	1	0	1	1	0
17	1	1	0	1	0	0	0	1	0	0	1
18	1	1	0	1	0	0	0	0	1	0	1
19	1	0	1	1	0	0	0	1	0	0	1
20	1	0	1	1	0	0	0	0	1	0	1
21	1	1	0	0	1	0	0	1	0	0	1
22	1	1	0	0	1	0	0	0	1	0	1
23	1	0	1	0	1	0	0	1	0	0	1
24	1	0	1	0	1	0	0	0	1	0	1
25	1	1	0	0	0	1	0	1	0	0	1
26	1	1	0	0	0	1	0	0	1	0	1
27	1	0	1	0	0	1	0	1	0	0	1
28	1	0	1	0	0	1	0	0	1	0	1
29	1	1	0	0	0	0	1	1	0	0	1
30	1	1	0	0	0	0	1	0	1	0	1
31	1	0	1	0	0	0	1	1	0	0	1
32	1	0	1	0	0	0	1	0	1	0	1
33	0	0	0	0	0	0	0	0	0	0	0

33 is, as you can see, the no choice option, where all levels (incl. the constant) are set to zero.

By using the following formula in excel, the dummycoding was applied to the excel spreadsheet:

=INDEX('Dummycoding per alt'!B:B;VERGELIJKEN($C2;'Dummycoding per alt'!$A:$A))

The constant was renamed into No Green Roof (No Green). The constant is coded as zero in case of no green roof, the no choice option. However, the constant is coded as one for a choice alternative with a green roof. The result of the excel spreadsheet is shown below:

Qno	Choice	Profile	No Green I	Ext	Int	Price30	Price60	Price90	Price120	Engage	Enable	Encour	Exempl
1	1	12	1	0	1	0	0	1	0	0	1	1	0
1	0	28	1	0	1	0	0	1	0	0	1	0	1
1	0	33	0	0	0	0	0	0	0	0	0	0	0
2	1	21	1	1	0	0	1	0	0	1	0	0	1
2	0	23	1	0	1	0	1	0	0	1	0	0	1
2	0	33	0	0	0	0	0	0	0	0	0	0	0
3	1	5	1	1	0	0	1	0	0	1	0	1	0
3	0	18	1	1	0	1	0	0	0	0	1	0	1
3	0	33	0	0	0	0	0	0	0	0	0	0	0
4	1	20	1	0	1	1	0	0	0	0	1	0	1
4	0	13	1	1	0	0	0	0	1	1	0	1	0
4	0	33	0	0	0	0	0	0	0	0	0	0	0
5	1	30	1	1	0	0	0	0	1	0	1	0	1
5	0	29	1	1	0	0	0	0	1	1	0	0	1
5	0	33	0	0	0	0	0	0	0	0	0	0	0
6	1	22	1	1	0	0	1	0	0	0	1	0	1
6	0	15	1	0	1	0	0	0	1	1	0	1	0
6	0	33	0	0	0	0	0	0	0	0	0	0	0
7	1	16	1	0	1	0	0	0	1	0	1	1	0
7	0	11	1	0	1	0	0	1	0	1	0	1	0
7	0	33	0	0	0	0	0	0	0	0	0	0	0
8	1	14	1	1	0	0	0	0	1	0	1	1	0
8	0	9	1	1	0	0	0	1	0	1	0	1	0
8	0	33	0	0	0	0	0	0	0	0	0	0	0

Explanation of columns:

Qno: Represents the question number for the respective respondent. There are three question numbers with an equal value, since all questions have three possibilities (two alternatives and the no-choice).

Choice: the column 'choice' shows whether the alternative is chosen (1) or not chosen (0).

Profile: the column 'profile' shows which alternative belongs to the coding to its right in the row.

No Green: this column represents the no-choice option, which was explained above.

The rest of the columns are attributes and levels of the choice experiment and are explained in the coding scheme above.

The choice experiment is now ready for analysis, which is explained in the next Appendix. For the whole dataset, the excel sheet is included in submission.

Appendix IV - Analysis data Nlogit

Analysis choice experiment

Important to know for the analysis is, which alternatives were more popular and which were less popular in general. Since not all alternatives are in every version, the frequencies were calculated as followed:

Using frequencies of variable 'version' and subtract it with 24 (only one version per 8 questions and every question consists of three rows (3*8=24)), is the amount of times a version is used. Looking at the alternatives (1-33) per version and multiplying them with the factor of frequencies that belongs to the particular version a maximum possible frequency per alternative is calculated. In the next column that actual amount of times the particular alternative was chosen is indicated. In the column to the right, the relative percentage between the max.possible frequency and the actual frequency is calculated. At last, the rank is estimated via the Rank function in Excel. This gives an impression in which alternative was most popular and which were not.

Frequencies chosen Alternatives:

Alternative	Max. possible frequency	Actual times chosen	Relative (%)	Rank
1	70	59	84%	1
2	74	62	84%	2
3	83	35	42%	15
4	70	26	37%	17
5	86	40	47%	11
6	87	55	63%	4
7	74	38	51%	10
8	86	30	35%	18
9	72	56	78%	3
10	86	29	34%	19
11	86	19	22%	26
12	90	23	26%	21
13	85	37	44%	14
14	76	18	24%	23
15	73	11	15%	28
16	76	18	24%	23
17	82	49	60%	6
18	89	56	63%	5
19	86	38	44%	13
20	76	34	45%	12
21	86	32	37%	16
22	86	50	58%	7
23	73	8	11%	31
24	86	21	24%	22
25	70	36	51%	9
26	69	39	57%	8
27	69	4	6%	33
28	76	8	11%	32
29	73	19	26%	20
30	76	17	22%	25
31	87	13	15%	29
32	86	12	14%	30
33	1272	280	22%	27

Main effects using Nlogit (Model: discrete choice model Mlogit)

In order to be able to conduct MNL analysis, reference categories are chosen, which are shown below per attribute

Type of green roof: Intensive green roof

Price: €120 per m²

Policy 1: Enable

Policy 2: Exemplify

In the analysis, these reference categories are used as a zero measurement. The utility of other levels of attributes are measured in reference to the reference categories. All reference categories are set to zero in analysis.

