Aalto University
School of Business

ADOPTING SUSTAINABLE INNOVATION: CITIZEN'S CAP-AND-TRADE CO-CREATED

What motivates the adoption of eco-innovations?

Master's thesis

Katariina Sinivaara
Aalto University School of Business
Department of Marketing

Spring 2021

Aalto University
School of Business

Aalto University, P.O. BOX 11000, 00076 AALTO
www.aalto.fi

Abstract of master's thesis

Author Katariina Sinivaara

Title of thesis Adopting sustainable innovation: Citizen's cap-and-trade co-created

Degree Master of Science (Economics and Business Administration)

Degree programme Master's Programme in Marketing

Thesis advisor(s) Sanna-Katriina Asikainen

Year of approval 2021 **Number of pages** 84 **Language** English

Abstract

This thesis aims to shed light on the adoption of eco-innovations. The purpose is to discover what cognitive, affective and normative factors motivate the adoption of the CitiCAP application, a mobile application designed for personal cap-and-trade.

The theoretical framework of the study includes three theories from behavioral sciences: the diffusion of innovation, the theory of planned behavior and the value-belief-norm theory. Based on the previous studies on eco-innovation adoption, altogether 12 hypotheses are set.

The empirical part consists of an online questionnaire targeted to active users of the CitiCAP application. The response rate of the study is 18,8 %, and the collected data is analyzed using SPSS statistical analysis program.

In order to create a better understanding of the relationships between the different variables, the collected data is analyzed with mediation and regression analyses.

The results differ from the ones of previous literature, and most of the hypotheses are rejected. However, the present study focuses on researching the actual adoption behavior instead of interest for adoption or intention to adopt as the previous studies, which might have an impact on the results. For instance, the attitude-behavior gap might be affecting the adoption.

The main findings are that both monetary and informational relative advantage have a direct positive impact on the adoption. Personal norms are found to have indirect impact on the adoption through positive anticipated feelings. In addition, there is found support that descriptive norms are having a direct negative impact on eco-innovation adoption. Also, the results find proof that ascribed responsibility has a direct positive impact on personal norms.

Based on the findings, theoretical and managerial implications are presented. Besides, the limitations of the present study and suggestions for further research are discussed.

Keywords eco-innovation adoption, sustainable innovation, innovation adoption

Aalto-yliopisto
Kauppakorkeakoulu

Aalto-yliopisto, PL 11000, 00076 AALTO
www.aalto.fi

Maisterintutkinnon tutkielman tiivistelmä

Tekijä Katariina Sinivaara

Työn nimi Ekoinnovaatioiden omaksuminen: Citizen's cap-and-trade co-created

Tutkinto Kauppatieteiden maisteri

Koulutusohjelma Markkinointi

Työn ohjaaja(t) Sanna-Katriina Asikainen

Hyväksymisvuosi 2021 **Sivumäärä** 84 **Kieli** Englanti

Tiivistelmä

Tutkielma pyrkii lisäämään ymmärrystä ekoinnovaatioiden omaksumisesta. Tarkoitus on selvittää, mitkä kognitiiviset, affektiiviset ja normatiiviset tekijät motivoivat CitiCAP-applikaation omaksumista. CitiCAP on henkilökohtaiseen päästökauppaan kehitetty mobiilisovellus.

Tutkielman teoreettinen viitekehys sisältää kolme käyttäytymistieteisiin pohjaavaa teoriaa: Innovaatioiden diffuusion (Diffusion of Innovations), suunnitellun käyttäytymisen teorian (Theory of Planned Behavior) ja arvo-uskomus-normi-teorian (Value-Belief-Norm Theory). Aikaisempien ekoinnovaatioiden omaksumiseen liittyvien tutkimusten perusteella tutkimuksessa asetetaan yhteensä 12 hypoteesia.

Tutkielman empiria perustuu onlinekyselyllä kerättyyn tutkimusdataan (vastausprosentti 18,8 %), ja kyselyn kohteena ovat CitiCAP-applikaation aktiiviset käyttäjät. Kerätty data analysoidaan SPSS-ohjelmistolla, ja muuttujien välisten suhteiden ymmärtämiseksi käytetään mediaatio- ja regressioanalyysia.

Tulokset eroavat jonkin verran aiempien tutkimusten tuloksista, ja suurin osa hypoteeseista joudutaan hylkäämään. Erot tutkimustuloksissa saattavat kuitenkin olla selitettävissä tutkimusasetelmien eroilla. Tässä tutkielmassa tarkasteltiin innovaation omaksumista, kun aiemmissa tutkimuksissa on tutkittu kiinnostusta tai aikomusta ottaa käyttöön jokin innovaatio. Ero tuloksissa viittaa siihen, että ekoinnovaatioiden omaksumiseen saattaa liittyä arvojen ja toiminnan välinen ristiriita (Attitude-Behavior gap).

Tutkimustulosten perusteella sekä rahallinen että informaatioon liittyvä suhteellinen etu vaikuttavat suoraan positiivisesti ekoinnovaation omaksumiseen. Henkilökohtaiset normit puolestaan vaikuttavat omaksumiseen positiivisten tunteiden, kuten ylpeyden kautta. Lisäksi selvisi, että deskriptiivisillä normeilla on negatiivinen vaikutus ekoinnovaation omaksumiseen. Tulokset viittaavat myös siihen, että koetulla velvollisuudentunnolla on positiivinen vaikutus henkilökohtaisiin normeihin.

Lopuksi esitellään tulosten pohjalta tehdyt johtopäätökset, tutkielman rajaukset, sekä ehdotukset jatkotutkimuskohteiksi.

Avainsanat ekoinnovaatioiden omaksuminen, ekoinnovaatioiden käyttöönotto

Table of Contents

List of figures

List of tables

1 Introduction

1.1 Background

Sustainability is a highly rising trend in the consumer market (Unnikrishnan et al., 2020), but also public actors need to take the environment into account more actively in their decision-making. Sustainability is defined in the Brundtland Commission report in 1987 as being actions that simultaneously fulfill the needs of the individuals and meet the present and future needs of the environment (WCED, 1987 in Lorek and Spangenberg, 2014). Developed countries are living above their natural boundaries which require serious lifestyle changes to reach a sustainable path, whereas developing countries need to find ways to increase the standard of living without exceeding their ecological footprint (United Nations Environment Programme (UNEP), 2019). To succeed in the transition towards the green economy, fundamental changes in production and consumption patterns have to be made (UNEP, 2011). According to Fichter and Clausen (2016), sustainable innovations and their diffusion is the solution towards sustainable development and a green economy. For example, solar panels, electric cars, and biofuels are innovations that have managed to cut down emissions and are already familiar to many consumers.

Many countries have made concrete objectives to cut down emissions shortly by investing in sustainable development. According to a UNEP report (2017), the transport sector can have a crucial role in the transition to more sustainable mobility especially in urban environments where 80% Europeans are expected to live in by 2030. Also, Bamberg et al. (2007) note that transportation-related fuel consumption reduction is required for protecting the climate. This means that not only businesses and public actors, but also individual citizens need to be activated to participate in this transition. As a response, many pan-European cities have already considered promoting cycling as a means to decrease air pollutants and CO2 emissions (UNEP, 2017).

In Finland, the amount of private cars has been increasing (OSF, 2019a) despite the existence of well-functioning public transport. To decrease emissions caused by private motoring, many cities in Finland have started to discover new ways to promote more sustainable mobility. The city of Lahti has created as a part of a citizen's cap-and-trade co-created

(CitiCAP) project, a mobile application for personal cap-and-trade. The mobile application is a new sustainable innovation, and the aim is to research the adoption of this specific eco-innovation. The application measures the user's mobility based on the location data and determines how much emissions the user's mobility causes. There exists a personal carbon cap for each user and if the user can pass underneath it he receives virtual currency which can be traded into actual products or services which the city provides. The application is based on gamification, and the user is actively rewarded for making the right choices. The application aims to change the behaviors of citizens to be more sustainable by encouraging sustainable mobility. Incentives have been proved to promote sustainable behavior (Huber et al., 2017) - the user is rewarded for using more sustainable transport options such as walking, cycling, and using public transport instead of private motoring.

1.2 Literature review (preliminary)

When reviewing the previous studies on eco-innovation adoption, it can be noticed that the adoption of eco-innovations have been researched widely from a company perspective but research from the consumer perspective is lacking. A lot of research on the consumer side tends to focus on the energy sector, and how the energy innovations such as the use of solar power panels, or green electricity have been adopted in different households (e.g. Wolske et al., 2017; Ozaki, 2011). An individual's decision-making on innovation adoption is influenced by external influences (e.g. costs and functionality of the innovation) and internal factors (e.g. how the innovation reflects one's identity, values, and norms) (Ozaki, 2011). Table 1 outlines the research focused on consumer eco-innovation adoption.

Table 1. Summary of research focusing on consumer eco-innovation adoption.

Author(s)	Objective and findings
Elmustapha et al. (2018)	Analysis of consumers' decision-making behavior on solar water heater adoption. Confirmed the significance of different product characteristics such as relative advantage, observability, independent judgment-making, and novelty-seeking on the adoption. Also found support that combining environmental psychology models to the diffusion of innovation model improves the explanatory power of the research model.
Han et al. (2017)	Analysis of cognitive, affective, and normative triggers that affect sustainable intentions among convention-goers. The research found that cognitive, affective, and normative factors play a significant role in convention traveler's pro-environmental decision-making processes.

Noppers et al. (2014)	Analysis of the significance of instrumental, environmental, and symbolic attributes for the adoption of electric cars and local renewable energy systems. The study found that evaluations of symbolic and environmental attributes helped to predict different indicators of adoption (e.g. interest in or intention to adopt). However, symbolic motives weren't recognized by the consumers themselves. Moreover, the impact of positive evaluations of symbolic attributes was stronger when respondents evaluated the instrumental attributes more negatively.
Ozaki (2011)	Analysis of what factors are influencing the adoption of green electricity. The results showed perceived personal benefits such as compatibility with their values, identity, and social references, a sense of control over the costs, convenience, perceived risk, and good information affected the adoption. Also, social factors such as strong social influence and normative beliefs influenced green electricity adoption.
Wolske et al. (2017)	Analysis of the determinants of interest in adopting solar photovoltaic systems. The research showed that pro-environmental personal norms are affecting the adoption indirectly through perceived personal benefits, suggesting that also non-environmental benefits should be addressed in marketing efforts. Also, trusted social networks are efficient in leveraging the benefits of solar electricity to consumers.

Since the CitiCAP application aims to lower the user's emissions by encouraging sustainable mobility, it is necessary to also discuss consumer behavior besides eco-innovation adoption. The use of the application could be defined as sustainable behavior itself. Sustainable consumer behavior is defined as a behavior that intends to fulfill the present needs of the consumer without risking or affecting the consequences for the environment (e.g. Trudel, 2018). The application simulates the personal cap-and-trade and makes the emissions visible to the user. Therefore, it helps to motivate the consumer to choose more environmentally friendly transportation options. Sustainability is a fairly new area in scientific research, and it has been studied more widely from the 1970s onwards. The early research on the area focused on identifying key characteristics of green consumers, conceptualizing environmental consciousness, and researching attitudes towards environmental problems (Kilbourne & Beckmann, 1998). However, Trudel (2018) argues that the results of the early research have been inconclusive and sometimes contradictory, and therefore should be considered cautiously. In the 21st century, the focus has shifted from consumer's motivations and psychological factors to decision-making processes (Trudel, 2018).

Although consumer behavior is strongly related to the use of the application, the main focus of the study is eco-innovation adoption. The most traditional theory which is often used to explain innovation adoption is the diffusion of innovation theory by Rogers (2003). Many

researchers however think that the diffusion of innovation theory alone is incapable of providing a greater understanding of the adoption of eco-innovations. For example, Wolske et al. (2017) criticize earlier research for its ability to build comprehensively on behavioral theories presented in social sciences. They see that behavioral theories could have an important role in predicting the adoption of eco-innovations. Elmustapha et al. (2018) in turn suggest combining diffusion innovation theory to environmental psychology, which could increase the explanatory power of the research model. Environmental psychology research has mainly focused on attitudinal factors and certain values, and how they have related to pro-environmental behavior (Elmustapha et al., 2018).

It seems to be common to also utilize behavioral theories in eco-innovation adoption studies. For example, Wolske et al. (2017) note that using multiple behavioral theories gives a more holistic view of the reasons for the adoption. In their framework, the value-belief-norm theory explains what predisposes the decision to do pro-environmental actions, the theory of planned behavior explains why individuals choose to perform certain behaviors and diffusion of innovation theory helps to characterize the individuals who may be motivated to adopt the service. Even though Elmustapha et al. (2018) are mainly using the diffusion of innovation theory in their study, they also consider utilizing behavioral theories as a fountain of their study. They demonstrated that a model combining perceived product attributes, attitudinal factors, and innovativeness offered better predictability and fit than the models that tested these factors separately (Elmustapha et al., 2018).

A few findings should be addressed regarding the previous literature. The first one is that the previous research has not focused on the role of incentives in the adoption process. They have been researched fractionally in other contexts such as sponsoring the purchase of solar panels (Wolske et al., 2017), but only superficially. Since incentives are central motivators in the CitiCAP application, this study aims to discover their significance in the adoption process within the relative advantage. This research also takes into account the affective dimension to better explain the interest in adoption. Han et al. (2017) researched the effect of affective factors such as guilt and pride behind sustainable intentions. The affective dimension of their study is however a bit narrow for the adoption of the CitiCAP application, which utilizes elements similar for gamification. Therefore more affective factors such as enjoyment are added into the framework. Besides, previous research has focused on the interest or intentions which drive sustainable behavior without taking into consideration the

actual behavior. This research tends to focus on clarifying the factors that affect the actual adoption of eco-innovation.

1.3 Research questions

As often found, many people are reacting positively to intentions to live more sustainably or favor sustainable options, but this does not always lead to concrete actions (Carrington et al., 2014). Fichter and Clausen (2016) noted that the problem of the greening of the markets is not the lack of eco-innovations, but rather their diffusion in society. Therefore, the diffusion process and factors that affect the adoption of new eco-innovations need to be researched in more detail to find out how to diffuse them into the market more effectively. This research focuses on the motivation factors that drive the adoption of a new eco-innovation and aims to create a better understanding of the eco-innovation adoption process. The CitiCAP application is the first one whose objective is to encourage sustainable mobility through personal cap-and-trade, and therefore understanding the reasons behind adoption could help to develop the application further and also help with the planning of user acquisition. Although innovation is very functional, this study aims to examine also other dimensions of using the application. As Ozaki (2011) states, people don't think only about functional aspects of the innovation but also what innovation means to them. To gain a better understanding of the factors that affect the adoption of the application, it is required to examine also the emotions and prevailing norms behind the decision-making process in addition to instrumental attributes.

This study aims to discover how eco-innovations are adopted and what factors motivate the adoption. The study will concentrate on cognitive, affective, and normative factors. The research is based on the assumption that active use of the application encourages sustainable behavior. The research questions this thesis intends to answer are:

- What motivates the adoption of eco-innovation?
    - How cognitive factors affect eco-innovation adoption?
    - How affective factors affect eco-innovation adoption?
    - How normative factors affect eco-innovation adoption?
- How eco-innovations could be diffused more successfully?

These questions aim to increase understanding of the eco-innovation adoption process. The eco-innovation examined in this thesis is the CitiCAP application, and the research questions are answered based on the data collected from the users of the application.

1.4 Theoretical framework

The eco-innovation adoption has been researched from different standpoints. The theoretical framework, presented in Figure 1, combines the diffusion of innovation theory, the theory of planned behavior, and value-belief-norm theory. The diffusion of innovation theory introduces the five stages of adoption and addresses the role of perceived product characteristics (Rogers, 2003). The theory of planned behavior in turn intends to explain the formation of sustainable intentions through three factors: the attitude towards the behavior, subjective norm, and perceived behavioral control (Ajzen, 2005). Also, affective factors seem to impact the adoption process. The anticipated feelings of guilt and shame can encourage sustainable behavior (e.g. Onwezen et al. 2014). The feeling of enjoyment in turn can motivate the individual in the adoption (Antón et al., 2013). The value-belief-norm theory aims to explain how values are influencing the individual's ecological worldview, which in turn influences the awareness of the consequences of one's actions (Stern et al, 1999). This impacts the feeling of responsibility, which can lead to more sustainable behavior. Other normative factors that might give interesting insights are descriptive norms that can be easily adapted into marketing messages (Goldstein et al., 2008). Each of these theories is widely used in consumer innovation adoption studies and is discussed in more detail in chapter 2.