Dependent variable: choice

Independent variables:

Command:

Lhs= dependent variable

Rhs=independent variables

Choices=number of choices

PDS=number of questions per respondent

Output:

Creating interaction variables by computing in the syntax gives:

Name	Interaction
EXT_P30	EXT*PRICE30
EXT_P60	EXT*PRICE60
EXT_P90	EXT*PRICE90
EXT_ENG	EXT*ENGAGE
EXT_ENC	EXT*ENCOUR
P30_ENG	PRICE30*ENGAGE
P30_ENC	PRICE30*ENCOUR
P60_ENG	PRICE60*ENGAGE
P60_ENC	PRICE60*ENCOUR
P90_ENG	PRICE90*ENGAGE
P90_ENC	PRICE90*ENCOUR
ENG_ENC	ENGAGE*ENCOUR

Dependent variable: choices

Independent: look below

*CREATE; EXT_P60=EXT*PRICE60$*

*CREATE; EXT_P90=EXT*PRICE90$*

*CREATE; EXT_ENC=EXT*ENCOUR$*

*CREATE; P30_ENG=PRICE30*ENGAGE$*

*CREATE; P60_ENG=PRICE60*ENGAGE$*

*CREATE; P90_ENG=PRICE90*ENGAGE$*

```
CREATE; P30_ENC=PRICE30*ENCOUR$

CREATE; P60_ENC=PRICE60*ENCOUR$

CREATE; P90_ENC=PRICE90*ENCOUR$

CREATE; EXT_P30=EXT*PRICE30$

CREATE; ENG_ENC=ENGAGE*ENCOUR$

NLOGIT;Lhs=CHOICE

        ; CHOICES=1,2,3

        ;
Rhs=CONSTANT,EXT,EXT_P30,EXT_P60,EXT_P90,EXT_ENG,EXT_ENC,PRICE30,P30_ENG,P30_ENC,PRICE60,P60_ENG,P60_ENC,PRICE90,P90_ENG,P90_ENC,ENGAGE,ENCOUR,ENG_ENC

        ; PDS=8$
```

```
----------------------------------------
             Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)
Warning:  Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
----------------------------------------
Response data are given as ind. choices
Number of obs.=   1272, skipped    0 obs
```

CHOICE	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
CONSTANT	-.74751***	.22537	-3.32	.0009	-1.18921	-.30580
EXT	.77071***	.24049	3.20	.0014	.29936	1.24206
EXT_P30	.57507**	.27077	2.12	.0337	.04436	1.10578
EXT_P60	-.02134	.27329	-.08	.9378	-.55697	.51430
EXT_P90	.72675***	.28118	2.58	.0097	.17565	1.27784
EXT_ENG	.39600**	.18759	2.11	.0348	.02833	.76367
EXT_ENC	.14326	.19012	.75	.4511	-.22937	.51588
PRICE30	1.25688***	.28030	4.48	.0000	.70750	1.80627
P30_ENG	.05949	.26998	.22	.8256	-.46966	.58864
P30_ENC	-.28769	.29083	-.99	.3226	-.85771	.28232
PRICE60	1.09032***	.28242	3.86	.0001	.53679	1.64386
P60_ENG	-.29831	.28065	-1.06	.2878	-.84838	.25176
P60_ENC	-.08175	.28906	-.28	.7773	-.64829	.48478
PRICE90	-.11273	.31112	-.36	.7171	-.72252	.49707
P90_ENG	.32274	.28598	1.13	.2591	-.23776	.88324
P90_ENC	-.03476	.27983	-.12	.9012	-.58321	.51370
ENGAGE	-.27694	.24167	-1.15	.2518	-.75061	.19672
ENCOUR	.25184	.23823	1.06	.2905	-.21509	.71877
ENG_ENC	.45386**	.18052	2.51	.0119	.10004	.80768

Filtering out non-significant variables:

```
Discrete choice (multinomial logit) model
Dependent variable               Choice
Log likelihood function     -1166.76180
Estimation based on N =    1272, K =   8
Inf.Cr.AIC  =    2349.5 AIC/N =    1.847
---------------------------------------
            Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)
Warning:  Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.=  1272, skipped    0 obs
--------+--------------------------------------------------------------------
        |                Standard            Prob.       95% Confidence
  CHOICE|  Coefficient     Error       z    |z|>Z*          Interval
--------+--------------------------------------------------------------------
CONSTANT|   -.75345***     .11379    -6.62  .0000      -.97649    -.53042
     EXT|    .91756***     .14961     6.13  .0000       .62434    1.21078
 EXT_P30|    .59821***     .22193     2.70  .0070       .16324    1.03319
 EXT_P90|    .73463***     .16048     4.58  .0000       .42009    1.04917
 EXT_ENG|    .20292        .14668     1.38  .1665      -.08456     .49040
 PRICE30|   1.13244***     .14439     7.84  .0000       .84945    1.41543
 PRICE60|    .97100***     .12407     7.83  .0000       .72783    1.21418
 ENG_ENC|    .46856***     .10475     4.47  .0000       .26325     .67387
--------+--------------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
Model was estimated on Mar 09, 2021 at 10:35:46 AM
-----------------------------------------------------------------------------
```

NLOGIT;Lhs=CHOICE

; CHOICES=1,2,3

; Rhs=CONSTANT,EXT,EXT_P30,EXT_P90,EXT_ENG,PRICE30,PRICE60,ENG_ENC

; PDS=8$

Filtering out non-significant values (part 2)

NLOGIT;Lhs=CHOICE

; CHOICES=1,2,3

; Rhs=CONSTANT,EXT,EXT_P30,EXT_P90,PRICE30,PRICE60,ENG_ENC

; PDS=8$

```
-----------------------------------------------------------------------------
Discrete choice (multinomial logit) model
Dependent variable               Choice
Log likelihood function     -1167.72411
Estimation based on N =    1272, K =   7
Inf.Cr.AIC  =    2349.4 AIC/N =    1.847
---------------------------------------
            Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)
Warning:  Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.=  1272, skipped    0 obs
--------+--------------------------------------------------------------------
        |                  Standard            Prob.          95% Confidence
  CHOICE|  Coefficient       Error       z    |z|>Z*             Interval
--------+--------------------------------------------------------------------
CONSTANT|   -.76690***      .11361    -6.75  .0000      -.98958    -.54422
     EXT|   1.01789***      .13088     7.78  .0000       .76138    1.27441
 EXT_P30|    .55347**       .21879     2.53  .0114       .12464     .98229
 EXT_P90|    .72977***      .15956     4.57  .0000       .41704    1.04251
 PRICE30|   1.13448***      .14473     7.84  .0000       .85081    1.41816
 PRICE60|    .96444***      .12393     7.78  .0000       .72154    1.20735
 ENG_ENC|    .52314***      .09710     5.39  .0000       .33281     .71346
--------+--------------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
Model was estimated on Mar 09, 2021 at 10:38:26 AM
-----------------------------------------------------------------------------
```

R2=1-(LOGLIKELIHOOD/LOG(0))

R2=1-(-1,1167,72411/-1397,4348)=0,16438

Utilities of alternatives were calculated giving the following table with utilities per alternative:

Alternative #	*No Green Roof*	Extensive	Price 30	Price 60	Extensive & Price 30	Extensive & Price 90	Engage & Encourage	Total utility
1	-0,7669	1,10179	1,13448	*0*	0,55347	*0*	0,52314	2,545979
2	-0,7669	1,10179	1,13448	*0*	0,55347	*0*	0	2,022839
3	-0,7669	0	1,13448	*0*	0	*0*	0,52314	0,89072
4	-0,7669	0	1,13448	*0*	0	*0*	0	0,36758
5	-0,7669	1,10179	0	0,96444	0	*0*	0,52314	1,822469
6	-0,7669	1,10179	0	0,96444	0	*0*	0	1,299329
7	-0,7669	0	0	0,96444	0	*0*	0,52314	0,72068
8	-0,7669	0	0	0,96444	0	*0*	0	0,19754
9	-0,7669	1,10179	0	0	0	0,72977	0,52314	1,587799
10	-0,7669	1,10179	0	0	0	0,72977	0	1,064659
11	-0,7669	0	0	0	0	*0*	0,52314	-0,24376
12	-0,7669	0	0	0	0	*0*	0	-0,7669
13	-0,7669	1,10179	0	0	0	*0*	0,52314	0,858029
14	-0,7669	1,10179	0	0	0	*0*	0	0,334889
15	-0,7669	0	0	0	0	*0*	0,52314	-0,24376
16	-0,7669	0	0	0	0	*0*	0	-0,7669
17	-0,7669	1,10179	1,13448	*0*	0,55347	*0*	0	2,022839
18	-0,7669	1,10179	1,13448	*0*	0,55347	*0*	0	2,022839
19	-0,7669	0	1,13448	*0*	0	*0*	0	0,36758
20	-0,7669	0	1,13448	*0*	0	*0*	0	0,36758
21	-0,7669	1,10179	0	0,96444	0	*0*	0	1,299329
22	-0,7669	1,10179	0	0,96444	0	*0*	0	1,299329
23	-0,7669	0	0	0,96444	0	*0*	0	0,19754
24	-0,7669	0	0	0,96444	0	*0*	0	0,19754
25	-0,7669	1,10179	0	0	0	0,72977	0	1,064659
26	-0,7669	1,10179	0	0	0	0,72977	0	1,064659
27	-0,7669	0	0	0	0	*0*	0	-0,7669
28	-0,7669	0	0	0	0	*0*	0	-0,7669
29	-0,7669	1,10179	0	0	0	*0*	0	0,334889
30	-0,7669	1,10179	0	0	0	*0*	0	0,334889
31	-0,7669	0	0	0	0	*0*	0	-0,7669
32	-0,7669	0	0	0	0	*0*	0	-0,7669
33	0	0	0	0	0	*0*	0	0

The utilities of alternatives translated in the following ranking of the alternatives:

Rank	Alternative #	Type of green roof	Price		Policy 1	Policy 2	Total utility
1	1	Extensive	€	30	Engage	Encourage	2,55
2	2	Extensive	€	30	Enable	Encourage	2,02
3	17	Extensive	€	30	Engage	Exemplify	2,02
4	18	Extensive	€	30	Enable	Exemplify	2,02
5	5	Extensive	€	60	Engage	Encourage	1,82
6	9	Extensive	€	90	Engage	Encourage	1,59
7	6	Extensive	€	60	Enable	Encourage	1,30
8	21	Extensive	€	60	Engage	Exemplify	1,30
9	22	Extensive	€	60	Enable	Exemplify	1,30
10	10	Extensive	€	90	Enable	Encourage	1,06
11	25	Extensive	€	90	Engage	Exemplify	1,06
12	26	Extensive	€	90	Enable	Exemplify	1,06
13	3	Intensive	€	30	Engage	Encourage	0,89
14	13	Extensive	€	120	Engage	Encourage	0,86
15	7	Intensive	€	60	Engage	Encourage	0,72
16	4	Intensive	€	30	Enable	Encourage	0,37
17	19	Intensive	€	30	Engage	Exemplify	0,37
18	20	Intensive	€	30	Enable	Exemplify	0,37
19	14	Extensive	€	120	Enable	Encourage	0,33
20	29	Extensive	€	120	Engage	Exemplify	0,33
21	30	Extensive	€	120	Enable	Exemplify	0,33
22	8	Intensive	€	60	Enable	Encourage	0,20
23	23	Intensive	€	60	Engage	Exemplify	0,20
24	24	Intensive	€	60	Enable	Exemplify	0,20
25	33	No green roof	€	-	Nothing	Nothing	0,00
26	11	Intensive	€	90	Engage	Encourage	-0,24
27	15	Intensive	€	120	Engage	Encourage	-0,24
28	12	Intensive	€	90	Enable	Encourage	-0,77
29	16	Intensive	€	120	Enable	Encourage	-0,77
30	27	Intensive	€	90	Engage	Exemplify	-0,77
31	28	Intensive	€	90	Enable	Exemplify	-0,77
32	31	Intensive	€	120	Engage	Exemplify	-0,77
33	32	Intensive	€	120	Enable	Exemplify	-0,77

Analysis of MNL with demographic- and experience groups

Below commands and MNL analysis regarding differences in demographic- and experience groups are elaborated upon. Commands regarding creating interaction terms and conducting MNL analysis, used in analysis, are shown. First all demographic- and experience groups are analysed separately. The significant effects from all demographic- and experience groups are then analysed together in order to avert correlation.

Gender interaction terms

|-> RESET

|-> IMPORT;FILE="C:\Users\Ruud\OneDrive\Documenten\Masterscriptie\Werkbestand Nlogit\Gender datafiles\Data for Nlogit_lt_gender.csv"$

Creation of interaction terms:

*|-> CREATE; GEXT30=Gx_Ext*Gx_P30$*

*|-> CREATE; GEXT60=Gx_Ext*Gx_P60$*

*|-> CREATE; GEXT90=Gx_Ext*Gx_P90$*

*|-> CREATE; GEXENG=Gx_Ext*Gx_ENG$*

*|-> CREATE; GEXENC=Gx_Ext*Gx_ENC$*

*|-> CREATE; G30ENG=Gx_P30*Gx_ENG$*

*|-> CREATE; G30ENC=Gx_P30*Gx_ENC$*

*|-> CREATE; G60ENG=Gx_P60*Gx_ENG$*

*|-> CREATE; G60ENC=Gx_P60*Gx_ENC$*

*|-> CREATE; G90ENG=Gx_P90*Gx_ENG$*

*|-> CREATE; G90ENC=Gx_P90*Gx_ENC$*

*|-> CREATE; G_NGNC=Gx_ENG*Gx_ENC$*

Analysis was conducted including all main effects and interaction effects. By filtering out non-significant main effects and interaction effects, the following significant main- and interaction effects remained:

|-> NLOGIT;Lhs=CHOICE

; CHOICES=1,2,3

;
Rhs=Gx_NoGr,Gx_Ext,Gx_ENG,GEXENG,G30ENC,G60ENG,G_NGNC,NoGrRo,EXT,EXT_P30,EXT_P90,PRICE30,PRICE60,ENG_ENC

; PDS=8$

Iterative procedure has converged

Normal exit: 5 iterations. Status=0, F= .1154344D+04

Discrete choice (multinomial logit) model

Dependent variable   Choice

Log likelihood function   -1154.34427

Estimation based on N =   1272, K = 14

Inf.Cr.AIC =   2336.7 AIC/N =   1.837

Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)

Warning: Model does not contain a full

set of ASCs. R-sqrd is problematic. Use

model setup with ;RHS=one to get LogL0.

Response data are given as ind. choices

Number of obs.= 1272, skipped 0 obs

CHOICE	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
GX_NOGR	.64116***	.21584	2.97	.0030	.21812	1.06421
GX_EXT	-.74574***	.24254	-3.07	.0021	-1.22110	-.27038
GX_ENG	-.75800***	.23471	-3.23	.0012	-1.21803	-.29797
GEXENG	.71332***	.26611	2.68	.0074	.19174	1.23489
G30ENC	-.49442**	.24287	-2.04	.0418	-.97043	-.01840
G60ENG	-.79784***	.29687	-2.69	.0072	-1.37970	-.21597
G_NGNC	.59478**	.25490	2.33	.0196	.09519	1.09437
NOGRRO	-.97001***	.15383	-6.31	.0000	-1.27152	-.66851
EXT	1.24136***	.17407	7.13	.0000	.90019	1.58254
EXT_P30	.52564**	.22222	2.37	.0180	.09009	.96118
EXT_P90	.73041***	.16252	4.49	.0000	.41189	1.04894
PRICE30	1.25915***	.15723	8.01	.0000	.95099	1.56731
PRICE60	1.05766***	.13319	7.94	.0000	.79661	1.31870
ENG_ENC	.52979***	.13762	3.85	.0001	.26006	.79952

****, **, * ==> Significance at 1%, 5%, 10% level.*

Model was estimated on Mar 15, 2021 at 09:47:35 AM

Education:

Interaction terms were created, secondary school was left out of analysis due to low amount (N=7), Practical (n=17) is included:

Example of creating interaction effect for university:

*CREATE; U_EXTP30=U_Ext*U_P30$*

*CREATE; U_EXTP60=U_Ext*U_P60$*

*CREATE; U_EXTP90=U_Ext*U_P90$*

*CREATE; U_EXTENG=U_Ext*U_ENG$*

*CREATE; U_EXTENC=U_Ext*U_ENC$*

*CREATE; U_P30ENG=U_P30*U_ENG$*

*CREATE; U_P30ENC=U_P30*U_ENC$*

*CREATE; U_P60ENG=U_P60*U_ENG$*

*CREATE; U_P60ENC=U_P60*U_ENC$*

*CREATE; U_P90ENG=U_P90*U_ENG$*

*CREATE; U_P90ENC=U_P90*U_ENC$*

*CREATE; U_ENGENC=U_ENG*U_ENC$*

Analysis was conducted including all main effects and interaction effects. By filtering out non-significant main effects and interaction effects, the following significant main- and interaction effects remained:

```
|-> NLOGIT;Lhs=CHOICE

        ; CHOICES=1,2,3

  ;
Rhs=U_NGR,H_EXT,H_ENC,P_ENC,U_EXTENG,P_EXTENG,P_P90ENG,NOGREEN,EXT_P90,PR
ICE30,PRICE60,ENG_ENC

        ; PDS=8$

Iterative procedure has converged

Normal exit:   5 iterations. Status=0, F=   .1182759D+04



-----------------------------------------------------------------------

Discrete choice (multinomial logit) model

Dependent variable                Choice

Log likelihood function    -1182.75898

Estimation based on N =    1272, K =  12

Inf.Cr.AIC  =   2389.5 AIC/N =     1.879

-------------------------------------

        Log likelihood R-sqrd R2Adj



Note: R-sqrd = 1 - logL/Logl(constants)
```

Warning: Model does not contain a full

set of ASCs. R-sqrd is problematic. Use

model setup with ;RHS=one to get LogL0.

Response data are given as ind. choices

Number of obs.= 1272, skipped 0 obs

CHOICE	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
U_NGR	.62660***	.15729	3.98	.0001	.31832	.93487
H_EXT	1.07212***	.15308	7.00	.0000	.77208	1.37216
H_ENC	.22186*	.13356	1.66	.0967	-.03992	.48364
P_ENC	.74860***	.22606	3.31	.0009	.30553	1.19168
U_EXTENG	.82231***	.17336	4.74	.0000	.48254	1.16209
P_EXTENG	1.39700***	.35584	3.93	.0001	.69957	2.09443
P_P90ENG	-1.14362**	.53983	-2.12	.0341	-2.20167	-.08557
NOGREEN	-.92093***	.13245	-6.95	.0000	-1.18052	-.66134
EXT_P90	1.06282***	.15170	7.01	.0000	.76550	1.36015
PRICE30	1.45467***	.11446	12.71	.0000	1.23033	1.67900
PRICE60	.96566***	.12063	8.01	.0000	.72923	1.20209
ENG_ENC	.22994**	.10857	2.12	.0342	.01714	.44273

****, **, * ==> Significance at 1%, 5%, 10% level.*

Model was estimated on Mar 18, 2021 at 00:37:31 PM

Income interaction

0-1000 not included (too small sample)

I10=1000-2500

I25=2500-5000

I5000=5000+

Example of creating interaction effects for income 1000 or less:

```
|-> CREATE; I10EX_P3=I10_EXT*I10_P30$

|-> CREATE; I10EX_P6=I10_EXT*I10_P60$

|-> CREATE; I10EX_P9=I10_EXT*I10_P90$

|-> CREATE; I10EX_NG=I10_EXT*I10_ENG$

|-> CREATE; I10EX_NC=I10_EXT*I10_ENC$

|-> CREATE; I10P3_NG=I10_P30*I10_ENG$

|-> CREATE; I10P6_NG=I10_P60*I10_ENG$

|-> CREATE; I10P9_NG=I10_P90*I10_ENG$

|-> CREATE; I10P3_NC=I10_P30*I10_ENC$

|-> CREATE; I10P6_NC=I10_P60*I10_ENC$

|-> CREATE; I10P9_NC=I10_P90*I10_ENC$

|-> CREATE; I10_NGNC=I10_ENG*I10_ENC$
```

Analysis was conducted including all main effects and interaction effects. By filtering out non-significant main effects and interaction effects, the following significant main- and interaction effects remained:

```
|-> NLOGIT;Lhs=CHOICE

        ; CHOICES=1,2,3

        ; Rhs=NOGREEN,EXT,EXT_P90,PRICE30,PRICE60,P60_ENG,P60_ENC,ENG_ENC

        ,I50_P60

        ,I50EX_P3,I50P6_NC

        ; PDS=8$
```

Iterative procedure has converged

Normal exit: 5 iterations. Status=0, F= .1158873D+04

Discrete choice (multinomial logit) model

Dependent variable Choice

Log likelihood function -1158.87310

Estimation based on N = 1272, K = 11

Inf.Cr.AIC = 2339.7 AIC/N = 1.839

Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)

Warning: Model does not contain a full

set of ASCs. R-sqrd is problematic. Use

model setup with ;RHS=one to get LogL0.