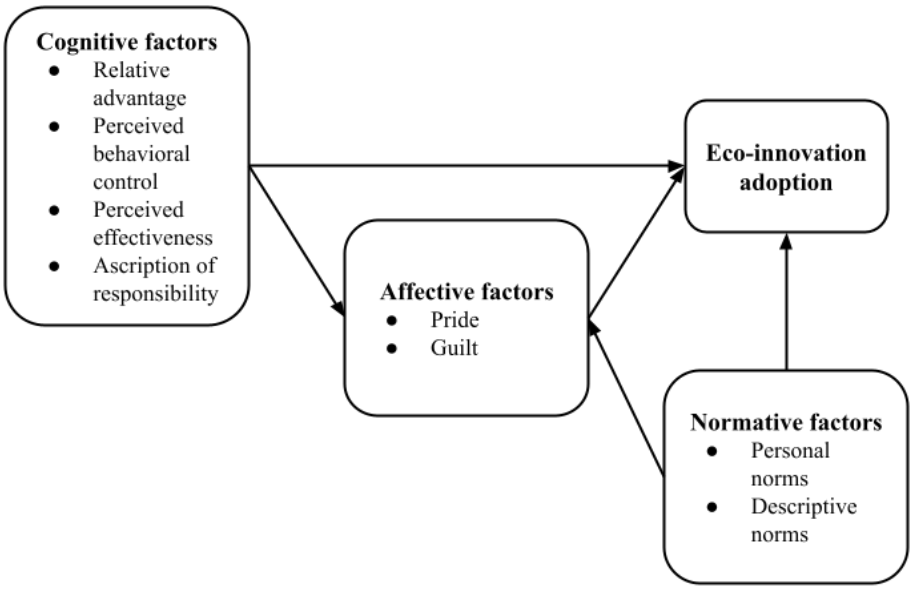


Figure 1. Theoretical framework

1.5 Key concepts of the study

The key concepts of the present study are presented below in Table 2.

Table 2. Key concepts of the present study

Concept	Definition	Adopted from
Eco-innovation	Eco-innovations (also known as sustainable innovations) are new products or services that have both innovative and eco-friendly features (e.g. solar water heaters, electric cars etc.)	Paparoidamis & Tran (2019)
Relative advantage	Relative advantage is the attractiveness of the product to the customer. A product has relative advantage if it exceeds the expectations of the customer.	Rogers (2003)
Perceived behavioral control	Perceived behavioral control means the experienced level of individual's ability to perform a behavior or be in control of the behavior. In general, the person feels in control when he has the required resources to perform the behavior.	Ajzen (2005)
Perceived effectiveness	Perceived effectiveness describes the consumer's belief of how much his choices and actions can really make a difference. It is a concept tightly related to sustainable consumption choices.	Han et al. (2017)
Ascribed responsibility	Ascribed responsibility means the experienced responsibility of one's actions. It is related to sustainable behavior since feeling responsible for e.g. causing emissions makes the person engage in sustainable actions.	Han et al. (2017)
Pride	Pride is an anticipated feeling that is associated with feelings of achievement and self-worth. The feeling of pride is found to increase the motivation to achieve the personal standards.	Antonetti & Maklan (2017b)
Guilt	Guilt is a negative moral feeling which is experienced when a person is responsible for causing a negative outcome. Because it is a negative feeling, a person tries to avoid it with his actions.	Tangney & Dearing (2002)
Descriptive norms	Descriptive norms are the assumptions of what other people would do in a specific situation. They are described as predictions of what other people commonly do.	Matthies et al. (2012), Trudel (2018)
Personal norms	Personal norms are described to be the amount of moral obligation the person experiences to behave in a certain way. They are the moral rules which to follow, and are affected by a person's values.	Stern et al. (1999)

1.6 Research methodology

The empirical part of the study focuses to examine the adoption of the CitiCAP application. The hypotheses were tested based on the quantitative data, which was collected on an online questionnaire in October 2020. The questionnaire was targeted to the active users of the

CitiCAP application, and it was distributed to the users with an online link through the application.

The collected data was analyzed by using SPSS statistical analysis program. The data analysis consisted of several parts and multiple methods were used. First, factor analyses was used to form the measurement constructs for all the variables, and the reliability of the constructs were assured. After that, mediation analysis was conducted to test the mediation effects between the selected independent variables and the eco-innovation adoption. Third, regression analysis was conducted by using backward elimination to test the hypotheses and analyze the relationships in order to find the factor directly affecting the eco-innovation adoption. After that, hypotheses were discussed based on the results.

1.7 Delimitations

The CitiCAP application is a certain type of innovation, and therefore the results of this study might not be applicable to other types of innovations. The present study also differs from the previous studies since it focused on the actual adoption behavior instead of interest for adoption or intention to adopt. Therefore, the results are not fully comparable with previous eco-innovation adoption studies, and the actual adoption should be researched more in the future in order to make reliable conclusions. Also, the sample size of the present study was quite small, which decreases the reliability of the results. Besides, the present study utilized only mediation and regression analysis, but in the future moderation analysis or structural equation modelling could offer additional information of the relationship between independent variables and the dependent variable.

In addition, some theoretical limitations were made when forming the research model. Some variables (e.g. observability and trialability) were excluded from the model in order to simplify it, since some variables were considered as less important in the adoption of the CitiCAP application. However, when researching other types of eco-innovations these variables should be considered to include in order to increase the understanding of the adoption process and factor affecting it. Another limitation considering the theoretical framework was the exclusion of the UTAUT theory (the unified theory of acceptance and use of technology).

1.8 Structure of the study

The present study consists of theoretical and empirical part. The theoretical part consists of two chapters. The first chapter of the study introduces the research topic by explaining the background of the study and discussing the most relevant previous literature. After that, research questions, the theoretical framework and key concepts of the study are presented, and research methodology and delimitations are discussed. Chapter 2 introduces the theoretical background of the study including diffusion of innovation, the theory of planned behavior and the value-belief-norm theory. After that, the research constructs are discussed based on the previous literature, and research hypotheses and conceptual model are formed.

The empirical part of the study begins with chapter 3, where research methodology is discussed. At first, questionnaire design and data collection methods are introduced, and pilot testing and response rate are presented. Besides, demographics of the respondents are described, and finally the focus turns into measurement development.

In chapter 4, the results of the study are analyzed and hypotheses are tested. At first, the indirect relationships are examined in mediation analyses. After that, regression analyses is conducted to examine the direct relationships between the research constructs. Chapter 5 goes through the findings, and discusses how cognitive, affective and normative factors are affecting the eco-innovation adoption. In chapter 6, the research is summarized and theoretical and managerial implications are discussed. Also, limitations of the study are acknowledged, and suggestions for further research are given.

2 Literature review

2.1 Theoretical framework

This literature review aims to give a comprehensive overview of the most common theories in the field of eco-innovation adoption and give examples of how these theories have been utilized in current research. The literature review is divided into five sections. The first one introduces the theoretical framework of the study and familiarizes with the innovation diffusion theory, the theory of planned behavior, and the value-belief-norm theory. The second section focuses on the cognitive factors behind the adoption decision such as advantages and disadvantages for the individual and the environment. The third section discusses the affective factors, and more closely the anticipated feelings and their role in driving sustainable behavior. Lastly, the fourth section familiarizes with normative factors such as social norms and emphasizes the role of personal norms. Also, the fifth section summarizes the hypotheses and introduces the research model.

2.1.1 Diffusion of innovation

The diffusion of innovation theory by Rogers (2003) has been used in many studies regarding eco-innovation adoption among consumers (e.g. Ozaki, 2011; Wolske et al., 2017). The adoption and diffusion of technology are seen as a social process in Rogers' (2003) theory, where an individual forms an attitude towards the innovation based on their perception of the characteristics of the innovation (Elmustapha et al., 2018). For example, Wolske et al. (2017) researched the adoption of residential photovoltaics by examining the factors that increased the interest among non-adopters. They found that innovation diffusion theory had a large predictive value for their research, and helped to explain the reasons which might lead to the adoption. Other phenomena that have been established to affect innovation diffusion are network effects (Bikhchandani et al., 1992) and herd behavior (Banerjee, 1992).

Rogers (2003) introduces five stages of innovation adoption: 1) gaining knowledge, 2) forming an attitude, 3) decision of adopting or rejecting 4) implementation, and 5) confirmation. Things that affect the decision of the individual to start the adoption process are his previous experiences of the product or service, existing problems or needs, his state of innovativeness, and social norms that surround him. According to the theory, the innovations are diffused in a community through certain communication channels among

the members of the community. However, Wolske et al. (2017) noted that mass media is less useful in promoting innovations. The social network of the individual in turn has an important role in the diffusion process (Ozaki, 2011).

According to Rogers' (2003) innovation diffusion theory, the individual forms a general attitude towards innovation in the second phase of the adoption process. Rogers (2003) claims that the perceived characteristics of the innovation are capable of explaining most of the variance in the adoption rate. Wolske et al. (2017) verify this since they found that product characteristics matter, and relative advantage, need for trialability, observability, and trustworthy communication channels affected positively the interest in the adoption of residential photovoltaics. The perceived characteristics of the innovation have been discovered to be better predictors of adoption than the demographic or psychographic characteristics of the adopter (Ostlund, 1974). The perceived characteristics according to Rogers (2003) are 1) relative advantage, 2) compatibility, 3) complexity, 4), trialability, and 5) observability.

Relative advantage is considered to be very important in innovation adoption, and according to Rogers (2003, p. 229) it means "the degree to which an innovation is perceived as being better than the idea it supersedes". Relative advantage can be experienced in economic, social, or personal terms. In the case of personal carbon trade, the relative advantage could be for example the achieved points which act as incentives, the savings in public transport tickets or fuel costs, and in encouraging individuals to exercise. Also, *compatibility* is an important factor, and it reflects how well innovation suits an individual's existing values, experiences, and needs (Rogers, 2003). Highly compatible innovation requires less adjustment from the individual, and therefore it is more likely that the innovation will be adopted (Ozaki, 2011)

Complexity means how difficult the individual considers the usage of innovation (Rogers, 2003). Complexity is not considered as important as relative advantage or complexity, but for some innovations it can be an important barrier for behavior to acknowledge (Elmustapha et al., 2018). The more complex the innovation is considered to be, the more negative influence it has on innovation adoption. The CitiCAP application might be suffering from some level of complexity, and therefore it should be taken into account in the research. *Trialability* accounts for the level that the innovation is able to be tested beforehand (Rogers, 2003). However, its ability to influence innovation adoption has caused contradictory results,

and therefore must be dependent on the used technology (Elmustapha et al., 2018). Due to the nature of the CitiCAP application, the trialability is an irrelevant factor in the present research because the application is free to download and therefore does not require a trial.

Observability accounts for the degree the innovation is visible to others (Rogers, 2003). The CitiCAP application is not very well observable by others, because it is in an individual's phone, and doesn't require constant checking. However, the change in mobility behavior can be observable by others, and the individual can make it visible in conversations with other people. Besides, some researchers have added *perceived risk* to the analysis (Elmustapha et al., 2018). Elmustapha et al. (2018) found that adopters of the solar water heaters perceived the product as more advantageous, compatible with their values, and observable by others. They also perceived the product as less complex. This is in line with Rogers' (2003) theory. However, the perceived risk did not have a significant relationship with the decision of adopting solar water heaters.

However, also the psychographic characteristics of the individual are found to be important in the innovation adoption process. According to Rogers (2003), several conditions e.g. previous practices, existing needs, innovativeness, and social norms influence the decision-making of the individual before the innovation adoption process can start.

2.1.2 Theory of planned behavior

Ajzen (2005) introduced the theory of planned behavior (TPB) as a continuum to the theory of reasoned action. The theory of planned behavior offers a framework for understanding behavior better and is based on the assumption that human behavior is sensible. Madden et al. (1992) found that when the behavior in question is not under volitional control the theory of planned behavior is superior in explaining the behavior when compared to the theory of reasoned action because it adds perceived behavioral control to the original model. Wolske et al. (2017) argue that TBP is one of the best approaches developed within social psychology which can be used to explain pro-environmental behavior and which takes into account a variety of factors that affect the adoption process.

According to the theory, three factors determine the intentions: attitude towards the behavior, subjective norm, and perceived behavioral control. The first determinant, the attitude

towards the behavior, accounts for the individual's positive or negative evaluation of performing the behavior. The second determinant, subjective norm, is the perceived amount of social pressure that the individual associates with performing the behavior or not performing it. The contribution of these two determinants is depending on both the individual's weighing and also the behavior in question (Ajzen, 2001). The third determinant, perceived behavioral control, means the sense of the individual's ability to perform the behavior or control it. Sometimes all these determinants aren't relevant for explaining the behavior, and in certain situations, some determinants are more important in offering explanations than others. Ajzen (2005) also mentions that there might exist a direct relationship between perceived behavioral control and behavior.

However, as Ajzen notes (2005, p. 123), "for a more complete understanding, it is necessary to explore why people hold certain attitudes, subjective norms, and perceptions of control over behavior". Therefore, the theory is complemented with different beliefs that underlie the determinants of intentions. According to TPB, the attitude towards a behavior is formed based on the beliefs the individual has about the consequences of the behavior, termed behavioral beliefs. The subjective norms in turn are based on normative beliefs, which account for the individual's beliefs of others approving or disapproving of performing the behavior. Other people here mean specific individuals or groups of people, and for most cases, the people are relatives, friends, coworkers, or some other influential people in an individual's life. The third determinant, perceived behavioral control, is formed based on the beliefs the individual has about his resources or opportunities to perform the behavior. It means the personal perception of whether the individual can perform the behavior or not.

The theory also takes into account background factors that may influence behavioral, normative, or control beliefs. However, the background factors do not necessarily have a direct connection to the beliefs, which is why it is shown in the figure as dotted arrows. The background factors include personal factors such as general attitudes, values, and emotions, the social factors include demographic information and the information factors include the individual's former experiences and knowledge about the behavior.

The theory of planned behavior is common in pro-environmental research (e.g. Han et al., 2017; Ozaki, 2011; Wolske et al., 2017), and other researchers support utilizing the theory. For example, Wolske et al. (2017) researched the adoption of residential photovoltaics and

noted that since they can be defined as a consumer good despite being an unusual one, they thought that the theory of planned behavior could help to create an understanding of consumer's decision-making since the theory has been deployed in analyzing a variety of consumer behavior. They noted that the beliefs that RPV would be personally beneficial, and that the individual's peers would be supportive of the decision affected positively the interest for the adoption. However, negative beliefs such as a belief that the system was too expensive or unsuitable for one's properties harmed the interest. Many respondents were also interested in hearing other user's experiences which means that social curiosity plays a strong role.

However, Bamberg and Möser (2007) criticize the explanatory power of the TPB model, and suggest the integration of personal norms into the model. Bamberg et al. (2007) raise personal norms in their framework as the third predictor of pro-environmental intention, and view social norms as the predictor of attitude, personal norms, and perceived behavioral control (is the choice 'favorable', 'right' and 'easy'). Also, Han et al. (2017) have seen personal norms beneficial in increasing the explanatory power of pro-environmental intentions. Therefore personal norms are added into the framework to give a better explanation but also to better take into account the affective factors which affect the personal norms. The influence of personal norms is discussed further in section 2.4.

2.1.3 Value-belief-norm theory

Stern et al. (1999) developed the value-belief-norm theory (VBN theory) which intends to explain pro-environmental consumer behavior by conceptualizing the attitudinal factors. The value-belief-norm theory has its base on Schwartz's (1977) moral norm-activation theory, which sees personal norms as the only direct determinants for pro-social behavior.

Stern et al. (1999, p. 83) generalized the model and proposed that "norm-based actions flow from three factors: acceptance of particular personal values, beliefs that things important to those values are under threat, and beliefs that actions initiated by the individual can help alleviate the threat and restore the values". The context of their study is the environmental movement, in which category the CitiCAP application suits well. The theory has been utilized in several environmental studies, e.g. energy conservation, eco-aware consumer behavior, garbage inhibition, and reduction of car use (Elmustapha et al., 2018). As the name

of the theory already suggests, Stern et al. (1999) propose that individuals who accept the pro-environmental values believe that the environment is threatened and believe that their actions can help to restore those values and experience a moral obligation (personal norm) for pro-environmental action. In other words, the value-belief-norm theory draws on the idea that pro-environmental values are affecting the beliefs on the ecological paradigm, and the awareness of the consequences is impacting the personal norms.

The theory intends to explain individual environmental decision-making and has been useful in understanding pro-environmental consumer behavior. According to Wolske et al. (2017), Ajzen (2012) notes that values complement the theory of planned behavior well, and therefore the value-belief-norm theory is well suitable for examining pro-environmental behavior together with the theory of planned behavior. In their study, Wolske et al. (2017) argue that the value-belief-norm theory helps to take into account the nature of residential photovoltaics having an impact on reducing emissions and therefore being an environmentally friendly choice. Therefore the theory is also suitable for explaining eco-innovation adoption.

VBN theory argues that pro-environmental behavior is reliant on values (Wolske et al., 2017). Originally, Stern et al. (1999) suggest that the values include altruistic values, egoistic values, traditional values, and openness to change values. However, many researchers have developed the model further. For example, Wolske et al. (2017) have specified the values, and have divided them into biospheric altruism, social altruism, self-interest, traditionalism, and openness to change. By social and biospheric altruism the theory intends to emphasize altruism towards other people and altruism towards other species and the biosphere (Wolske et al., 2017). In the case of personal carbon-trade application, both of the altruistic value factors are relevant since the reduced emissions will benefit the biosphere as well as other humans. Self-interest in turn can have either positive or negative effects on eco-innovation adoption. If the individual shows environmental concern or interest in the economic or health benefits of the CitiCAP application, he is more likely to adopt the innovation. Traditional values such as a sense of belonging and self-discipline might be relevant in the adoption of the CitiCAP application, but other values such as honoring parents and elders and family security should not be addressed as much attention. In turn, openness to change, which is described as being curious, showing interest, and exploring (Wolske et al., 2017) could be very relevant, since the innovation is fairly new.

Beliefs in value-belief-norm theory consist of three parts, and all these are causally connected. The first one is the new environmental paradigm. Dunlap and van Liere (2008) introduced a new environmental paradigm (NEP) - a view that human actions affect the biosphere. They defined the core statements emphasizing the respect for natural limits and the importance of preserving the environment. NEP is the most widely known social-psychological measure in environmental studies (Stern et al., 1999), and also other terms such as ecological worldview are used (e.g. Wolske et al., 2017). The NEP scale helps to measure broad beliefs about the state of the biosphere, and how human actions are affecting it (Dunlap, 2008). It explains the awareness of the general consequences for the environment whereas most studies utilizing norm-activation theory focus on problem-specific consequences (Stern et al., 1999). To tackle this gap, Stern et al. (1999) included in the value-belief-norm model also two other variables from the original norm-activation theory. These variables are awareness of consequences and ascription of responsibility. In other words, the values of the individual shape his environmental worldview, which in turn influences his beliefs about how the environmental impact of the things he values (awareness of consequences). Also, Han et al. (2017) note that the perceived effectiveness of one's actions is influencing the adoption, which supports the role of the awareness of consequences. The beliefs about consequences affect the responsibility the individual feels for his actions (ascription of responsibility) and affects his pro-environmental personal norms. In the theory personal norms refer to the extent that an individual feels a moral obligation to act in a certain way (Stern et al., 1999).

The VBN theory has been utilized in many studies related to eco-innovation adoption. For example, Ozaki (2011) researched the adoption of green electricity and found that social norms and social influence both are needed to encourage adoption. Wolske et al. (2017) in turn found that personal norms, altruism, awareness of consequences, self-interest, and traditionalism have positive effects on the interest in adopting residential photovoltaics.

2.2 Cognitive factors

As all of the aforementioned theories suggest, cognitive factors are influencing the adoption of eco-innovation. In this section, the roles of relative advantage, perceived behavioral

control, perceived effectiveness, and ascribed responsibility are discussed in more detail, and hypotheses of their modes of action are presented.

2.2.1 Relative advantage

Wolske et al. (2017) noted that the belief that residential photovoltaics would be personally beneficial affected positively the interest for their adoption. This confirms that the personal consequences for the individual have an important role in the adoption. The CitiCAP application has a notable difference when compared to traditional products or services. It could be described as altruistic by nature in the sense that the use of the application will benefit the environment instead of the individual. However, the application rewards the users for their sustainable behavior which occurs as a consequence of using the application and choosing more sustainable mobility options.

The altruistic nature of the CitiCAP application is a challenge for user acquisition. In general, the relative advantage means the product's attractiveness to customers. Wolske et al. (2017) found that the belief that solar photovoltaic systems would be personally beneficial had the strongest direct effect on the interest to adopt. They say that if people perceive a certain innovation to have more advantages than the other similar available innovations, they are more likely to adopt the innovation. Also, Wolske et al. (2017) note that relative advantage and personal benefits had a positive and significant impact on the intention to adopt solar photovoltaic systems. Elmustapha et al. (2018) verify the role of a relative advantage since in their study the adopters of solar water heaters exhibited significantly higher levels of relative advantage. The relative advantage of the innovation is tightly related to the instrumental attributes of the innovation. The instrumental attributes reflect the functional outcomes for the user of the innovation and include both the advantages (e.g. the ability to track one's carbon emissions) and the disadvantages (e.g. inconvenience) (Noppers et al., 2014). To better understand the relative advantage of the CitiCAP application, the study focuses on three different dimensions of relative advantage.

Monetary relative advantage

Wolske et al. (2017) suggest that the marketing efforts of eco-innovations should also emphasize non-environmental benefits, which in the case of CitiCAP application could be for example monetary. The application rewards the user with points if he can keep his

emissions on a wanted level. The points can be exchanged for services such as a cup of coffee, bus tickets, or Lahti merchandise. The reward system is still in the development phase, and there are only a few benefits offered at the moment even though the city plans to widen the repertoire.

There often exists a trade-off between financial and sustainable goals. In their fieldwork, Huber et al. (2017) tried to find a balance in a trade-off situation between financial and sustainable goals and found that creating monetary incentives for promoting sustainability has a positive effect on sustainable behavior. According to Trudel (2018), one way governments can encourage sustainable behavior is to increase incentives to act more sustainably. For example, some countries offer subsidies for emissions-based vehicle taxes for those who have registered electric vehicles (Sierzchula et al., 2014). Elmustapha et al. (2018) propose that financial incentives are often used by governmental actors to persuade households to pro-environmental behavior. However, they point that financial incentives have been effective in cases where adoption of technology is relatively expensive, which is not the case with the CitiCAP application. Elmustapha et al. (2018) also found that financial incentives did not have a significant relationship with a householder's decision to adopt solar water heaters. However, they note that the process of applying for the grant became more difficult after the first round and this might have affected the results.

Besides, favoring sustainable mobility can also be a cost-efficient way to travel due to the low monetary costs of public transport and cycling. Therefore, earning virtual points by using the application is not the only way to receive monetary benefits. Some of the users might be motivated to use the application and favor public transportation or cycling because it saves them money. Based on these findings and assumptions it is hypothesized that monetary relative advantage has a direct positive impact on eco-innovation adoption.

H1a: Monetary relative advantage has a direct positive impact on eco-innovation adoption.

Informational relative advantage

Besides monetary incentives, a central feature of the application is that it calculates the user's carbon emissions based on their mobility, and offers information, and makes the personal emissions visible to the user. Some people who find environmental values important might see the information aspect interesting, and use the application for raising awareness of the consequences of their actions. Researchers have found evidence that increasing awareness

of emissions caused by an individual's behavior can make them change their behavior to be more sustainable. For example, a similar application as CitiCAP was tested in Helsinki, and half of the subjects considered the information about emissions as interesting or useful (Gabrielli et al., 2014). Also, 3 out of 8 subjects said that the emission estimates motivated them in reducing emissions. This entails that people are interested in their ecological footprint and that environmental awareness can affect the behavior. Waygood and Aniveri (2016) in turn noticed that offering CO2 information about different transport modes had a stronger impact on women when looking at actions, and not just concerns or intentions to change behavior. It is interesting to see whether this holds in the case of the CitiCAP application. Similar findings have been done in other sectors as well. For example, Motoshita et al. (2015) found that disclosure of information on CO2 reductions of different shopping methods increased the likelihood of choosing the more environmentally friendly option regardless of the previous preferences. Therefore it could be suggested that informational relative advantage has a direct positive impact on eco-innovation adoption.

H1b: Informational relative advantage has a direct positive impact on eco-innovation adoption.

Health-related relative advantage

Other examples of indirect benefits of the CitiCAP application are related to personal health. Sallis et al. (2003) note that physical inactivity is a major public health challenge that could be responded with more information on the reasons to walk or cycle. The CitiCAP application encourages the use of emission-free mobility options such as walking and cycling, which can also bring long-term health benefits to the user. Sahlqvist et al. (2013) found that increasing active travel (i.e. walking or cycling for commuting) also increased the amount of physical activity, which entails that promoting active travel could be a way to improve health. Since the CitiCAP application is so unique, there is not relevant research made on whether the cap-and-trade application use can be motivated by health benefits. However, wearables are a rising trend, and many tracks for example their activity levels during the day. Self-tracking seems to motivate people for example to exercise more, and in a health app study made in the US, most of the people who used health apps regularly felt that the usage had improved their health (Krebs and Duncan, 2015). The CitiCAP application tracks the distance traveled on each mode of transport, but instead of showing burned calories, it counts the emissions caused by the travel. Because the CitiCAP application tries

to motivate users to do more active travel (e.g. walking or cycling), the health dimension is important to include in the research model, and the hypothesis is that health-related relative advantage has a positive impact on eco-innovation adoption.

H1c: Health-related relative advantage has a direct positive impact on eco-innovation adoption.

2.2.2 Perceived behavioral control

Through incentives, the individual can gain direct personal benefits for using the application. However, as Noppers et al. (2014, p. 53) note, "sustainable innovations typically have less favorable instrumental attributes compared to their traditional (less sustainable) alternatives, which may inhibit their adoption". This means that choosing a sustainable option often requires sacrifices for the user. This also goes for the CitiCAP application. The decision to use the application and favor sustainable mobility options such as public transport or cycling often requires more time and effort used in traveling. Another thing the individual might have to give up is the convenience of private motoring. *Perceived behavioral control* is one determinant of planned behavior (Ajzen, 2005). It means the sense of the individual's ability to perform the behavior or control it. In general people have intentions to perform a particular behavior when they feel that they can perform it with the available resources.

The perceived behavioral control is formed based on the beliefs the individual has about his resources or opportunities to perform the behavior (Ajzen, 2005). The individual's resources include things such as time, money, the ability to use public transport, and the knowledge of the application use. Madden et al. (1992, p. 9) discovered that when "the perceptions of control are accurate and the behavior is not under complete volitional control, perceived behavioral control can provide valuable information for the prediction of target behavior". In other words, if these two conditions apply, the perceived behavioral control is influencing the behavior directly. Both conditions apply in the use of the CitiCAP application since the actual control over the behavior is rather easy to evaluate realistically. Also, the individual does not have full control over his mobility choices, and for example, the location and the traffic communications of public transportation might be factors that decrease the amount of control.

The eco-innovation research has found support for this. Wolske et al. (2017) found that negative beliefs of behavioral control such as a belief that the system was too expensive or unsuitable for one's properties harmed the interest of adopting residential photovoltaics. This indicates that the individual's perceptions of his ability to use the CitiCAP application and favor sustainable transport (PBC) have a direct positive impact on the adoption. Besides, Ozaki (2011) found a positive correlation between green electricity adoption and prior basic knowledge on the innovation, which indicates that the innovation adoption is more likely when the individual feels that he is capable of adopting the innovation. If the individual feels that he can use for example more time commuting he is more likely to become an active user of the application. In turn, the lack of available transport options could make the adoption less probable. Some of these attributes have been taken into account in the application, and for example, people who have a longer distance to available public transport options have a larger personal carbon cap.

However, despite the perceived behavioral control being dependent on an individual's resources it is also tightly related to product characteristics such as compatibility and complexity. Compatibility refers to the extent that innovation is compatible with an individual's existing values, experiences, and needs (Rogers, 2003). For example, strong environmental values and former positive experiences with public transport could increase the compatibility of the CitiCAP application. In their research, Elmustapha et al. (2018) found that compatibility was significantly higher on the adopters of solar water heaters when compared to the non-adopters. Therefore good compatibility could indicate that the individual has a personal perception that he can perform the behavior. In turn, high complexity might indicate that the individual lacks the ability or knowledge to use the application. Complexity refers to a level of difficultness the individual experiences related to innovation use (Rogers, 2003). Ozaki (2011) notes that the feeling of being under pressure in daily life when using the innovation might have negative effects on the adoption. On the other hand, Elmustapha et al. (2018) found that adopters thought that solar water heaters were less complex to install and use when compared to non-adopters. This supports that perceived behavioral control would have a direct positive impact on innovation adoption.

H2: Perceived behavioral control has a direct positive impact on eco-innovation adoption.

2.2.3 Perceived effectiveness

In addition to the personal advantages and disadvantages that the use of eco-innovation allows, it also has consequences for the environment. Even though Ozaki (2011) notes that personal consequences may have more impact than distant and elusive environmental benefits, the environmental dimension of the innovation also matters especially in the case of the CitiCAP application. Protecting the environment is in general an important goal in an individual's life (Noppers et al., 2014), and therefore also environmental attributes of the innovation should be taken into account. Sustainable products and services have a less negative environmental effect than traditional ones. However, the CitiCAP application cannot be compared to the traditional equivalent since there does not exist one. The application's main focus is to decrease the carbon emissions caused by private motoring, and therefore the individual's perception of the consequences and effectiveness plays a central role in the adoption. Another thing that affects the adoption directly is the level of responsibility the individual experiences.

Individual beliefs about whether the use of the application benefits the environment are important for the decision-making process. *Perceived effectiveness* is a variable that describes how much the consumer believes that his choices will make a difference (Han et al., 2017). Antonetti and Maklan (2014b) note the perceived effectiveness is a key construct in understanding sustainable consumption choices. Han et al. (2017) verify this since they found that the perceived effectiveness of one's actions is influencing sustainable behavior among convention-goers. If the individual believes that the CitiCAP application can motivate him towards using sustainable mobility options and decrease his carbon emissions which will benefit the environment, he is more likely to adopt the application. Antonetti and Maklan (2014b) note that it requires direct feedback to be able to see whether the behavior helps to contribute positively to environmental or social issues. This is the strength of the CitiCAP application since it gives the user constant feedback on the emissions caused by the user's mobility, and therefore it could be assumed that perceived effectiveness plays an important role in the adoption.

Han et al. (2017) found that perceived effectiveness did not impact sustainable behavior through personal norms as they suggested, but rather through anticipated feelings. Onwezen et al. (2014) point out that guilt and pride are commonly used as predictors of pro-environmental behavior because they share some general characteristics: both emotions arise

when individuals feel responsible for their actions. Guilt is a negative feeling which is associated with feeling responsible for causing a negative outcome (Tangney and Dearing, 2002). In turn, pride is a positive emotion, which is achievement-oriented and associated with self-worth (Antonetti and Maklan, 2014b), and gives the individual the feeling of confidence and accomplishment (Tracy and Robins, 2007).

According to Han et al. (2017), perceived effectiveness had a direct influence on anticipated guilt and pride, and through those an indirect influence on the intention to practice green activities. Antonetti and Maklan (2014a) explain the phenomenon in more detail. They note that pride and guilt felt in previous consumption situations act as indirect feedback that the individual is responsible for the positive or negative outcomes of his behavior, and therefore influences future consumption choices. Based on these previous findings, this study assumes that perceived effectiveness has a positive indirect effect on eco-innovation adoption through anticipated pride and guilt.

H3: Perceived effectiveness has a positive indirect effect on eco-innovation adoption through anticipated pride.

H4: Perceived effectiveness has a positive indirect effect on eco-innovation adoption through anticipated guilt.

2.2.4 Ascribed responsibility

Ascribed responsibility means the responsibility the individual feels for his actions (Han et al., 2017). If the individual feels he is responsible for the emissions caused by the citizens, he is more likely to engage in sustainable activities such as using the CitiCAP application. In the value-belief-norm theory, the ascription of responsibility is directly affecting the pro-environmental personal norms of the individual, and indirectly consumer behavior (Stern et al., 1999). De Groot and Steg (2009) found ascribed responsibility increases the feeling of moral obligation, and therefore leads into prosocial intentions. Also, Han et al. (2017) found that the link between ascribed responsibility and personal norms was positive and significant, and note that it is the most influential driver of personal norms. In their research, the more the respondent felt responsible for environmental problems caused by convention tourism, the more impact it had on his norms. They also found that ascribed responsibility has an indirect effect on practicing green activities through personal norms (Han et al., 2017). Also

De Groot and Steg (2009) suggest that ascribed responsibility is affecting intentions and behavior indirectly through personal norms, and state that there exist a mediating effect between the variables (De Groot & Steg, 2009). Therefore it is suggested that ascription of responsibility has an indirect positive impact on eco-innovation through personal norms.

H5: Ascription of responsibility has an indirect positive impact on eco-innovation adoption through personal norms.

Han et al. (2017) also found that ascribed responsibility had a positive impact on anticipated pride. If the respondent felt responsible for the environmental issues caused by convention tourism, he also felt more pride when thinking about engaging in eco-friendly practices. As with personal norms, ascribed responsibility impacted intention to practice green activities indirectly through anticipated pride (Han et al., 2017). However, Han et al. (2017) found that the linkage between ascribed responsibility and anticipated guilt was insignificant. Therefore it is suggested that ascription of responsibility has an indirect positive impact on the eco-innovation adoption through anticipated feeling of pride.

H6: Ascription of responsibility has an indirect positive effect on eco-innovation adoption through anticipated pride.

2.3 Affective factors

Besides the cognitive dimension, also affective factors have their role in explaining pro-environmental behavior (Han et al., 2017). Therefore it could be assumed that affective factors would also affect the adoption of eco-innovation since, for example, the use of the CitiCAP application can lead to pro-environmental behavior. Ozaki (2011) claims that there are often motivational factors underlying the innovation adoption process such as the meanings people attribute to them. The innovation adoption process can also be affective by nature because it resembles the purchasing situation which involves both hedonic and self-expressive motivations (Fitzmaurice, 2005). Adding an emotional dimension to the TPB model can increase its explanatory power (Perugini and Bagozzi, 2001). For example, in their meta-analysis, Bamberg and Möser (2007) studied the anticipated feeling of guilt and found that it is a significant predictor of moral norms, attitudes, and perceived behavioral control which are the building blocks of the TPB model.

The affective reactions to individual experiences, when they are conducting a certain behavior, are described as anticipated feelings (Perugini and Bagozzi, 2001). Those feelings can be either positive or negative. However, many studies have researched the anticipated guilt and pride as predictors of pro-environmental behavior during the last decade (Han et al., 2017). Han et al. (2017) also note that negative anticipated feelings have a greater influence on ecological intentions than positive ones. Antonetti and Maklan (2014b) in turn note that self-conscious emotions that arise in a consumption situation are also affecting future consumption choices which are similar to the previous ones. This study examines closer the impact of anticipated pride and guilt. It also takes into consideration the feeling of enjoyment, since the CitiCAP application utilizes gamification in which enjoyment has a central role.

2.3.1 Pride

The most common positive anticipated feeling researched is pride. Pride is generally seen as a two-asset account that comprises both authentic and hubristic components (Tracy and Robins, 2007), and it is associated with a sense of achievement and self-worth (Antonetti and Maklan, 2014b). Authentic pride is linked to achievement-orientation which culminates into feelings of confidence, pride and accomplishment whereas hubristic pride has a more negative echo and is better described through self-indulgence and arrogance (Tracy and Robins, 2007). This study discusses authentic pride, which can have a positive impact on eco-innovation adoption. In the case of the CitiCAP application, the awareness that public transport use generates less harm for the environment may elicit the feeling of pride. This increases the motivation to behave according to personal standards (Antonetti and Maklan, 2014a). This could indicate that the anticipated pride would have an impact on an individual's norms.