Response data are given as ind. choices

Number of obs.= 1272, skipped 0 obs

CHOICE	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
NOGREEN	-.80568***	.11290	-7.14	.0000	-1.02697	-.58439
EXT	1.12811***	.11243	10.03	.0000	.90776	1.34846
EXT_P90	.69120***	.15672	4.41	.0000	.38403	.99837
PRICE30	1.26702***	.11791	10.75	.0000	1.03593	1.49812
PRICE60	.67429***	.19761	3.41	.0006	.28698	1.06159
P60_ENG	-.50432**	.20759	-2.43	.0151	-.91119	-.09746
P60_ENC	.45737**	.21365	2.14	.0323	.03863	.87611
ENG_ENC	.56787***	.11396	4.98	.0000	.34451	.79123
I50_P60	1.11405***	.33104	3.37	.0008	.46521	1.76288
I50EX_P3	.77950**	.32148	2.42	.0153	.14940	1.40959
I50P6_NC	-.72467*	.39795	-1.82	.0686	-1.50463	.05529

--------+--

***, **, * ==> *Significance at 1%, 5%, 10% level.*

Model was estimated on Mar 22, 2021 at 09:57:03 AM

Age interactions

First categories were created via SPSS transform àrecode into different variables, as shown below:

Frequencies were derived from SPSS:

AgeCat

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	480	12,6	12,6	12,6
	2,00	1080	28,3	28,3	40,9
	3,00	1608	42,1	42,1	83,0
	4,00	528	13,8	13,8	96,9
	5,00	120	3,1	3,1	100,0
	Total	3816	100,0	100,0	

Agecat 5 has too less (120/24=5) respondents so is left out. Explanation of calculation: 120 is the amount of alternatives. Every respondent has eight questions times three possibilities, so 24 alternatives. The total alternatives divided by 24 gives the amount of respondents.

Agecat 1

First interaction terms were created. Thereafter, analysis was conducted including all main effects and interaction effects. By filtering out non-significant main effects and interaction effects, the following significant main- and interaction effects remained:

```
|-> NLOGIT;Lhs=CHOICE
        ; CHOICES=1,2,3
        ; Rhs=NOGREEN,EXT,EXT_P90,PRICE30,PRICE60,P60_ENG,ENG_ENC
        ,A1_NGR,A1_ENG,A1_NGNC
        ; PDS=8$
Iterative procedure has converged
Normal exit:   6 iterations. Status=0, F=   .1149430D+04

-----------------------------------------------------------------------------
Discrete choice (multinomial logit) model
Dependent variable                  Choice
Log likelihood function    -1149.43038
Estimation based on N =   1272, K =  10
Inf.Cr.AIC  =   2318.9 AIC/N =     1.823
---------------------------------------
        Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)
Warning:  Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.=  1272, skipped 0 obs
--------+------------------------------------------------------------------
        |                   Standard        Prob.    95% Confidence
  CHOICE|  Coefficient           Error    z    |z|>Z*        Interval
```

```
--------+-------------------------------------------------------------------
 NOGREEN|   -.96974***        .11650  -8.32  .0000      -1.19808   -.74141
     EXT|   1.19116***        .10986  10.84  .0000       .97585   1.40647
 EXT_P90|    .66535***        .15728   4.23  .0000      .35708  .97361
 PRICE30|   1.35791***        .11523  11.78  .0000      1.13206   1.58377
 PRICE60|   1.10178***        .14431   7.63  .0000      .81893   1.38463
 P60_ENG|   -.51110**         .20628  -2.48  .0132      -.91540   -.10680
 ENG_ENC|    .57199***        .11105   5.15  .0000      .35433  .78964
  A1_NGR|     1.55872***      .34028     4.58  .0000    .89178   2.22566
  A1_ENG|     -.66325*        .37745  -1.76  .0789      -1.40303        .07654
 A1_NGNC|    .97050**         .42382   2.29  .0220      .13983   1.80118
--------+-------------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
Model was estimated on Mar 18, 2021 at 06:30:32 PM
-----------------------------------------------------------------------------
```

Agecat 2

First interaction terms were created. Thereafter, analysis was conducted including all main effects and interaction effects. By filtering out non-significant main effects and interaction effects, the following significant main- and interaction effects remained:

```
|-> NLOGIT;Lhs=CHOICE
        ; CHOICES=1,2,3
        ; Rhs=NOGREEN,EXT,EXT_P90,PRICE30,PRICE60,ENG_ENC
        ,A2EX_ENC
        ; PDS=8$
Iterative procedure has converged
Normal exit:   5 iterations. Status=0, F=   .1165583D+04

-----------------------------------------------------------------------------
Discrete choice (multinomial logit) model
```

Dependent variable Choice

Log likelihood function -1165.58339

Estimation based on N = 1272, K = 7

Inf.Cr.AIC = 2345.2 AIC/N = 1.844

Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)

Warning: Model does not contain a full

set of ASCs. R-sqrd is problematic. Use

model setup with ;RHS=one to get LogL0.

Response data are given as ind. choices

Number of obs.= 1272, skipped 0 obs

CHOICE	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
NOGREEN	-.82111***	.11184	-7.34	.0000	-1.04032	-.60190
EXT	1.11608***	.11189	9.97	.0000	.89677	1.33538
EXT_P90	.65115***	.15540	4.19	.0000	.34657	.95574
PRICE30	1.38817***	.11418	12.16	.0000	1.16438	1.61197
PRICE60	.92977***	.12307	7.55	.0000	.68855	1.17098
ENG_ENC	.42775***	.10048	4.26	.0000	.23081	.62469
A2EX_ENC	.64718***	.20200	3.20	.0014	.25126	1.04309

****, **, * ==> Significance at 1%, 5%, 10% level.*

Model was estimated on Mar 18, 2021 at 06:35:19 PM

--

Agecat 3

First interaction terms were created. Thereafter, analysis was conducted including all main effects and interaction effects. By filtering out non-significant main effects and interaction effects, the following significant main- and interaction effects remained:

```
|-> NLOGIT;Lhs=CHOICE
        ; CHOICES=1,2,3
        ; Rhs=NOGREEN,EXT,EXT_P30,EXT_P90,PRICE30,PRICE60,ENG_ENC
        ,A3_NGR
        ; PDS=8$
Iterative procedure has converged
Normal exit:   5 iterations. Status=0, F=   .1158590D+04

-----------------------------------------------------------------------------
Discrete choice (multinomial logit) model
Dependent variable                  Choice
Log likelihood function     -1158.59015
Estimation based on N =   1272, K =   8
Inf.Cr.AIC  =   2333.2 AIC/N =     1.834
--------------------------------------
        Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)
Warning:  Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
--------------------------------------
Response data are given as ind. choices
Number of obs.=  1272, skipped 0 obs
--------+-------------------------------------------------------------------
```

```
        |                    Standard        Prob.     95% Confidence
 CHOICE|  Coefficient              Error    z    |z|>Z*        Interval
--------+------------------------------------------------------------------
NOGREEN|    -.49668***          .13259  -3.75  .0002       -.75654   -.23681
          EXT|    1.01320***          .13132  7.72  .0000       .75582   1.27057
EXT_P30|     .55851**             .21957  2.54  .0110       .12817  .98886
EXT_P90|     .74472***            .16032  4.65  .0000       .43050   1.05895
PRICE30|   1.15076***             .14543  7.91  .0000       .86571   1.43580
PRICE60|    .98208***             .12474  7.87  .0000       .73759   1.22656
ENG_ENC|     .52021***            .09745  5.34  .0000       .32921  .71122
 A3_NGR|       -.60989***         .14293    -4.27  .0000    -.89002   -.32975
--------+------------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
Model was estimated on Mar 18, 2021 at 06:50:28 PM
```

Agecat 4

No significant interactioneffects of agecat 4, shown below:

First interaction terms were created. Thereafter, analysis was conducted including all main effects and interaction effects. By filtering out non-significant main effects and interaction effects, no significant main- and interaction effects remained.

Perception of local microclimate

Pmicrocl

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	24	,6	,6	,6

	2	216	5,7	5,7	6,3
	3	1464	38,4	38,4	44,7
	4	1776	46,5	46,5	91,2
	5	336	8,8	8,8	100,0
	Total	3816	100,0	100,0	

Frequencies show that perception levels 1 (24/24=1 respondent) and 2 (216/24=9 respondents) cannot be analysed due to low frequencies.

First interaction terms were created. Thereafter, analysis was conducted including all main effects and interaction effects. By filtering out non-significant main effects and interaction effects, the following significant main- and interaction effects remained:

Example of creating interaction effects:

*|-> CREATE;P3_EXP30=P3_EXT*P3_P30$*

*|-> CREATE;P3_EXP60=P3_EXT*P3_P60$*

*|-> CREATE;P3_EXP90=P3_EXT*P3_P90$*

*|-> CREATE;P3_EXENG=P3_EXT*P3_ENG$*

*|-> CREATE;P3_EXENC=P3_EXT*P3_ENC$*

*|-> CREATE;P3_P30NG=P3_P30*P3_ENG$*

*|-> CREATE;P3_P60NG=P3_P60*P3_ENG$*

*|-> CREATE;P3_P90NG=P3_P90*P3_ENG$*

*|-> CREATE;P3_P30NC=P3_P30*P3_ENC$*

*|-> CREATE;P3_P60NC=P3_P60*P3_ENC$*

*|-> CREATE;P3_P90NC=P3_P90*P3_ENC$*

*|-> CREATE;P3_NGNC=P3_ENG*P3_ENC$*

PLM 3

|-> NLOGIT;Lhs=CHOICE

; CHOICES=1,2,3

; Rhs=NOGREEN,EXT,EXT_P30,EXT_P90,PRICE30,PRICE60,ENG_ENC

,P3_EXP30

; PDS=8$

Iterative procedure has converged

Normal exit: 5 iterations. Status=0, F= .1163163D+04

Discrete choice (multinomial logit) model

Dependent variable Choice

Log likelihood function -1163.16327

Estimation based on N = 1272, K = 8

Inf.Cr.AIC = 2342.3 AIC/N = 1.841

Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)

Warning: Model does not contain a full

set of ASCs. R-sqrd is problematic. Use

model setup with ;RHS=one to get LogL0.

Response data are given as ind. choices

Number of obs.= 1272, skipped 0 obs

--------+--

	Standard		Prob.	95% Confidence
CHOICE	Coefficient	Error	z	|z|>Z*	Interval

--------+--

*NOGREEN| -.76949*** .11371 -6.77 .0000 -.99236 -.54662*

*EXT| 1.02265*** .13113 7.80 .0000 .76563 1.27967*

*EXT_P30| .91376*** .25641 3.56 .0004 .41120 1.41632*

*EXT_P90| .72315*** .15964 4.53 .0000 .41026 1.03603*

*PRICE30| 1.13536*** .14481 7.84 .0000 .85155 1.41918*

*PRICE60| .96513*** .12410 7.78 .0000 .72189 1.20837*

*ENG_ENC| .52816*** .09745 5.42 .0000 .33717 .71915*

*P3_EXP30| -.83825*** .27834 -3.01 .0026 -1.38378 -.29272*

--------+--

****, **, * ==> Significance at 1%, 5%, 10% level.*

Model was estimated on Mar 20, 2021 at 04:24:46 PM

PLM 4

|-> *NLOGIT;Lhs=CHOICE*

; CHOICES=1,2,3

; Rhs=NOGREEN,EXT,PRICE30,PRICE60,P90_ENC,ENG_ENC

,P4_EXP30

; PDS=8$

Iterative procedure has converged

Normal exit: 5 iterations. Status=0, F= .1164724D+04

Discrete choice (multinomial logit) model

Dependent variable Choice

Log likelihood function -1164.72361

Estimation based on N = 1272, K = 7

Inf.Cr.AIC = 2343.4 AIC/N = 1.842

Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)

Warning: Model does not contain a full

set of ASCs. R-sqrd is problematic. Use

model setup with ;RHS=one to get LogL0.

Response data are given as ind. choices

Number of obs.= 1272, skipped 0 obs

CHOICE	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
NOGREEN	-.80268***	.11569	-6.94	.0000	-1.02943	-.57594
EXT	1.26436***	.10332	12.24	.0000	1.06185	1.46686
PRICE30	1.11194***	.12233	9.09	.0000	.87218	1.35171
PRICE60	.90496***	.12534	7.22	.0000	.65929	1.15062
P90_ENC	.45250***	.15361	2.95	.0032	.15142	.75357
ENG_ENC	.48677***	.10032	4.85	.0000	.29015	.68338
P4_EXP30	1.15558***	.27912	4.14	.0000	.60851	1.70266

****, **, * ==> Significance at 1%, 5%, 10% level.*

Model was estimated on Mar 20, 2021 at 04:30:50 PM

--

PLM 5

Analysis was conducted including all main effects and interaction effects. By filtering out non-significant main effects and interaction effects, no significant main- and interaction effects remained.

Overall analysis

After analysing the different demographic- and experience main- and interaction effects seperately, all significant main- and interaction effects were analysed all together in one analysis to filter out collinearity.