This view is also supported by Bamberg and Möser (2007), who found that anticipated feelings can be a significant predictor of moral norms, which underlines the importance of moral feelings in pro-environmental studies. Han et al. (2017) in turn discovered that if the respondent felt pride when thinking about engaging in eco-friendly activities, it influenced the intention to recommend green activities to other convention-goers. This supports the assumption that the feeling of pride has an impact also on eco-innovation adoption. However, Han et al. (2017) question the relationship between anticipated feelings and

personal norms, since in their research the linkages from guilt and pride to personal norms were insignificant. They suggest that the anticipated feeling of pride and guilt are influencing the pro-environmental behavior directly. Onwezen et al. (2013) did similar findings when they researched the role of anticipated emotions in the norm activation model. They found that anticipated feelings such as pride and guilt are acting as mediators between personal norms and sustainable behavior. Therefore it could be suggested that personal norms are defining whether the behavior the individual might engage in is right or wrong, and helps to predict how the individual will eventually feel about performing the behavior. The fact that there are different standpoints on the relationship between anticipated feelings, personal norms, and behavior is interesting. It might indicate that there is some mode of action not yet understood, or that some variable is missing from the model.

H7: The feeling of pride has a direct positive impact on eco-innovation adoption.

2.3.2 Guilt

Bamberg et al. (2007) found evidence that negative emotions such as guilt, shame, and regret may play a central role in pro-environmental decision-making. They found that these feelings are indirectly affecting the pro-environmental decision-making through personal norms and that they eventually contribute to forming the decision to use public transport instead of using a car. Guilt is a 'self-conscious' and 'moral' feeling, which could be defined as a negative feeling that arouses when an individual feels responsible for causing a negative outcome (Tangney and Dearing, 2002). Bamberg and Möser (2007) claim that only a few research has taken into account the 'moral' feelings such as guilt as predictors of pro-environmental behavior, and they claim that further research is urgently needed.

Bamberg and Möser (2007) studied the anticipated feeling of guilt and found that it is a significant predictor of moral norms, attitudes, and perceived behavioral control. According to Antonetti and Maklan (2014a), the feeling of guilt can have a positive influence on consumer's future intentions to engage in sustainable activities. Because of the feeling of guilt, the individual might feel an obligation to recompense the caused harm (Han et al., 2017). For example, the awareness that the use of one's car generates more harm to the environment than the use of public transport elicits feelings of guilt (Bamberg et al., 2017). According to Bamberg et al. (2007), this leads to the felt obligation (personal norm), which

drives the individual to prefer the use of public transport. This indicates that some anticipated feelings could affect the decision-making on whether to use public transport or car through personal norms. Besides, Han et al. (2017) found that the feeling of guilt when discussing engaging in eco-friendly activities influenced the intention to recommend green activities to other convention-goers as well as intention to engage in green activities.

However, as with pride, Han et al. (2017) found that the relationship between guilt and personal norms was insignificant, and therefore argue that the mode of action is direct. Han et al. (2017) also note that the impact of guilt was greater than the impact of pride which indicates that the negative anticipated feelings are more effective in engaging pro-environmental behavior. This is also supported by Onwezen et al. (2013), who found that personal norms are impacting the emotional response of the individual, and therefore anticipated feelings are seen as mediators for sustainable behavior. Even though there are different views on the mode of action, this study leans on the latter view, and therefore it is suggested that the feeling of guilt has a direct positive impact on eco-innovation adoption.

H8: The feeling of guilt has a direct positive impact on eco-innovation adoption.

2.3.3 Enjoyment

Due to the nature of the eco-innovation, also other types of emotions should be considered. Since the CitiCAP application utilizes gamification to encourage the user of the application, feelings such as excitement or enjoyment should be considered. In the eco-innovation adoption research, the role of enjoyment has not been examined, but technology adoption literature has provided some evidence that enjoyment could impact the adoption. For example, Song and Han (2009) conducted an empirical analysis and found that the user's perceived enjoyment affects technology adoption. Antón et al. (2013) verify this since they researched the adoption of e-book readers, and found that the perceived enjoyment led to a more favorable attitude towards the e-book readers, and therefore had a direct positive impact on the adoption. This predicts that enjoyment could also influence CitiCAP application adoption.

H9: The feeling of enjoyment has a direct positive impact on eco-innovation adoption.

2.4 Normative factors

In addition to product characteristics and cognitive and affective factors, also normative factors are affecting eco-innovation adoption. Normative factors include both social and personal norms. Social norms take into account other people in the individual's inner circle or community, and their impact on one's choices. The individual might want to act on others' expectations or he might be learning from the behavior of others.

2.4.1 Social norms

Previous literature has shown that social influence and social norms in particular influence sustainable behavior (Trudel, 2018). Research has also demonstrated that communicating social norms can influence e.g. adoption of green electricity and increase sustainable intentions (Ozaki, 2011; Han et al., 2017). Also, Ozaki (2011) found that individuals are engaging in activities that require them to start to use the social norms which are important in the community they belong to. This indicates that social influence plays an important role in innovation adoption. Bamberg et al. (2007) note that the power of social norms seems to be more dependent on the fact that other people are seen as providers of easy information rather than the fear of social sanctions. It means that if people are unsure of how they should behave, they look for cues from others. Especially difficult choices such as having to choose between what is right and what is easy might require support from others.

In the theory of planned behavior, the second determinant for behavior is subjective norms (Ajzen, 2005). Subjective norms could be defined as the perceived amount of social pressure that the individual associates with performing the behavior or not performing it. In general, people have the intention to perform a particular behavior when they experience social pressure. For example, an individual might be more engaged to use public transport when he sees his peers using it daily. The subjective norms are based on normative beliefs, which account for the individual's beliefs of others approving or disapproving of performing the behavior (Ajzen, 2005). 'Other people' in this context are specific individuals or groups of people, and for most cases, the people are relatives, friends, coworkers, or some other influential people in an individual's life.

Wolske et al. (2017) found that the beliefs that the individual's peers would be supportive of the decision affected positively the interest in the adoption of residential photovoltaics.

Many respondents were also interested in hearing other user's experiences which means that social curiosity plays a strong role. From the innovation product characteristics observability is tightly related to social norms. Observability refers to the level the innovation is visible to others (Rogers, 2003), and therefore takes into account the social aspect of the innovation. Wolske et al. (2017) found that observability indirectly affected the interest in the adoption by increasing relative advantage and decreasing the riskiness of the innovation. They also found that trust in one's social network correlated positively with a want to try the solar photovoltaic system and learn more about other similar systems. Besides, Elmustapha et al. (2018) found that observability was significantly higher on the adopters of the water solar heaters. These findings verify that social influence indeed plays an important role in eco-innovation adoption. Calder and Burnkrant (1977) found that social influence is more powerful when the individual engages in behavior at least partly because he wants to express himself. As sustainability and green values, in general, are a rising trend, the use of the CitiCAP application can be a way for some to express their commitment to sustainability, or show that they care about the environment.

Social norms are defined to be the unwritten rules which are shared by a social group through interactions with the group members (Trudel, 2018). Descriptive norms in turn are social norms that reflect what the individual thinks that other members of the social group would do in the given situation (Matthies et al., 2012). According to Trudel (2018, p. 91), they are "characterized by the perception of what people commonly do". Strong descriptive norms can be beneficial for marketers, since they are easy to integrate into marketing messages (Goldstein et al., 2008), e.g. "60% of citizens of Lahti are using the personal carbon-trade application" or "Two-thirds of commuters are walking or cycling to work". Han et al. (2017) found that descriptive norms significantly increased personal norms, although they did not have a significant direct impact on intention to sacrifice or practice green activities. However, descriptive norms had a positive impact on the intention to sacrifice and practice green activities indirectly through personal norms (Han et al., 2017). Trudel (2018) noted that social proof, which means proof of how people behave in given situations has a positive effect on performing the behavior. Often if people are unsure how they should behave, they might look for appropriate behavior from others. This supports the assumption that descriptive norms would influence eco-innovation adoption. Based on these findings, the hypothesis is that descriptive norms have a direct positive impact on personal norms.

H10: Descriptive norms have a positive indirect effect on eco-innovation adoption through personal norms.

2.4.3 Personal norms

Even though social norms are important, Elmustapha et al. (2018) remind that also including personal norms in the research model is needed, because subjective social norms alone are not sufficient for explaining the correlation between norms and pro-environmental behavior. Some researchers even think that personal norms are more important than social norms because the existing social norms are not relevant when there is a need for social change (Stern et al., 1999). Personal norms also play an important role in the value-belief-norm theory that is a well-known behavioral theory in environmental studies. Personal norms (also known as moral norms) refer to the extent that an individual feels a moral obligation to act in a certain way (Stern et al., 1999). According to the value-belief-norm theory, one's values are affecting his beliefs about the environment and the consequences of his actions, which in turn shape his norms. Personal norms function as an individual's moral rules that he aspires to follow.

Wolske et al. (2017) found that personal norms have a direct positive impact on the interest to adopt solar photovoltaic systems once social curiosity was added in the model as a predictor of interest to adopt. Han et al. (2017) also found that personal norms had a positive and significant impact on intention to sacrifice and practice green activities. Nordlund and Garvill (2003) in turn researched the willingness to reduce private car use and found that personal norms had a significant positive effect on willingness. Besides, Bamberg et al. (2007) raise personal norms in their framework as the third predictor of pro-environmental intention, and view social norms as the predictor of attitude, personal norms, and perceived behavioral control (is the choice 'favorable', 'right' and 'easy'). All of these findings suggest that personal norms are impacting the adoption of eco-innovation directly. However, Elmustapha et al. (2018) found that environmental personal norms did not show any significant difference between the adopters and non-adopters of solar water heaters. Therefore the role of personal norms should be researched in the adoption of the CitiCAP application.

H11: Personal norms have a direct positive impact on eco-innovation adoption.

As discussed in section 2.3, the mode of action between personal norms and anticipated feelings has divided opinions. Some researchers have found evidence that anticipated feelings (e.g. pride and guilt) are acting as predictors of personal norms (Bamberg and Möser, 2007; Bamberg et al., 2007). On the other hand, some argue that personal norms are impacting the forming of anticipated feelings (Onwezen et al., 2013). To get a better understanding of the mode of action between these variables, the hypothesis is that personal norms are also impacting the eco-innovation adoption indirectly through anticipated feelings.

H12: Personal norms have an indirect impact on eco-innovation adoption through anticipated feelings (pride and guilt).

2.5 Research model

This study aims to research eco-innovation adoption. In more detail, the study investigates how different cognitive, affective, and normative factors are influencing eco-innovation adoption. The developed research model is based on previous literature on eco-innovation adoption, and the extensive literature review is presented in the previous chapter. The research model and the assumed relationships with different factors are illustrated below in Figure 2. The summary of the hypotheses presented in the previous chapter is in Table 2.

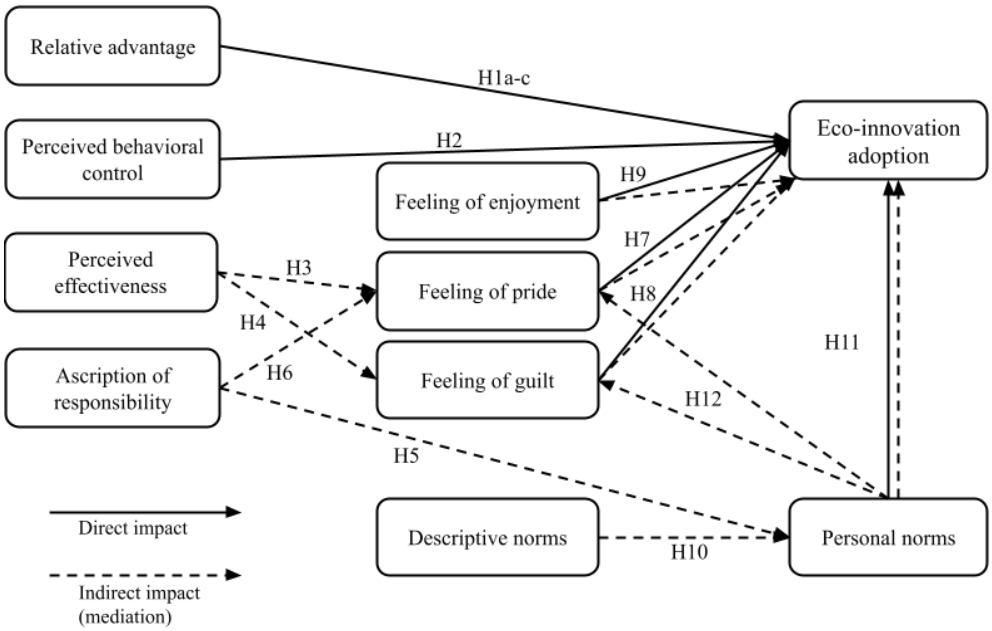


Figure 2. The research model

Table 3. Summary of the hypotheses

H1a	Monetary relative advantage has a direct positive impact on eco-innovation adoption.
H1b	Informational relative advantage has a direct positive impact on eco-innovation adoption.
H1c	Health-related relative advantage has a direct positive impact on eco-innovation adoption.
H2	Perceived behavioral control has a direct positive impact on eco-innovation adoption.
H3	Perceived effectiveness has a positive indirect effect on eco-innovation adoption through anticipated pride.
H4	Perceived effectiveness has a positive indirect effect on eco-innovation adoption through anticipated guilt.
H5	Ascription of responsibility has an indirect positive impact on eco-innovation adoption through personal norms.
H6	Ascription of responsibility has an indirect positive effect on eco-innovation adoption through anticipated pride.
H7	The feeling of pride has a direct positive impact on eco-innovation adoption.
H8	The feeling of guilt has a direct positive impact on eco-innovation adoption.
H9	The feeling of enjoyment has a direct positive impact on eco-innovation adoption.
H10	Descriptive norms have a positive indirect effect on eco-innovation adoption through personal norms.
H11	Personal norms have a direct positive impact on eco-innovation adoption.
H12	Personal norms have an indirect positive impact on eco-innovation adoption through anticipated feelings (pride and guilt).

3 Research methodology

The present study utilizes quantitative methods, and the empirical part of the study consists of several parts presented below in Figure 3.

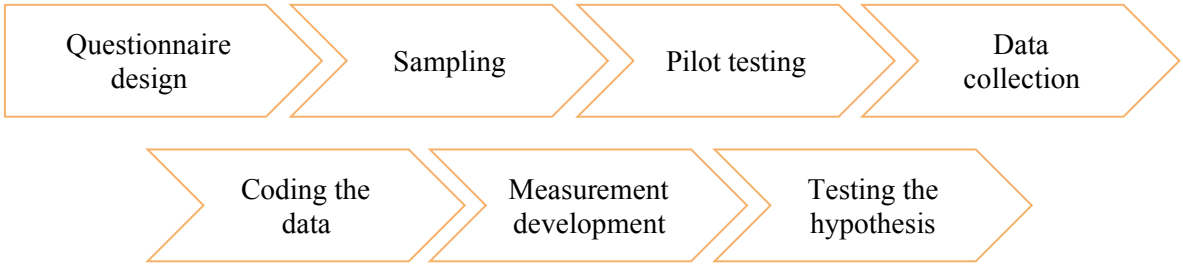


Figure 3. Phases of the empirical study

This chapter discusses the methodology utilized in this study and describes the data collection in more detail. At first, the questionnaire design is described and the used questionnaire is presented. Second, sampling is described and the choice of the data collection method is justified. Third, pilot testing and response rate are discussed. After that, the respondent demographics are described, and finally, the measurement development is discussed.

3.1 Questionnaire design

Questionnaires are the most widely used data collection method in the survey strategy, and they work best with standardized questions (Saunders et al., 2015). In the present study, the online questionnaire was standardized and consisted of a set of predetermined questions. In standardized questionnaires, all the questions are presented with the same wording and order for all the respondents. This makes the answering easy for the respondents, but also makes the coding and analyzing the data easier for the researcher. In the present study, dichotomous questions were used to measure the dependent variable, scaled questions were used to measure independent variables, and multichotomous questions were included to collect data on the demographics of the respondents.

The questionnaire was based on the literature review and on the measurement scales of the factors which have already been proved to be valid and reliable. Conducting an online questionnaire with closed-ended questions offers the data already in digital form which speeds up the analyzing process (Malhotra et al., 2017). All constructs were measured using a multiple-item measurement scale. A 7-point Likert scale was utilized in all of the survey

questions except questions regarding demographic factors. The agreement or disagreement with the statements were measured with scale questions. One question regarding the perceived behavioral control is measured on a scale from "very little control" to "complete control". The questions regarding the affective factors are measured on a scale from 'not at all' to 'very intensely'.

The dependent variable was measured with dichotomous questions. The dependent variable in the study was the adoption behavior of the CitiCAP application users. Rogers (2003, p. 177) defines adoption as a decision of "full use of an innovation as the best course of action available", and if the innovation has an option for trial, the adoption happens more likely (Sahin, 2006). Also, rejection is possible, and Rogers (2003) notes that there are two types of rejection: active rejection and passive rejection. Active rejection means that the individual tries the innovation and thinks about adopting it, but still for some reason decides not to adopt it. Passive rejection happens, when the individual does not consider the adoption at all. The adoption behavior was measured with two items based on the individual's own experience on the level of the adoption.