First interaction terms were created. Thereafter, analysis was conducted including all significant main effects and interaction effects. By filtering out non-significant main effects and interaction effects, the following significant main- and interaction effects remained:

```
|-> NLOGIT;Lhs=CHOICE
           ; CHOICES=1,2,3
           ; Rhs=CONSTANT,EXT,EXT_P90,PRICE30,PRICE60,ENG_ENC,
    GX_NOGR,GX_EXT,GX_ENG,G30ENC,G60ENG,G_NGNC,
    H_EXT,P_ENC,U_EXTENG,P_EXTENG,P_P90ENG,
    I50_P60,I50EX_P3,
    A1_NGR,A1_NGNC,A2_EXTNC,A3_NGR,
    P4_EXP30
           ; PDS=8$
Iterative procedure has converged
Normal exit:   6 iterations. Status=0, F=    .1107571D+04

----------------------------------------------------------------------------
--
Discrete choice (multinomial logit) model
Dependent variable               Choice
Log likelihood function     -1107.57077
Estimation based on N =    1272, K =  24
Inf.Cr.AIC  =    2263.1 AIC/N =    1.779
---------------------------------------
            Log likelihood R-sqrd R2Adj

Note: R-sqrd = 1 - logL/Logl(constants)
Warning:  Model does not contain a full
set of ASCs. R-sqrd is problematic. Use
model setup with ;RHS=one to get LogL0.
---------------------------------------
Response data are given as ind. choices
Number of obs.=   1272, skipped    0 obs
--------+-------------------------------------------------------------------
--
        |                Standard            Prob.      95% Confidence
  CHOICE|  Coefficient     Error       z    |z|>Z*         Interval
--------+-------------------------------------------------------------------
--
CONSTANT|    -.89347***     .18347    -4.87  .0000    -1.25305   -.53388
     EXT|     .82585***     .20201     4.09  .0000      .42991   1.22179
 EXT_P90|     .82532***     .16535     4.99  .0000      .50124   1.14940
 PRICE30|    1.31715***     .13866     9.50  .0000     1.04538   1.58892
 PRICE60|     .94485***     .14628     6.46  .0000      .65815   1.23155
 ENG_ENC|     .34182**      .14959     2.29  .0223      .04863    .63501
 GX_NOGR|     .46243**      .21673     2.13  .0329      .03765    .88720
  GX_EXT|    -.48852**      .21949    -2.23  .0260     -.91871   -.05832
  GX_ENG|    -.56242***     .21353    -2.63  .0084     -.98094   -.14391
  G30ENC|    -.65788***     .25182    -2.61  .0090    -1.15144   -.16432
  G60ENG|    -.84302***     .29912    -2.82  .0048    -1.42928   -.25675
  G_NGNC|     .61391**      .26668     2.30  .0213      .09122   1.13660
   H_EXT|     .41727**      .18960     2.20  .0277      .04567    .78888
   P_ENC|     .52376**      .23072     2.27  .0232      .07156    .97597
U_EXTENG|     .50651**      .20991     2.41  .0158      .09510    .91791
```

```
P_EXTENG|    1.10487***      .39795     2.78  .0055      .32489   1.88484
P_P90ENG|   -1.19248**       .57375    -2.08  .0377    -2.31700   -.06796
 I50_P60|     .69234***      .23070     3.00  .0027      .24017   1.14451
I50EX_P3|     .70470**       .34625     2.04  .0418      .02606   1.38333
  A1_NGR|    1.26428***      .33345     3.79  .0001      .61072   1.91783
 A1_NGNC|     .59616*        .32878     1.81  .0698     -.04824   1.24056
A2_EXTNC|     .67668***      .22113     3.06  .0022      .24328   1.11008
  A3_NGR|    -.32902**       .15540    -2.12  .0342     -.63360   -.02443
P4_EXP30|    1.28692***      .29224     4.40  .0000      .71414   1.85969
--------+------------------------------------------------------------
--
***, **, * ==>  Significance at 1%, 5%, 10% level.
Model was estimated on May 04, 2021 at 06:14:42 PM
```

Rho-square= 1-(-1107,57077/-1397,4348)=0,2074

Appendix V - Questionnaire

Demographic- and experience questions

Stated choice experiment

The stated choice experiment consists of four different versions, that include all choice alternatives, from which each version is divided into two versions to avert drop out of respondents due to longitude of the questionnaire. Eight versions with eight questions were thus offered randomly to respondents. Below the general demographic- and experience questions are asked, followed by two versions. The two version together display all choice alternatives (32) in the stated choice experiment.

Questionnaire version 1

General questions:

What is your gender?: man/women/other… namely/I would rather not say it

What is your age? (number)

What is your level of education?

1. University
2. Higher education
3. Practical education
4. No further education
5. Other...namely

What is your households' netto income per month (the amount you receive)?:

1. less than €1000
2. €1000 to €2500
3. €2500 to €5000
4. €5000 or more
5. I would rather not say it

Is your house in your own property?

Yes/no

Questions about the current situation:

Which grade would you give, from one (low) to ten (high), to your average local climate (around your house)? (1-5)

Put the following numbers of the advantages of green roofs, which are all possibly applicable to your own surroundings and house, in the right order from least important to most important:

1. lowered outside temperature

2. Lowered inside temperature
3. Less floodings
4. Isolating effect
5. lower energy use
6. Protective effect on the roof construction
7. Higher productivity of solar panels
8. Increasing biodiversity

Question 1

<table>
<tr><th>Attribute</th><th>Choice 1</th><th>Choice 2</th></tr>
<tr><td>Functionality, price, maintenance & aesthetics</td><td>Intensive green roof

Functionality: usable space for people i.e. recreation and relaxation

Aesthetics:

Renovations in € per m² (over the lifespan): 100

Maintenance: High</td><td>Extensive green roof

Functionality: not usable for people

Aesthetics:

Renovations in € per m² over the lifespan: 35

Maintenance: Low</td></tr>
<tr><td>Price</td><td>€30</td><td>€30</td></tr>
<tr><td>Policy 1</td><td>Neighbourhood projects & media campaigns (Engaging)</td><td>Neighbourhood projects & media campaigns (Engaging)</td></tr>
<tr><td>Policy 2</td><td>Government gives good example (Exemplification)</td><td>Subsidy & certification (Encouragement)</td></tr>
</table>

Question 2

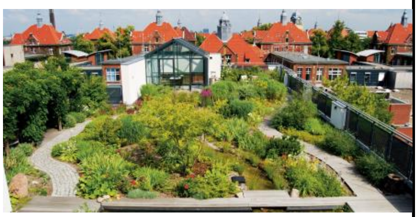
Attribute	Choice 1	Choice 2
Functionality, price, maintenance & aesthetics	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**  **Renovations in € per m² (over the lifespan): 100** **Maintenance:** High	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**  **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low
Price	**€30**	**€90**
Policy 1	**Advice & information evenings (Enabling)**	**Neighbourhood projects & media campaigns (Engaging)**
Policy 2	**Subsidy & certification (Encouragement)**	**Government gives good example (Exemplification)**

Question 3

Attribute	Choice 1	Choice 2
Functionality, price, maintenance & aesthetics	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**

	 **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low	 **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low
Price	**€60**	**€60**
Policy 1	**Neighbourhood projects & media campaigns (Engaging)**	**Advice & information evenings (Enabling)**
Policy 2	**Government gives good example (Exemplification)**	**Subsidy & certification (Encouragement)**