All the questions regarding the factors that affect the innovation adoption process were validated by previous literature. Only measures having reliability over 0.7 were accepted, which can be considered as a sufficient level (Saunders et al., 2015). The questionnaire was translated into Finnish by using back-translation to establish the equivalence of meaning (Douglas & Graig, 2007). The translations were compared and some slight changes were made based on the results.

The questions are presented below in table 3. The final questionnaire (in Finnish) is presented in Appendix 1.

Table 4. Measures and measurement items used in the present study

	Questions	Adopted from
AD1	I use the CitiCAP application actively.	Liao & Lu (2008)
AD2	I use the CitiCAP application regularly.	
MRA1	The use of the CitiCAP application will help me to earn products or use services for free.	Wolske et al. (2017)
MRA2	The use of the CitiCAP application will help me to save money.	
HRA1	The use of the CitiCAP application will encourage me to increase my physical activity.	
HRA2	The use of the CitiCAP application helps me to increase the amount of incidental exercise in my daily life.	
IRA1	The use of the CitiCAP application will help me receive information about my emissions.	

IRA2	The use of the CitiCAP application helps me to better understand the emissions my actions are causing.	
PBC1	For me using the CitiCAP application would be very easy	Ajzen (2002) (who had reviewed several other study measures)
PBC2	If I wanted I could easily favor more environmentally friendly travel options.	
PBC3	How much control do you think you have over your ability to choose more environmentally friendly travel options?	
PE1	Through my personal choices, I can contribute to the solution of environmental issues.	Antonetti & Maklan (2014b), Roberts (1996)
PE2	My actions are too insignificant to affect environmental problems. (reversed)	
PE3	Environmental issues are affected by my individual choices.	
PE4	Ecological degradation is partly a consequence of my own consumption choices.	
AR1	I believe that every citizen is partly responsible for the environmental problems caused by the city.	Verma et al. (2019)
AR2	I feel that every citizen is jointly responsible for the environmental deterioration caused by the city.	
AR3	Every citizen must take responsibility for the environmental problems caused by the city.	
P1	Thinking about your feelings when using the CitiCAP application, how intensely do you feel pleased?	Antonetti & Maklan (2014b), Roseman (1991), Soscia (2007)
P2	Thinking about your feelings when using the CitiCAP application, how intensely do you feel pride?	
P3	Thinking about your feelings when using the CitiCAP application, how intensely do you feel good about yourself?	
G1	Thinking about your feelings when NOT using the CitiCAP application, how intensely do you feel remorse?	Antonetti & Maklan (2014b), Han et al. (2017), Roseman (1991), Soscia (2007)
G2	Thinking about your feelings when NOT using the CitiCAP application, how intensely do you feel bad?	
G3	Thinking about your feelings when NOT using the CitiCAP application, how intensely do you feel guilt?	
E1	Thinking about your feelings when using the CitiCAP application, how intensely do you feel happy?	Richins (1997)
E2	Thinking about your feelings when using the CitiCAP application, how intensely do you feel pleased?	
E3	Thinking about your feelings when using the CitiCAP application, how intensely do you feel joy?	
DN1	I believe that most of my acquaintances would encourage me in using the CitiCAP application.	Thøgersen (2006), Wolske et al. (2017), Han et al. (2017)
DN2	I believe that most of my acquaintances take the bus or train to work and shopping if the choice is between bus or train and their car.	
DN3	I believe that most of the citizens favor environmentally-friendly mobility options to decrease emissions.	
PN1	I feel a personal obligation to prevent climate change, no matter what other people do.	Elmustapha et al. (2018), Han et al. (2017), Stern et al. (1999)
PN2	People like me should do everything they can to reduce their emissions and help prevent climate change.	
PN3	I feel that it is important to make cities environmentally sustainable and reduce harm to the wider environment.	

3.2 Sampling

The target population in the present study was the active users of the CitiCAP application. The responses were collected from the user database of the CitiCAP application, and the sample included all the users, who actively used the application during the weeks the questionnaire was open for responding. Altogether the sample covered 341 active users during the testing period.

3.3 Selection of data collection method

There exists a variety of data collection methods in quantitative research, for example, personal or telephone interviews, and different types of questionnaires such as postal, online, and e-mail questionnaires. In the present study, the chosen data collection method was a questionnaire because conducting an online questionnaire is a fast and cost-efficient way to gain quantitative data, and it offers an opportunity to have a diversity of questions (Malhotra et al., 2017). Distributing the online questionnaire is easy because it only requires sharing a web link with the intended respondents. Getting a sufficient amount of responses is also more likely through the online questionnaire even though response rates tend to be lower in online surveys compared to other survey methods (Malhotra et al., 2017).

In the present study, the respondents were active users of the CitiCAP application. Therefore, the primary data for the research was most effective to collect through an online questionnaire. Cooperation with the city of Lahti enabled the distribution of the online survey to active users easily through the application. This made the responding effortless for users since they were able to respond to the questionnaire anywhere and anytime when they were using the application. The questionnaire was located on the top of one of the subpages of the application, and also a notification was sent to users at the beginning of the testing period, and a reminder after two weeks of the testing period.

3.4 Pilot testing

Pilot testing should be used to refine the questionnaire and make sure the respondents will not have any problems when answering the questionnaire. The respondents of the pilot testing should be similar to those who will participate in the actual questionnaire (Saunders et al., 2015). Even though pilot testing requires resources, it is highly recommended to do. Even a small-scale pilot testing provides at least some idea of the questionnaire's face

validity (Saunders et al., 2015). Using a pilot questionnaire ensures that the respondents understand the questions correctly and can follow the instructions as intended.

In the present study, pilot testing was made to validate the translation of the questionnaire in Finnish, since the questions and measurement scales used were mainly adopted from previous studies conducted in English. The aim of pilot testing was also to test the structure and length of the questionnaire. The respondents of the pilot test questionnaire were familiar with the CitiCAP application, and altogether 8 people participated. Participants had a telephone connection to the interviewer while responding to the online questionnaire to provide immediate comments. Telephone connection also enabled discussion, which increased the understanding of the questionnaire. Based on the feedback received, few statements were corrected, and the structure of the questionnaire was clarified.

3.5 Response rate

In general, the response rates for online questionnaires tend to be very low, and there are problems related to non-response bias because the respondent has to take multiple steps before completing the questionnaire (Saunders et al., 2015). However, the response rate can be improved by several strategies (e.g. addressing anonymity, offering incentives, and using a follow-up).

In the present study, the following efforts to improve the response rate were made. First, the questionnaire was filled anonymously, which ensures that the answers cannot be associated directly with the respondents. Second, after filling the questionnaire, the respondents were able to participate in a draw where the winners were gifted with movie tickets sponsored by the city of Lahti. This was also mentioned in the CitiCAP application subpage where the questionnaire was located as well as the notifications to raise interest in and motivation towards the questionnaire. Third, a reminder of the questionnaire was sent as a notification for all the active users two weeks after the questionnaire was published.

The questionnaire was open for responding during weeks 40-44 in October 2020. In total 64 responses were received, which means that the effective response rate for the questionnaire was 64/341=18,8%. It can be considered as a sufficient one since usually comparable online questionnaires have a response rate of 10% or even lower (Saunders et al., 2015).

3.6 Respondents

This chapter describes the respondents of the study. The collected background information of the respondents included gender, age, education, and financial status.

The respondents represent a versatile group of active users. A majority of the respondents were female (57,8%) and the remaining 42,2% were male.

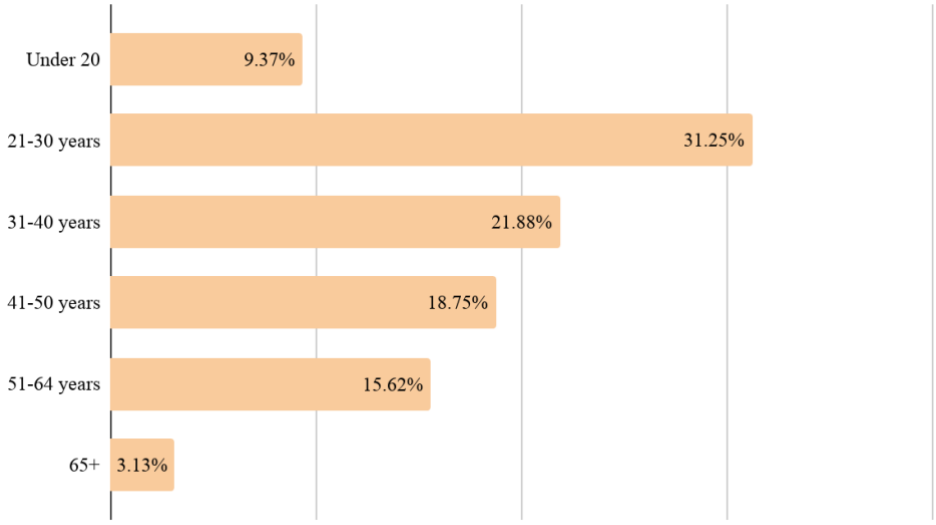


Figure 4. Age

Respondents' age distribution is presented above in Figure 4. Under 10% of the respondents were under 20. Over half of the respondents were 21-40 year-olds, and the largest age segment was 21-30 year-olds. The smallest percentage (3,13%) were over 65-year-olds.

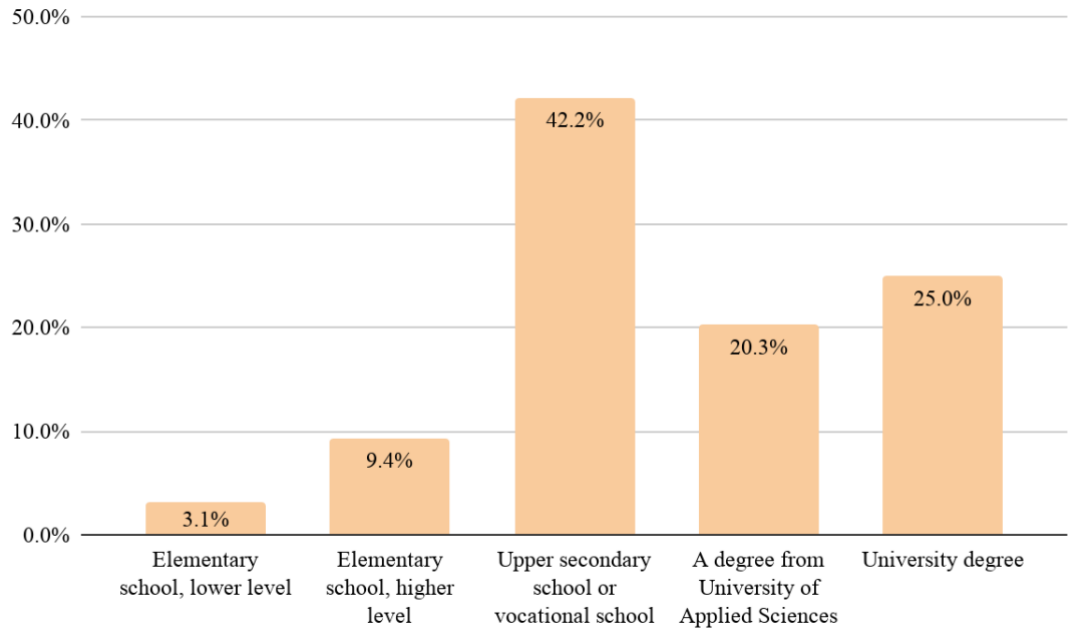


Figure 5. The highest educational level

A majority (45,3%) of the respondents had a higher education level degree either from a university (25%) or a university of applied sciences (20,3%). Nearly the same percentage (42,2%) of the respondents stated that their highest level of education was secondary education (upper secondary school or vocational school). This differs from the respondents of Elmustapha et al. (2018) and Han et al. (2017), from which a majority had at least an undergraduate degree. The rest (12,5%) had an elementary education, either lower or higher, as their highest level of education. The respondents of the present study were more highly educated when compared to the level of education of the Finnish population (OSF, 2019b).

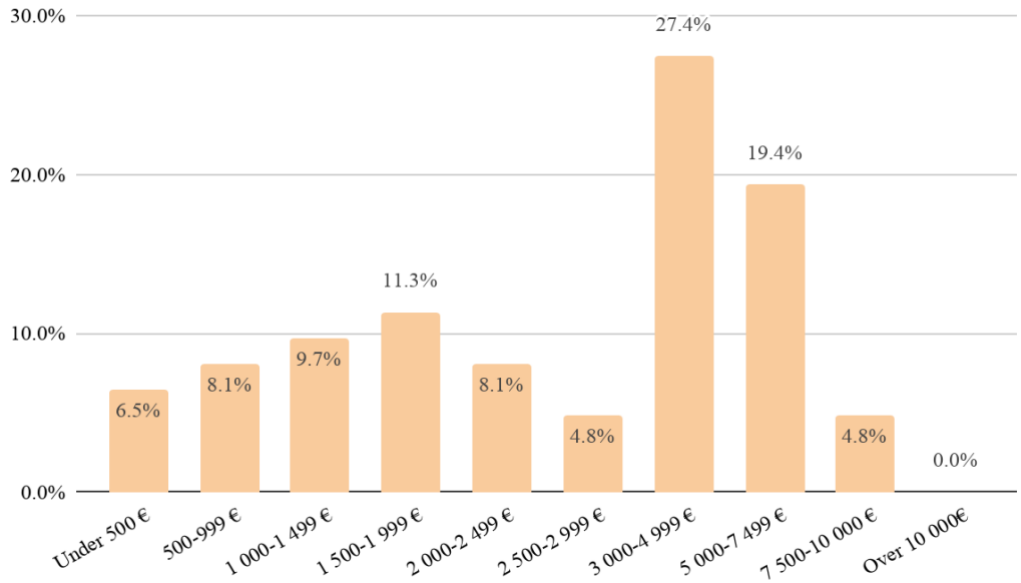


Figure 6. The monthly gross income of the household

A majority of the respondents (51,6% in total) informed that their household's monthly gross income was over 3000 euros. Respectively, the lower income levels received answers from 4-12% of the respondents each. The income distribution was similar to Han et al. 's (2017) and Ozaki's (2011) studies, which indicates that people with higher income levels are more interested in eco-innovations.

3.7 Measurement development

Factor analysis, also called exploratory factor analysis (EFA), is a generic name for a class of procedures used for data reduction and summarization, and its main purpose is to examine the potential interrelationships between several variables, and the relationships are represented in terms of a few underlying factors (Malhotra et al., 2017). Factor analysis explains the correlations among the set of variables and helps to identify a smaller set of variables to replace the original set of variables for the inclusion of subsequent multivariate analysis (e.g. regression) (Malhotra et al., 2017). Factor analysis also calculates a factor loading for each variable on the factor, which describes how much of the variance of the variable the factor can explain (Malhotra et al., 2017). A sufficient measurement scale should include only items that are loading highly on the same factor.

Reliability describes the degree of consistency of measuring the variable multiple times. The most frequently used method for testing reliability is Cronbach's alpha. It measures the

consistency of scale items to measure a particular concept. Usually, values over 0.7 are considered sufficient and indicate that the scale items are measuring the same thing (Saunders et al., 2015). However, the sufficient level of reliability may decrease to 0.6 in exploratory research (Hair et al., 1998).

In the present study, the measurement scales were formed based on the questionnaire statements. To confirm the measurement scales, both factor analysis and reliability were used. At first, factor analysis was conducted to assure that the suggested scales were measuring the same concept. Reductions were made if some group of items did not load sufficiently on the same factor. After that reliability of the scales was analyzed. Based on the reliability analysis, all scales were considered sufficient.

An exploratory factor analysis applying VARIMAX rotation was conducted for all the scales in the present study. Four separate factor analyses were conducted, and they are presented in Table 4. Altogether 10 factors were extracted, and based on the results adjustments were made. The items of perceived behavioral control did not have sufficient loadings, and therefore the concept of perceived behavioral control was removed from the research model. Also, one statement (the second one) was dropped out from the scale of perceived effectiveness. Besides, the items of pride and enjoyment were loaded to the same factor, and therefore the concepts of pride and enjoyment were combined as a concept of 'positive feelings'. For all the other concepts the items were loading on the correct factor. The items of the measurement scales were mostly adopted from previous studies (e.g. Liao and Lu, 2008; Wolske et al., 2017; Ajzen, 2002; Antonetti and Maklan, 2014a; Verma et al., 2019, and Elmustapha et al., 2018), and modified to describe the adoption and use of the CitiCAP application.

Table 5. Final factor solution for the concepts of the study

Factor analysis 1	***Factor 1***	***Factor 2***	***Factor 3***
Adoption 1	.997		
Adoption 2	.947		
Personal norms 1		.853	
Personal norms 2		.689	
Personal norms 3		.781	
Descriptive norms 1			.657

Descriptive norms 2			.851
Descriptive norms 3			.521
Eigenvalue	2.474	1.905	1.737
% of variance explained	30.926	23.815	21.717
Cumulative % of variance explained	30.926	54.741	76.458

Factor analysis 2	***Factor 1***	***Factor 2***	
Pride 1	.888		
Pride 2	.875		
Pride 3	.930		
Enjoyment 1	.907		
Enjoyment 2	.930		
Enjoyment 3	.861		
Guilt 1		.955	
Guilt 2		.966	
Guilt 3		.918	
Eigenvalue	5.571	1.764	
% of variance explained	69.633	22.046	
Cumulative % of variance explained	69.633	91.679	

Factor analysis 3	***Factor 1***	***Factor 2***	
Perceived effectiveness 1	.818		
Perceived effectiveness 3	.855		
Perceived effectiveness 4	.719		
Monetary relative advantage 1		.998	
Monetary relative advantage 2		.815	
Eigenvalue	2.292	1.792	
% of variance explained	45.832	35.844	
Cumulative % of variance explained	45.832	81.676	

Factor analysis 4	***Factor 1***	***Factor 2***	***Factor 3***
Ascribed responsibility 1	.820		
Ascribed responsibility 2	.755		

Ascribed responsibility 3	.847		
Health-related relative advantage 1		.972	
Health-related relative advantage 2		.871	
Informational relative advantage 1			.831
Informational relative advantage 2			.975
Eigenvalue	3.046	2.045	1.028
% of variance explained	43.508	29.216	14.682
Cumulative % of variance explained	43.508	72.724	87.406

The results of the reliability analysis are presented below in Table 5. All the other scales had a sufficient reliability level (Cronbach's alpha over 0.7), but descriptive norms had a bit suspicious reliability (Cronbach's alpha 0.689). However, as previously stated, in exploratory research the reliability can be considered sufficient when Cronbach's alpha is over 0.6, and therefore the scale of descriptive norms is also acceptable.

Table 6. Measurement scales with reliability statistics

Scale	*Cronbach's α*	*Number of items*	*Number of cases*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*	*Variance*
Adoption	0.970	2	64	1	7	4.344	2.041	4.166
Monetary relative advantage	0.896	2	63	1	7	3.230	1.805	3.257
Health-related relative advantage	0.951	2	63	1	7	3.468	1.922	3.693
Informational relative advantage	0.934	2	63	1	7	5.040	1.669	2.785
Perceived effectiveness	0.829	3	62	1.67	7	5.376	1.179	1.390
Ascribed responsibility	0.848	3	63	3	7	5.619	1.076	1.157
Positive feelings	0.966	5	63	1	7	3.959	1.666	2.776
Guilt	0.985	3	63	1	6	2.344	1.742	3.036
Descriptive norms	0.689	3	63	1	6.33	3.556	1.267	1.606
Personal norms	0.825	3	63	2.33	7	5.931	1.039	1.079

After the factor and reliability analysis, the research model was refined. Based on the analysis, perceived behavioral control was removed from the original model, and pride and enjoyment were united as a one 'positive affective feelings' variable. The refined research model is presented below in Figure 7.

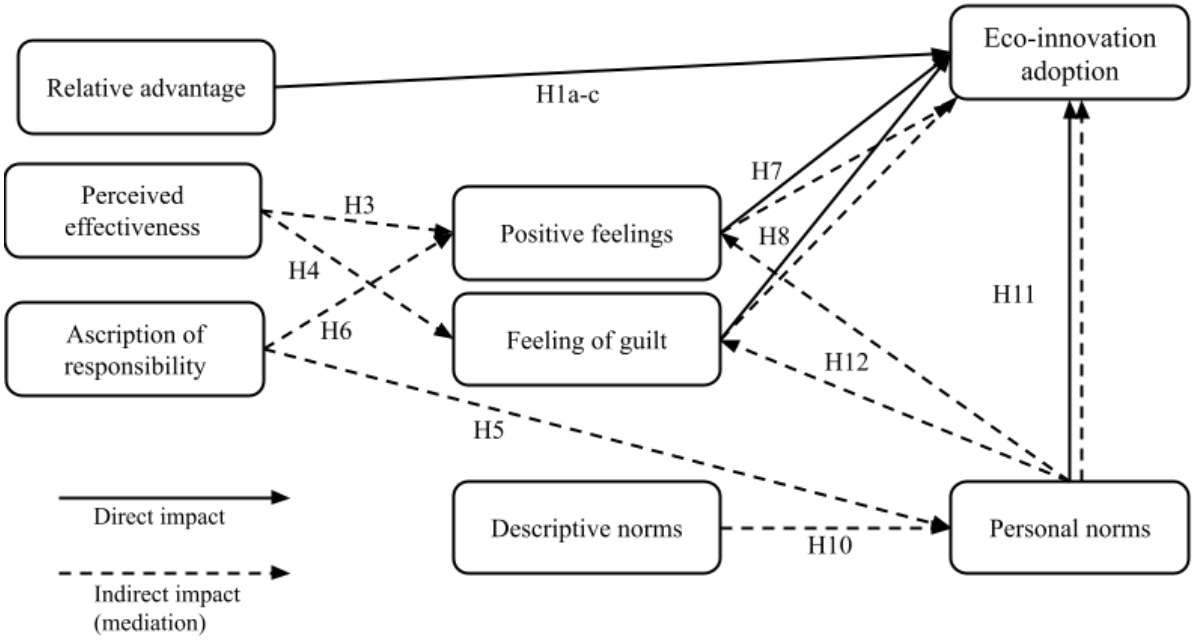


Figure 7. Refined research model

4 Analyses and findings

In this chapter, the purpose is to find the factors affecting eco-innovation adoption. The hypothesis testing is separated into two phases. First, mediation analysis is used to examine the indirect relationships, and to clarify whether affective feelings and personal norms are acting as mediators in the adoption process. Second, regression analysis is used to analyze direct relationships between eco-innovation adoption and the measures introduced in chapter 3.

4.1 Mediation analysis

Mediation analysis is a popular statistical method for hypothesis testing, and it examines the mechanisms by which a causal relationship between an independent variable and a dependent variable operates (Hayes et al., 2017). In the mediation model, the relationship between the independent variable and the dependent variable is influenced by at least one mediator variable which is causally between the independent and dependent variable such that the effect is transmitted through the joint causal effect of the independent and mediator variable, which in turn affects the dependent variable (Hayes et al., 2017). The independent variable's total effect on the dependent variable is formed from both direct effect (c') and indirect effect (ab) (Hayes, 2009). The simple mediation is demonstrated in Figure 8.

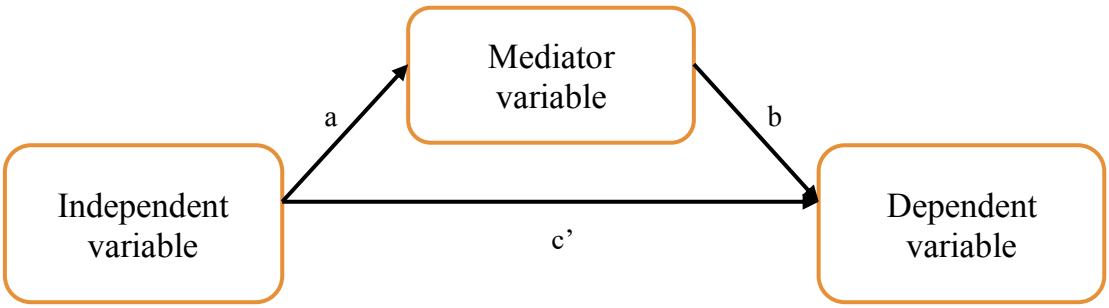


Figure 8. Simple mediation model

In the present study, the mediation analysis was conducted in SPSS version 27 by using the PROCESS macro 3.5 introduced by Hayes (2013). PROCESS simplifies the implementation of mediation by utilizing the bootstrapping method and estimates all the required statistics (Hayes et al., 2017). The received results are analyzed in the following manner. First, the direct effects between all the variables are calculated, and if the effects are statistically significant, there exists a mediation between the independent variable and the dependent

variable. Second, the indirect effect of the mediation is evaluated, and the significance of the indirect effect is tested with bootstrapping procedures (Memon et al., 2018).

Next, hypotheses related to mediating effects are analyzed. The relationships tested are presented below in Figure 9.

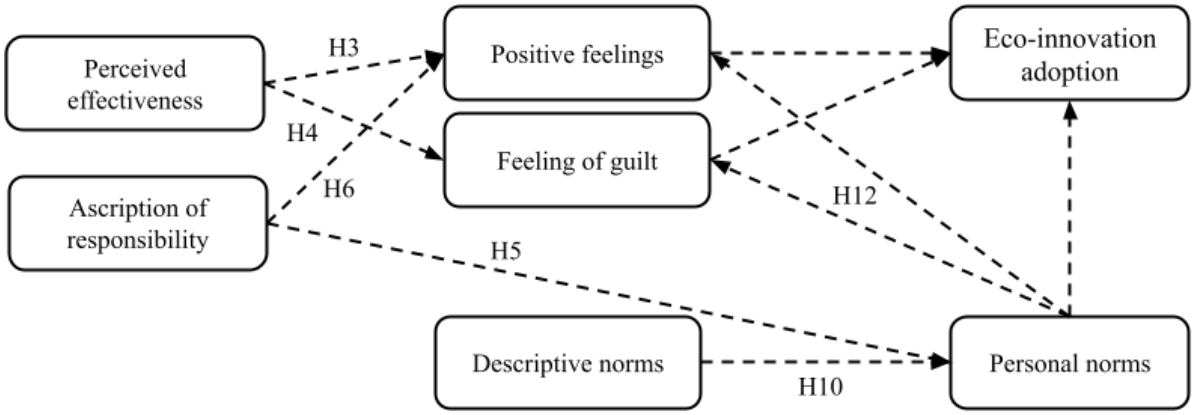
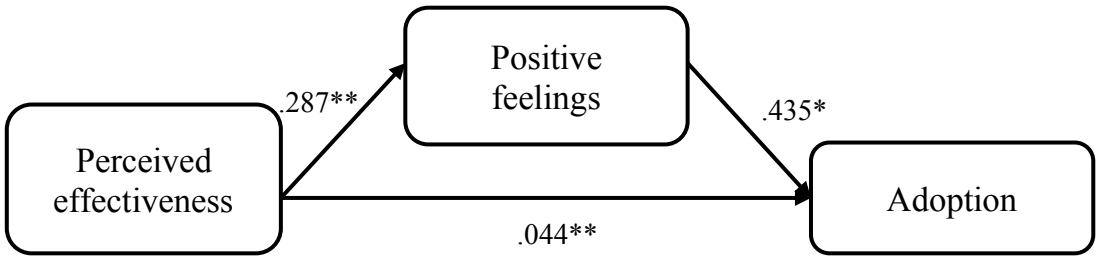


Figure 9. Relationships tested in mediation analysis

4.1.1 Affective feelings acting as mediators

The literature review in chapter 2 showed evidence that affective feelings are acting as mediators in the innovation adoption process. In this section, hypotheses H3, H4, and H6 are tested.

H3 hypothesized that perceived effectiveness has a positive indirect effect on eco-innovation adoption through anticipated positive feelings. The results are presented below in Figure 9.



*p <.05

**p >.05

Figure 10. Positive feelings as mediators between perceived effectiveness and adoption

The path (direct effect) from perceived effectiveness to positive feelings was positive but statistically insignificant (b = 0.287, p = 0.119). The results indicate that positive feelings are not acting as mediators between perceived effectiveness and adoption. However, the direct effect of positive feelings on adoption was positive and significant (b = 0.435, p = 0.006), indicating that people with positive feelings towards the use of the innovation are more likely to adopt the innovation. Besides, the path (direct effect) from perceived effectiveness to adoption was positive but insignificant (b = 0.044, p = 0.842), which indicates that there is no direct relationship between perceived effectiveness and innovation adoption. Based on the results, H3 is rejected.

H4 hypothesized that perceived effectiveness has a positive indirect effect on eco-innovation adoption through anticipated guilt. The results are presented below in Figure 10.

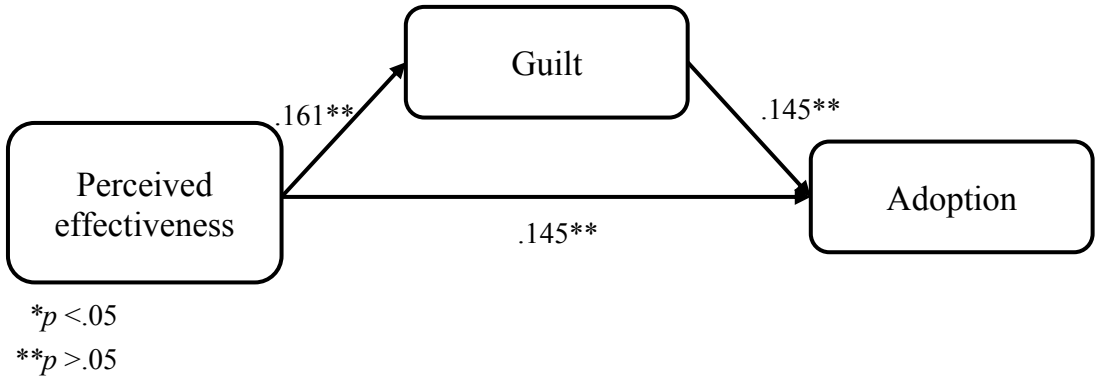
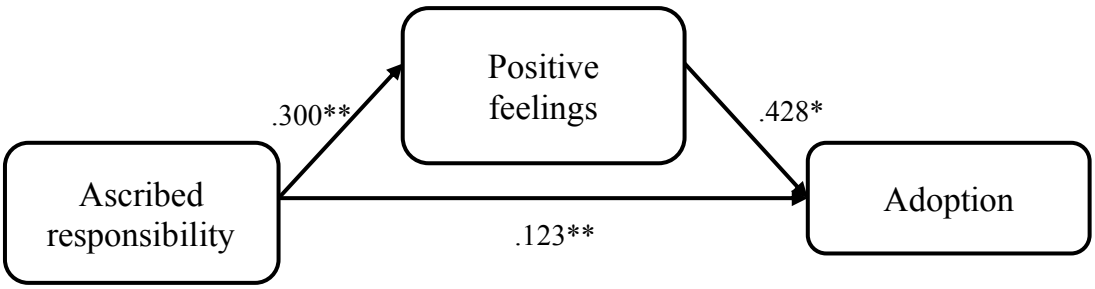


Figure 11. Guilt as a mediator between perceived effectiveness and adoption

The path (direct effect) from perceived effectiveness to guilt was positive but statistically insignificant (b = 0.161, p = 0.394), which indicates that guilt is not acting as a mediator between perceived effectiveness and adoption. Also, the direct effect of guilt on adoption was positive but insignificant (b = 0.145, p = 0.359). The path (direct effect) from perceived effectiveness to adoption was positive but insignificant (b = 0.145, p = 0.525), which indicates that there is no direct relationship between perceived effectiveness and innovation adoption. Based on the results, H4 was rejected.

H6 hypothesized that the ascription of responsibility has an indirect positive effect on eco-innovation adoption through anticipated pride. The results are presented below in Figure 11.

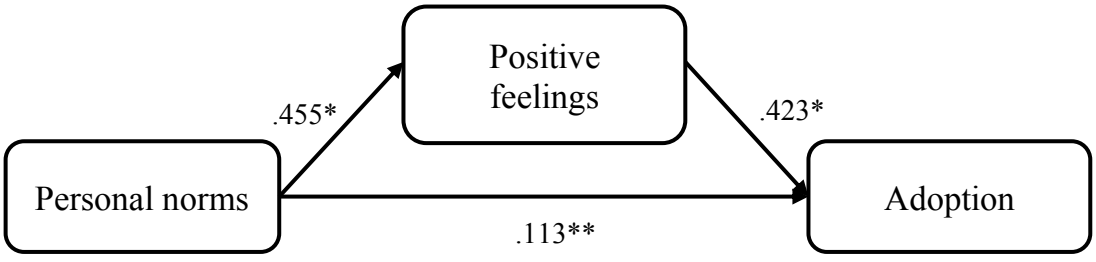


*p <.05
**p >.05

Figure 12. Positive feelings as mediators between ascribed responsibility and adoption

The path (direct effect) from ascribed responsibility to positive feelings was positive but statistically insignificant (b = 0.300, p = 0.135), which indicates that positive feelings are not acting as mediators between ascribed responsibility and adoption. However, the direct effect of positive feelings on adoption was positive and significant (b = 0.428, p = 0.006), indicating that people with positive feelings towards the use of the innovation are more likely to adopt the innovation. The path (direct effect) from ascribed responsibility to adoption was positive but also insignificant (b = 0.123, p = 0.604), which indicates that there is no direct relationship between perceived effectiveness and innovation adoption. Based on the results, H6 was rejected.

H12 hypothesized that personal norms have an indirect positive effect on eco-innovation adoption through anticipated feelings (pride and guilt). The results are presented below in Figures 12 and 13.



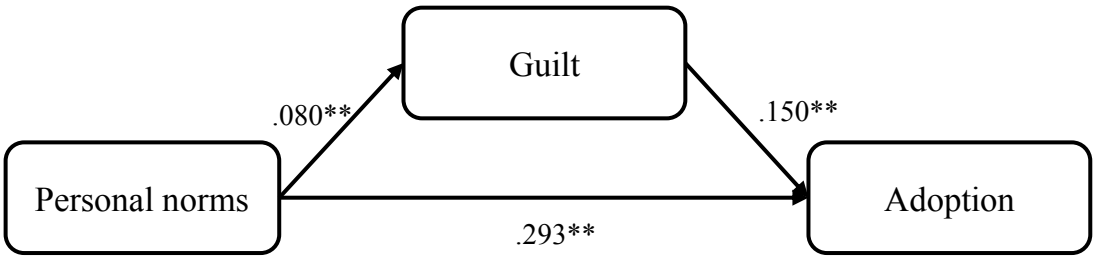
*p <.05
**p >.05

Figure 13. Positive feelings as mediators between personal norms and adoption

The path (direct effect) from personal norms to positive feelings was positive and statistically significant (b = 0.455, p = 0.027). Also, the direct effect of positive feelings on adoption was positive and significant (b = 0.423, p = 0.008). These results indicate that positive feelings

are acting as mediators between personal norms and adoption. The indirect effect (IE = 0.1925) is statistically significant: 95%CI = (0.014, 0.470).