Question 4

Attribute	Choice 1	Choice 2
Functionality, price, maintenance & aesthetics	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**  **Renovations in € per m² over the lifespan:** 35	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:** 

	Maintenance: Low	**Renovations in € per m² (over the lifespan): 100** **Maintenance:** High
Price	**€120**	**€90**
Policy 1	**Advice & information evenings (Enabling)**	**Neighbourhood projects & media campaigns (Engaging)**
Policy 2	**Government gives good example (Exemplification)**	**Subsidy & certification (Encouragement)**

Question 5

Attribute	**Choice 1**	**Choice 2**
Functionality, price, maintenance & aesthetics	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**  **Renovations in € per m² (over the lifespan): 100** **Maintenance:** High	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**  **Renovations in € per m² (over the lifespan): 100** **Maintenance:** High
Price	**€60**	**€120**

<table>
<tr><td>Policy 1</td><td>Neighbourhood projects & media campaigns (Engaging)</td><td>Neighbourhood projects & media campaigns (Engaging)</td></tr>
<tr><td>Policy 2</td><td>Subsidy & certification (Encouragement)</td><td>Government gives good example (Exemplification)</td></tr>
</table>

Question 6

<table>
<tr><td>Attribute</td><td>Choice 1</td><td>Choice 2</td></tr>
<tr><td>Functionality, price, maintenance & aesthetics</td><td>Intensive green roof

Functionality: usable space for people i.e. recreation and relaxation

Aesthetics:

Renovations in € per m² (over the lifespan): 100

Maintenance: High</td><td>Intensive green roof

Functionality: usable space for people i.e. recreation and relaxation

Aesthetics:

Renovations in € per m² (over the lifespan): 100

Maintenance: High</td></tr>
<tr><td>Price</td><td>€90</td><td>€120</td></tr>
</table>

Policy 1	**Advice & information evenings (Enabling)**	**Advice & information evenings (Enabling)**
Policy 2	**Government gives good example (Exemplification)**	**Subsidy & certification (Encouragement)**

Question 7

Attribute	**Choice 1**	**Choice 2**
Functionality, price, maintenance & aesthetics	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**  **Renovations in € per m^2 (over the lifespan): 100** **Maintenance:** High	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**  **Renovations in € per m^2 over the lifespan:** 35 **Maintenance:** Low
Price	**€60**	**€90**
Policy 1	**Advice & information evenings (Enabling)**	**Advice & information evenings (Enabling)**

Policy 2	**Government gives good example (Exemplification)**	**Subsidy & certification (Encouragement)**

Question 8

Attribute	**Choice 1**	**Choice 2**
Functionality, price, maintenance & aesthetics	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**  **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**  **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low
Price	**€120**	**€30**
Policy 1	**Neighbourhood projects & media campaigns (Engaging)**	**Advice & information evenings (Enabling)**
Policy 2	**Subsidy & certification (Encouragement)**	**Government gives good example (Exemplification)**

Version 2

Question 1

Attribute	Choice 1	Choice 2
Functionality, price, maintenance & aesthetics	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**  **Renovations in € per m² (over the lifespan): 100** **Maintenance:** High	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**  **Renovations in € per m² (over the lifespan): 100** **Maintenance:** High
Price	**€90**	**€90**
Policy 1	**Neighbourhood projects & media campaigns (Engaging)**	**Advice & information evenings (Enabling)**
Policy 2	**Subsidy & certification (Encouragement)**	**Government gives good example (Exemplification)**

Question 2

Attribute	Choice 1	Choice 2
Functionality, price, maintenance & aesthetics	***Extensive green roof*** **Functionality:** not usable for people	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation

	Aesthetics:  **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low	**Aesthetics:**  **Renovations in € per m² (over the lifespan): 100** **Maintenance:** High
Price	**€60**	**€30**
Policy 1	**Advice & information evenings (Enabling)**	**Neighbourhood projects & media campaigns (Engaging)**
Policy 2	**Subsidy & certification (Encouragement)**	**Government gives good example (Exemplification)**

Question 3

Attribute	Choice 1	Choice 2
Functionality, price, maintenance & aesthetics	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**

	 **Renovations in € per m² (over the lifespan): 100** **Maintenance:** High	 **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low
Price	**€30**	**€90**
Policy 1	**Advice & information evenings (Enabling)**	**Neighbourhood projects & media campaigns (Engaging)**
Policy 2	**Subsidy & certification (Encouragement)**	**Government gives good example (Exemplification)**

Question 4

Attribute	**Choice 1**	**Choice 2**
Functionality, price, maintenance & aesthetics	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:** 	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:** 

	Renovations in € per m² (over the lifespan): 100 **Maintenance:** High	**Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low
Price	**€60**	**€30**
Policy 1	**Neighbourhood projects & media campaigns (Engaging)**	**Advice & information evenings (Enabling)**
Policy 2	**Subsidy & certification (Encouragement)**	**Government gives good example (Exemplification)**

Question 5

Attribute	**Choice 1**	**Choice 2**
Functionality, price, maintenance & aesthetics	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**  **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**  **Renovations in € per m² (over the lifespan): 100** **Maintenance:** High
Price	**€60**	**€120**

Policy 1	**Neighbourhood projects & media campaigns (Engaging)**	**Neighbourhood projects & media campaigns (Engaging)**
Policy 2	**Government gives good example (Exemplification)**	**Government gives good example (Exemplification)**

Question 6

Attribute	**Choice 1**	**Choice 2**
Functionality, price, maintenance & aesthetics	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**  **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**  **Renovations in € per m² (over the lifespan): 100** **Maintenance:** High
Price	**€90**	**€60**
Policy 1	**Advice & information evenings (Enabling)**	**Advice & information evenings (Enabling)**
Policy 2	**Subsidy & certification (Encouragement)**	**Government gives good example (Exemplification)**

Question 7

Attribute	Choice 1	Choice 2
Functionality, price, maintenance & aesthetics	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**  **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**  **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low
Price	**€30**	**€120**
Policy 1	**Neighbourhood projects & media campaigns (Engaging)**	**Advice & information evenings (Enabling)**
Policy 2	**Subsidy & certification (Encouragement)**	**Government gives good example (Exemplification)**

Question 8

Attribute	Choice 1	Choice 2
Functionality, price, maintenance & aesthetics	***Extensive green roof*** **Functionality:** not usable for people **Aesthetics:**	***Intensive green roof*** **Functionality:** usable space for people i.e. recreation and relaxation **Aesthetics:**

	 **Renovations in € per m² over the lifespan:** 35 **Maintenance:** Low	 **Renovations in € per m² (over the lifespan): 100** **Maintenance:** High
Price	**€120**	**€120**
Policy 1	**Neighbourhood projects & media campaigns (Engaging)**	**Advice & information evenings (Enabling)**
Policy 2	**Subsidy & certification (Encouragement)**	**Subsidy & certification (Encouragement)**

Other relevant information

This graduation project is fully executed at the University of Technology Eindhoven (TU/e).