The path (direct effect) from personal norms to adoption was positive but insignificant (b = 0.113, p = 0.653), which indicates that there is no direct relationship between personal norms and eco-innovation adoption. However, the fact that there is no direct relationship between the independent variable and the dependent variable does not mean that there does not exist an indirect relationship between the two variables (Hayes, 2009). The results indicate that there exists an indirect relationship between personal norms and eco-innovation adoption through positive feelings. In this case, some researchers tend to avoid the term 'mediator', but according to Hayes (2009), mediation is a term also accepted to describe the relationship.



*p <.05
**p >.05

Figure 14. Guilt as a mediator between personal norms and adoption

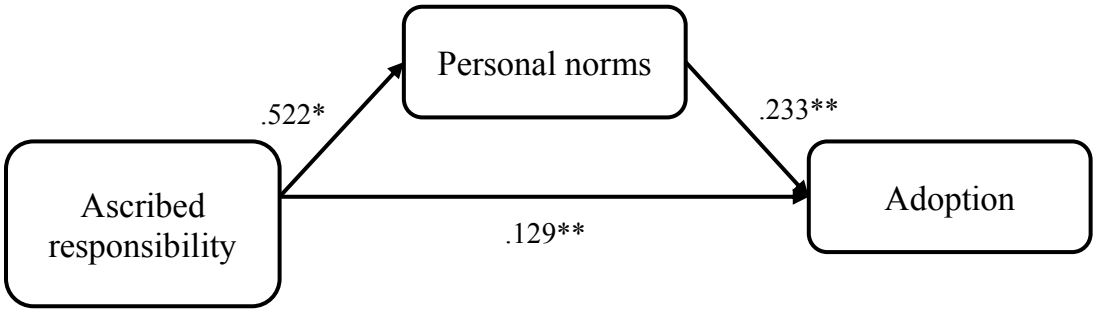
The path (direct effect) from personal norms to guilt was positive but statistically insignificant (b = 0.080, p = 0.713). The direct effect of guilt on adoption was also positive but insignificant (b = 0.150, p = 0.320), which indicates that guilt is not acting as a mediator between personal norms and adoption. Besides, the path (direct effect) from personal norms to adoption was also positive but insignificant (b = 0.293, p = 0.250), which indicates that there is no direct relationship between personal norms and eco-innovation adoption.

Based on the above results, H12 is partly accepted, since positive feelings are acting as mediators between personal norms and eco-innovation adoption.

4.1.2 Personal norms acting as mediators

The previous literature presented in chapter 2 showed evidence that personal norms are acting as mediators in the innovation adoption process. In this section, hypotheses H5 and H10 are tested.

H5 hypothesized that ascribed responsibility has a positive indirect effect on eco-innovation adoption through personal norms. The results are presented below in Figure 14.



*p <.05
**p >.05

Figure 15. Personal norms as a mediator between ascribed responsibility and adoption

The path (direct effect) from ascribed responsibility to personal norms was positive and statistically significant (b = 0.522, p = 0.000), indicating that felt ascribed responsibility has a positive effect on personal norms. The direct effect of personal norms on adoption was positive but insignificant (b = 0.233, p = 0.444). Therefore, the results indicate that personal norms are not acting as a mediator between ascribed responsibility and adoption. The path (direct effect) from ascribed responsibility to adoption was positive but insignificant (b = 0.129, p = 0.658), which indicates that there is no direct relationship between ascribed responsibility and innovation adoption. Based on the results H5 was rejected.

H10 hypothesized that descriptive norms have a positive indirect effect on eco-innovation adoption through personal norms. The results are presented below in Figure 15.

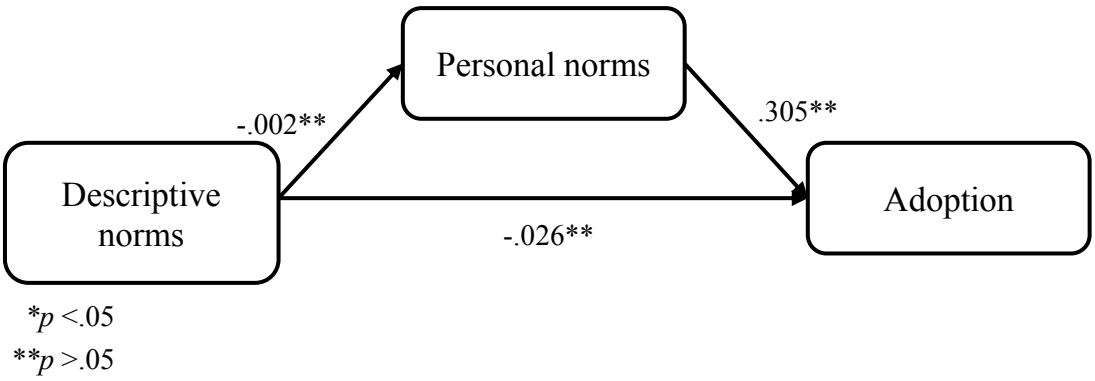


Figure 16. Personal norms as a mediator between descriptive norms and adoption

The path (direct effect) from descriptive norms to personal norms was negative but statistically insignificant (b = -0.002, p = 0.988). The direct effect of personal norms on adoption was positive but insignificant (b = 0.305, p = 0.235). These results indicate that personal norms are not acting as a mediator between ascribed responsibility and adoption. The path (direct effect) from descriptive norms to adoption was negative but insignificant (b = -0.026, p = 0.901), which indicates that there is no direct relationship between descriptive norms and innovation adoption. Based on the results H10 was rejected.

To conclude the results of the mediation analysis, H12 was partly accepted, since there was found a significant result that positive feelings are acting as mediators between personal norms and eco-innovation adoption. All the other hypotheses on the mediation effects were rejected. Additionally, the analysis revealed that there exists a positive direct effect between positive feelings and eco-innovation adoption and ascribed responsibility and personal norms.

4.2 Regression analysis

This chapter discusses the results of the regression analysis. The aim was to discover factors affecting eco-innovation adoption. All the measures introduced in chapter 3 were included. First, the multicollinearity of the regression model is analyzed. Second, the regression model for the survey data is formed by using backward elimination. Third, the hypotheses are tested and discussed based on the results.

4.2.1 Analyzing multicollinearity of independent variables

Before doing multiple regression, the multicollinearity of the regression model is advisable to analyze, since it can make it challenging to determine the separate effects of independent variables (Saunders et al., 2015). The simplest and most-used diagnostic is to use the correlation coefficients, and the rule of thumb is that high correlations (above 0.90) indicate that there exists multicollinearity in the regression model (Saunders et al., 2015). The correlation coefficients of all the variables are presented below in Table 6. None of the correlation coefficients get a value above 0.90, which indicates that there is no multicollinearity in the regression model.

Table 7. Correlation matrix for all variables

	1	2	3	4	5	6	7	8	9	10
1. Adoption	1									
2. Monetary relative advantage	**.345**	1								
3. Health-related relative advantage	**.293**	**.672**	1							
4. Informational relative advantage	**.353**	**.213**	**.447**	1						
5. Perceived effectiveness	.097	.049	.045	**.334**	1					
6. Ascribed responsibility	.135	.068	.123	.172	**.683**	1				
7. Positive feelings	**.361**	**.595**	**.705**	**.373**	.202	.198	1			
8. Guilt	.130	**.467**	**.451**	.163	.111	.191	**.490**	1		
9. Descriptive norms	-.025	**.543**	**.488**	.142	-.020	.006	**.437**	**.475**	1	
10. Personal norms	.156	.087	.069	.184	**.580**	**.541**	**.284**	.056	.005	1

Significant correlations ($p \leq .05$) bolded.

Other measures to analyze multicollinearity include tolerance value and variance inflation factor (VIF). A very small tolerance value (below 0.1) or a high VIF value (above 10) indicates high collinearity (Saunders et al., 2015). Besides, eigenvalues and condition indices are used to detect possible problems with multicollinearity. Multicollinearity is considered

to be moderate if some condition indices are greater than 10, and high if several eigenvalues are close to zero and/or some condition indices are greater than 30 (Tuffery, 2011).

Collinearity statistics for all variables are presented below in Table 7. All the independent variables of the present study got tolerance values above 0.1 and VIF values below 10, which indicates that there exists no multicollinearity. However, some of the eigenvalues are close to zero, and also most of the condition indices are above 10, even though still below 30, which indicates that there might be multicollinearity. Since this is the case, it is necessary to study the variance proportions. If two or more variance proportion columns contain values over 0.5, there is a problem with collinearity (Tuffery, 2011). However, because in each value proportion column tops one value is above 0.5, there is no multicollinearity between independent variables.

Table 8. Collinearity statistics

	Tolerance	*VIF*	*Dimension*	*Eigenvalue*	*Condition Index*
Monetary relative advantage	0.452	2.212	1	9.105	1
Health-related relative advantage	0.325	3.081	2	0.377	4.916
Informational relative advantage	0.663	1.508	3	0.194	6.854
Perceived effectiveness	0.41	2.438	4	0.106	9.285
Ascribed responsibility	0.465	2.15	5	0.07	11.434
Positive feelings	0.395	2.534	6	0.06	12.284
Guilt	0.631	1.584	7	0.045	14.169
Descriptive norms	0.619	1.614	8	0.02	21.096
Personal norms	0.571	1.751	9	0.012	27.01
			10	0.01	29.856

4.2.2 Regression model

The regression model for the survey data was formed by using backward elimination. Backward elimination is a common strategy for removing variables in a multiple regression model to improve the explanatory power of the model. The backward elimination strategy starts with the full model including all the independent variables. Variables are eliminated one at a time from the model until only the statistically significant variables remain.

The backward elimination was made using SPSS version 27. Altogether 7 models were predicted, and the best model was the last one with $R^2 = 0.270$. Only independent variables with a p-value below 0.05 were accepted to the model. Table 8 shows the results for the regression analysis.

Table 9. Regression analysis for eco-innovation adoption

	Model 1				*Model 7*				
	B	*SE*	*β*	*Sig.*	*B*	*SE*	*β*	*Sig.*	*Hypoth.*
(Constant)	2.058	1.709		.234	2.694	.926		.008	
Monetary relative advantage	.460	.195	.407	.022	.510	.154	.451	.002	H1a
Health-related relative advantage	-.156	.219	-.144	.481	-	-	-	-	H1b
Informational relative advantage	.395	.176	.320	.029	.372*	.143	.301	.012	H1c
Perceived effectiveness	-.344	.315	-.198	.280	-	-	-	-	
Ascribed responsibility	.265	.325	.139	.417	-	-	-	-	
Positive feelings	.315	.226	.257	.169	-	-	-	-	H7, H9
Guilt	-.030	.175	-.025	.864	-	-	-	-	H8
Descriptive norms	-.537	.242	-.327	.031	-.514	.222	-.313	.024	
Personal norms	.081	.303	.041	.791	-	-	-	-	H11
Adjusted R square	*0.231*				*0.194*				

p<0.05 bolded

4.2.3 Hypothesis testing

This section discusses hypothesis testing based on the hypotheses presented in chapter 2. Hypothesis testing was made based on the results provided by the regression analysis, and factors affecting the eco-innovation adoption are identified. The factors are discussed in three parts. First, the cognitive factors affecting eco-innovation adoption are discussed. Second, the focus is drawn on the affective factors impacting the adoption. The third part discusses normative factors affecting adoption.

Cognitive factors

Hypothesis H1a-c discussed the effect of relative advantage. It was hypothesized that monetary, health-related, and informational relative advantages have a direct positive impact on eco-innovation adoption. Besides, H2 hypothesized that perceived behavioral control has

a direct positive impact on eco-innovation adoption. However, as discussed in chapter 3, the perceived behavioral control did not have a sufficient factor loading, and therefore it was dropped from the measurement scale. Therefore, H2 cannot be tested. Additionally, the direct impact of perceived effectiveness and ascribed responsibility on adoption were also tested.

Table 10. Regression coefficients for cognitive factors

	Model 1				*Model 7*				
	B	*SE*	*β*	*Sig.*	*B*	*SE*	*β*	*Sig.*	*Results*
Monetary relative advantage	.460	.195	.407	.022	.510	.154	.451	.002	H1a accepted
Health-related relative advantage	-.156	.219	-.144	.481	-	-	-	-	H1b rejected
Informational relative advantage	.395	.176	.320	.029	.372	.143	.301	.012	H1c accepted
Perceived effectiveness	-.344	.315	-.198	.280	-	-	-	-	Not supported
Ascribed responsibility	.265	.325	.139	.417	-	-	-	-	Not supported

p<0.05 bolded

The results of regression analysis concerning cognitive factors are presented above in Table 9. Hypotheses H1a and H1c concerning the monetary relative advantage and informational relative advantage of eco-innovation were supported. Based on the analysis, the monetary relative advantage has a positive effect on eco-innovation adoption, meaning that a person is more likely to adopt the innovation the more monetary benefits he's able to receive from the use. Also, informational relative advantage has a positive effect on eco-innovation adoption. This means that if the person receives an informational advantage from the use of the innovation, he is more likely to adopt it. Hypothesis H1b was rejected since it did not have a significant effect on eco-innovation adoption in the present study. Additionally, neither perceived effectiveness nor ascribed responsibility had a significant effect on adoption.

Affective factors

Hypotheses H7-H9 were related to the impact of affective factors on adoption. It was hypothesized that pride, guilt, and feeling of enjoyment had all positive effects on eco-innovation adoption. In factor analysis in chapter 3, the measures of pride and enjoyment

were however united together as "positive feelings." Therefore, hypotheses H7 and H9 are also examined as one.

Table 11. Regression coefficients for affective factors

	Model 1				*Model 7*				
	B	*SE*	*β*	*Sig.*	*B*	*SE*	*β*	*Sig.*	*Hypoth.*
Positive feelings	.315	.226	.257	.169	-	-	-	-	H7, H9 rejected
Guilt	-.030	.175	-.025	.864	-	-	-	-	H8 rejected

The results of regression analysis concerning affective factors are presented above in Table 10. Based on the analysis, all the hypotheses H7-H9 related to the affective factors are rejected, which means that none of the factors tested did not have a significant effect on eco-innovation adoption in the present study.

Normative factors

Hypothesis H11 was related to the impact of normative factors on adoption. It was hypothesized that personal norms have a direct positive impact on eco-innovation adoption. Additionally, the direct relationship between descriptive norms and eco-innovation adoption was tested.

Table 12. Regression coefficients for normative factors

	Model 1				*Model 7*				
	B	*SE*	*β*	*Sig.*	*B*	*SE*	*β*	*Sig.*	*Hypoth.*
Descriptive norms	-.537*	.242	-.327	.031	-.514*	.222	-.313	.024	Supported
Personal norms	.081	.303	.041	.791	-	-	-	-	H11 rejected

p<0.05 bolded

The results of regression analysis concerning normative factors are presented above in Table 11. Based on the analysis, hypothesis H11 is rejected, which means that there was no significant effect on eco-innovation adoption in the present study. However, the analysis revealed that there exists a direct relationship between descriptive norms and eco-innovation adoption, which indicates that experienced descriptive norms have a negative effect on eco-innovation adoption.

5 Discussion

This thesis aims to give a theoretical contribution by creating new insight into the relationships of cognitive, affective, and normative factors and eco-innovation adoption and shed light on the motivations underlying the decision-making process. Also, this study creates new insights into the phenomenon of personal cap-and-trade and helps to understand it more comprehensively from the consumer side.

A summary of support for hypotheses is presented below in Table 12. Additionally, mediation analysis indicated that there might exist a positive direct effect between positive feelings and eco-innovation adoption. However, this was rejected in the regression analysis. Mediation analysis also indicated that there is a direct positive relationship between ascribed responsibility and personal norms. Also, regression analysis was found to support that there is a direct negative relationship between descriptive norms and eco-innovation adoption.

Table 13. Summary of support for hypotheses

Hypothesis		Supported?
H1a	Monetary relative advantage has a direct positive impact on eco-innovation adoption.	Yes
H1b	Informational relative advantage has a direct positive impact on eco-innovation	No
H1c	adoption.	Yes
	Health-related relative advantage has a direct positive impact on eco-innovation adoption.	
H2	Perceived behavioral control has a direct positive impact on eco-innovation adoption.	Not tested
H3	Perceived effectiveness has a positive indirect effect on eco-innovation adoption through anticipated pride.	No
H4	Perceived effectiveness has a positive indirect effect on eco-innovation adoption through anticipated guilt.	No
H5	Ascription of responsibility has an indirect positive impact on eco-innovation adoption through personal norms.	No
H6	Ascription of responsibility has an indirect positive effect on eco-innovation adoption through anticipated pride.	No
H7, H9	The positive feelings (pride and enjoyment) have a direct positive impact on eco-innovation adoption.	No
H8	The feeling of guilt has a direct positive impact on eco-innovation adoption.	No
H10	Descriptive norms have a positive indirect effect on eco-innovation adoption through personal norms.	No
H11	Personal norms have a direct positive impact on eco-innovation adoption.	No
H12	Personal norms have an indirect positive impact on eco-innovation adoption through anticipated feelings (pride and guilt).	Partially

When discussing the results, it is important to acknowledge that the research setting in the present study was a bit different from previously arranged ones, since many researchers have focused on discovering factors that affect interest for the adoption or intention to adopt rather than adoption behavior itself. Therefore, the differences in results might indicate that there exists an attitude-behavior gap, which means that even if a person might have an interest in, or intention to change their behavior, the intention does not necessarily lead to actions.

5.1 Cognitive factors

This section discusses how each cognitive factor contributed to eco-innovation adoption in my research and compares the results with what other researchers have found.

5.1.1 Relative advantage

The results were mostly in line with the conclusion of Wolske et al. (2017) and Elmustapha et al. (2018), as well as with Roger's (2003) theory that relative advantage has a positive effect on innovation adoption. The present study focused on three different dimensions of relative advantage, and the concerning findings are discussed next.

Monetary relative advantage

Monetary relative advantage worked similarly as Wolske et al. (2017) and Huber et al. (2017) and Trudel (2018) had found. The findings showed that monetary incentives for promoting the use of the CitiCAP application had a positive effect on its use. The results indicate that the ability to receive benefits encourages the use of the application. It also shows that the core concept of the CitiCAP application, which is to collect points that can be changed in monetary benefits, works at least for current users.

Informational relative advantage

Findings concerning the informational relative advantage's impact on innovation adoption were in line with the findings of Gabrielli et al. (2014) and Motoshita et al. (2015). The users seem to value the information of their emissions, which also drives the adoption of the CitiCAP application. The results indicate that the users are interested in following and decreasing their emissions, which is important for the aim of the CitiCAP application, which is to encourage citizens in more sustainable mobility. Waygood and Aniveri (2016) found

that information on personal emissions had a stronger impact on women when looking at actions, not just intentions. Even though this was not studied directly in the present study, the results presented in Figure 16 seem to be in line with Waygood and Aniveri's (2016) findings. Based on the results, women seem to agree more strongly that the CitiCAP application helps them to receive information about their personal emissions.

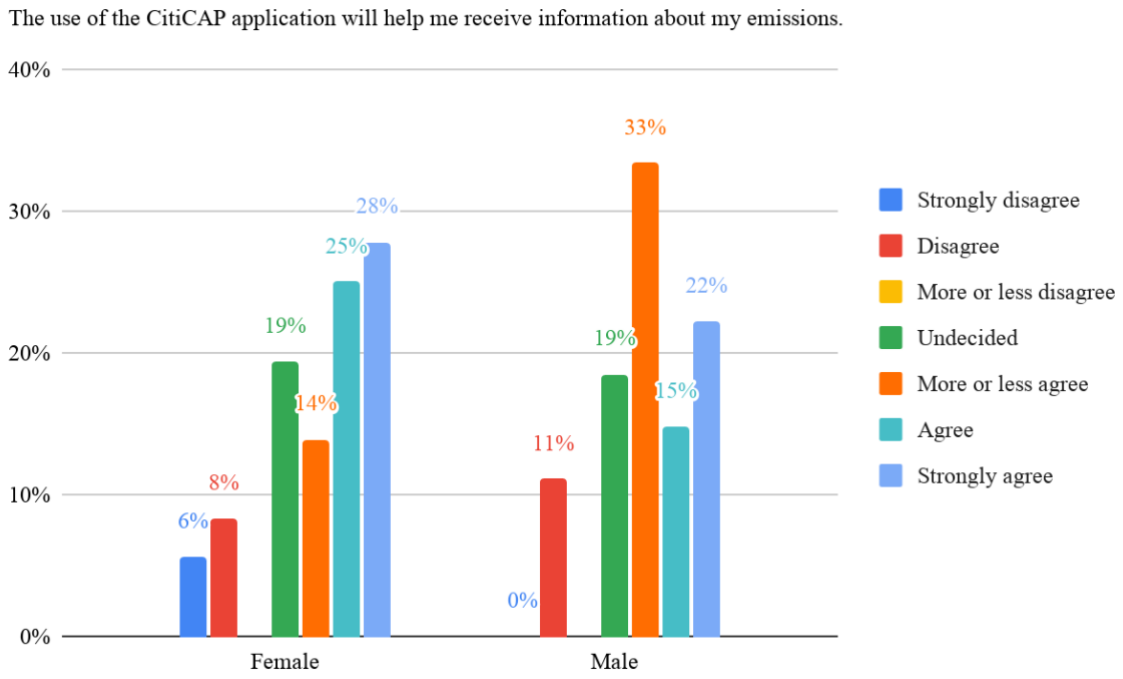


Figure 17. Differences between female and male on informational relative advantage

Health-related relative advantage

There was not found directly relevant research made on whether eco-innovation application use can be motivated by health benefits, but in general, the earlier studies supported that increasing sustainable mobility (e.g. cycling and walking) also increases physical activity (Sahlqvist et al., 2013), and self-tracking can increase the motivation to exercise and improve one's health (e.g. Krebs and Duncan, 2015). However, in the present study, the health-related relative advantage did not impact the adoption of the CitiCAP application. Therefore, it could be argued that the use of the application does not directly motivate one to increase physical activity, or that the users do not appreciate the health-related benefits enough to have an impact on their decision-making.

5.1.2 Perceived effectiveness

In the present study, the findings concerning perceived effectiveness were not in line with the earlier research. For example, Han et al. (2017) and Antonetti and Maklan (2014a) suggest that perceived effectiveness is indirectly affecting intention for adoption. However, perceived effectiveness was not affecting adoption indirectly through anticipated feelings, nor directly. This is perhaps surprising since the CitiCAP application produces direct feedback from the consequences to nature, which is required for the individual to experience perceived effectiveness in the first place (Antonetti and Maklan, 2014b). As previously stated, the difference might be explained with the different dependent variables: in earlier studies, the focus has been on intention to adopt rather than the action itself.

5.1.3 Ascribed responsibility

The findings concerning the ascribed responsibility were not in line with the value-belief-norm theory (Stern et al., 1999) or with the findings of Han et al. (2017), since ascribed responsibility did not have an indirect effect on eco-innovation adoption through personal norms nor through positive anticipated feelings as expected. This is interesting, and again, an explanation can be, that because of the attitude-behavior gap, the effect is not similar when measuring the intention and actual adoption. However, the relationship from ascribed responsibility to personal norms was significant, which indicates that even though it does not have influence on the adoption, the relationship still exists. The results show that overall the respondents felt strongly responsible for the environmental problems of their residence, and even if it affects personal norms directly, it does not increase the adoption of the CitiCAP application. Therefore, more research needs to be done in order to understand the role of ascribed responsibility more comprehensively.

5.2 Affective factors

In this section, the focus is drawn on how each affective factor contributed to eco-innovation adoption in the present study, and the results are compared with what other researchers have found. The earlier research had different standpoints on how anticipated feelings impact the adoption process. This section examines the direct impact of anticipated feelings. The relationship between personal norms and anticipated feelings is discussed further in section 5.3.2.

5.2.1 Positive feelings

In factor analysis, in chapter 3, the anticipated feeling of pride and the feeling of enjoyment were united as positive feelings. The regression analysis showed that even if a person experienced positive feelings (pride and/or enjoyment) when using the application, it did not have a direct impact on the adoption itself. This finding was not in line with the earlier research by Han et al. (2017) and Song and Han (2009). However, mediation analysis indicated that positive feelings could have a direct impact on eco-innovation adoption, which predicts that there some relationship between positive feelings and eco-innovation adoption not yet properly identified.

5.2.2 Guilt

Findings concerning the anticipated feeling of guilt were similar to positive feelings - guilt did not impact directly the adoption of the CitiCAP application. This was not in line with the findings of Han et al. (2017). However, as with positive feelings, there exist controversial views on the node of action the anticipated feelings are impacting the adoption process since some researchers argue that anticipated feelings are affecting the adoption through personal norms. This is examined further in section 5.3.2.

5.3 Normative factors

This section discusses how normative factors contributed to eco-innovation adoption in the present research and compares the results with what other researchers have found.

5.3.1 Descriptive norms

Findings concerning the descriptive norms' impact on innovation adoption were not in line with the ones of Han et al. (2017): in the present study, descriptive norms did not impact the innovation adoption through personal norms. However, regression analysis revealed that the impact of descriptive norms was direct instead of indirect. Surprisingly, the direct impact was negative, meaning that if a person feels like his peers would be supportive about his choice to use the CitiCAP application, the less likely he is to adopt the application. This finding is controversial for example Wolske et al. (2017), who argued that the effect is positive. It is interesting to think about what might be causing the negative impact in this context. One explanation could be the already stated one: descriptive norms increase the intention, but because of the attitude-behavior gap, it does not lead to actions. However, this

still does not explain why the impact is negative. Another explanation is, that the external pressure encourages sustainable choices anyhow, which might decrease the need for the application. However, it is impossible to confidently explain the phenomenon without further research.

5.3.2 Personal norms

Personal norms worked only partly similarly as Onwezen et al. (2013) has argued, and they had a positive indirect effect on innovation adoption through positive anticipated feelings (pride and enjoyment). However, the impact was not significant through negative feelings (guilt), as predicted. This indicates that only positive feelings associated with the use of eco-innovation have an impact on the personal norms, which then increase the likelihood of adoption. Another possibility is that not using the CitiCAP application does not drive as strong feelings of guilt or regret as does the positive feelings related to its use. There was not found a direct impact between personal norms and adoption, which is controversial with the findings of Wolske et al. (2017). However, as previously stated in section 5.2, the mode of action personal norms influence the adoption process has divided opinions. Nevertheless, the results of the present study turn to support the existence of an indirect relationship between personal norms and eco-innovation adoption.

6 Conclusions

First, this section summarizes the study and then gives theoretical and managerial recommendations for practitioners. Lastly, this section outlines the limitations of the study and gives suggestions for further research.

6.1 Research summary

In this study, the aim was to discover how eco-innovations are adopted, and what factors (cognitive, affective, and normative) motivate the adoption. The collected data included 64 survey responses, which were analyzed with mediation and regression analyses. The results were not completely in line with previous literature, and most of the hypotheses were rejected. However, in this study, the dependent variable was the adoption behavior itself instead of intention like in most of the previous studies, which might have affected the outcome.

To conclude the most important findings, the study found that monetary and informational relative advantage both have a direct positive effect on innovation adoption. Besides, personal norms were affecting adoption indirectly through positive anticipated feelings. Additionally, regression analysis was found to support that there exists a direct negative relationship between descriptive norms and eco-innovation adoption. Also, the results showed that there was a direct positive relationship between ascribed responsibility and personal norms.

6.2 Theoretical implications

Theory suggests that several cognitive, affective, and normative factors influence eco-innovation adoption. However, the present study found support for only three factors affecting the adoption directly, and one factor affecting the adoption indirectly (see Fig. 17). This study differs from the previously conducted ones since it examines the actual adoption instead of the intention to adopt. This is the most important contribution to existing theory, because it shows that factors that predict the intention to adopt do not necessarily lead to actually adopting the innovation. The adoption was measured with active and regular use of the CitiCAP application.

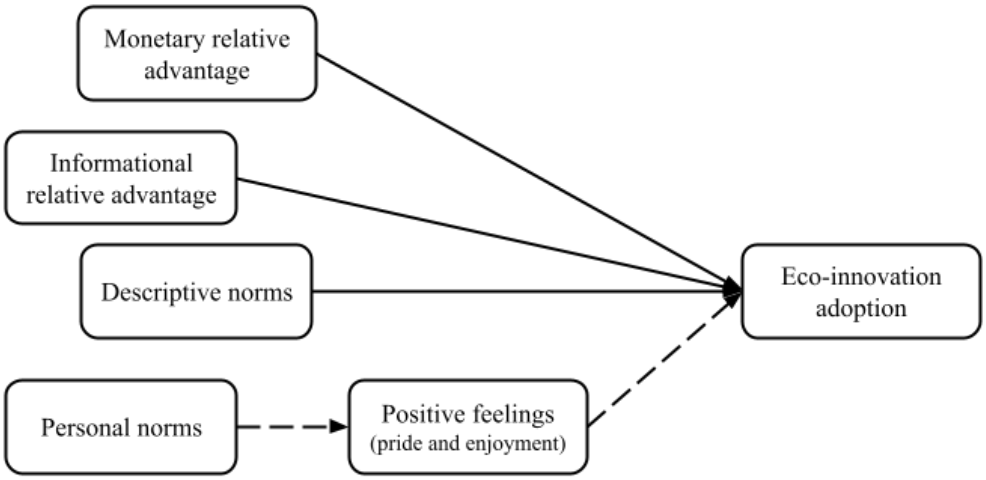


Figure 18. Final factors affecting the adoption

The study also included health-related relative advantage, which has not been researched before with eco-innovation adoption, as one of the independent variables. However, it did not impact the adoption process, which indicates that health-related benefits are not considered as important when deciding whether to actively use the innovation or not. Also, contrary to previous studies, descriptive norms had a negative impact on adoption. Therefore, the effect of descriptive norms might be situation-dependent, which should be taken into account in future research on eco-innovation adoption.

6.3 Managerial implications

In addition to the theoretical contribution, implications for policymakers and managers are derived based on the empirical results. For the city of Lahti, the research can give new insights into the reasons why some of the citizens are adopting the CitiCAP application or eco-innovations in general. The thesis also aims to give recommendations for the managers on how to better market the new eco-innovations such as the CitiCAP application, and on what factors they should concentrate on in their marketing messages.

The adapters are interested in receiving both monetary and informational benefits from the use of the application since those motivate them to use the application actively. These factors should be taken into consideration already when designing eco-innovations. Can the innovation cause cost savings to the user, or is the user able to get for example tax benefits or monetary support for the acquaintance of the innovation? Users should be also offered concrete information on the emission impact of the use of the innovation. How much

innovation is able to decrease the emissions in active use? The same factors can be also utilized when marketing eco-innovations, and monetary and informational benefits should be emphasized in marketing messages.

When considering the CitiCAP application, to persuade new users and keep the current ones, monetary benefits could be improved. The CitiCAP application could include a wider selection of products and services to choose from when using the points received if the user is able to pass underneath the set emission level. The users could also be taken along to the development of the selection, which would ensure that the benefits are responding to their expectations. The CitiCAP application should also focus on developing the information it brings to the user. They could make the information more understandable for the user, and maybe even offer tips on decreasing the emissions even more (e.g. how to drive more environmentally friendly way).

In addition, people with strong environmental norms were more likely to adopt the innovation if they are also feeling proud to use the application, and enjoy the use. Therefore, those people are a potential target segment for user acquisition in the future. The study also revealed the experiencing strong descriptive norms, i.e. thinking what other people would do in the given situation, can actually motivate people to not adopt the innovation. Therefore, for example, descriptive messages such as "Already 50% of citizens of Lahti are using the CitiCAP application" should be avoided.

6.4 Limitations and suggestions for further research

This section discusses the limitations of the present study and gives suggestions for further research.

First, certain choices had to be made considering the theoretical framework of the study. Two factors from the diffusion of innovation theory, observability, and trialability, were excluded from the independent variables in order to simplify the research model since those were not considered as relevant for the adoption of the CitiCAP application. In the future studies these variables should be considered to be included in the research model, since they can have more relevance in adoption of innovation that require trial or are easily observable by other people. Another theoretical limitation was made concerning the UTAUT theory (the unified theory of acceptance and use of technology), which was excluded from the study,

because it consists of similar elements already discussed in TPB and VBN theories, even though the CitiCAP application could also be classified as a technology. When studying similar technological eco-innovations, the UTAUT theory should be considered including in the theoretical framework.

Second, the CitiCAP application is a very unique eco-innovation, and therefore the results might not be applicable to other types of eco-innovations. Previous literature has focused on example the adoption of solar water heaters, electric cars, and renewable energy, which differ notably from the cap-and-trade mobile application in size, price, and functionalities. Therefore, more research on different types of eco-innovations is required in order to understand the process comprehensively. Also, the research should be broadened to different industries, since currently, it has focused merely on energy and transportation sectors.

Third, as previously mentioned, the present study focused on measuring the adoption behavior instead of intention for adoption, which also affects the comparability of the results. However, the existence of the attitude-behavior gap needs to be recognized better in future eco-innovation studies. Because the intention to perform the behavior does not always lead to actual behavior change, it is important to examine what drives the actual adoption behavior to more effectively increase the diffusion of eco-innovation in society.

Fourth, the sample size in the present study was quite small, which decreases the reliability and applicability of the results. Also, some other methods besides mediation analysis and regression analysis could be applied in order to get more accurate results. In the future, moderation analysis could provide in-depth information about the relationships between some of the independent variables which did not have a mediating effect as expected. Also, structural equation modeling could be used in assessing the unobservable relationship with different constructs not found with the methods used in the study.

In addition, the sample of the present study only consisted of people who had adopted the application, and therefore it could not provide any information on why people decide not to adopt the CitiCAP application. In the future, it would be valuable to understand also why some people decide not to adopt a certain eco-innovation, since it would help to develop more customer-centric innovations, and also to form more effective target groups to promote the innovations too.

References

Ajzen, I. (2005). *Attitudes, personality, and behavior*. McGraw-Hill Education (UK).

Ajzen, I. (2001). Nature and operation of attitudes. *Annual review of psychology*, 52(1), 27-58.

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior 1. *Journal of applied social psychology*, 32(4), 665-683.

Antón, C., Camarero, C., & Rodríguez, J. (2013). Usefulness, enjoyment, and self-image congruence: the adoption of e-book readers. *Psychology & Marketing*, 30(4), 372-384.

Antonetti, P., & Maklan, S. (2014a). Exploring Postconsumption Guilt and Pride in the Context of Sustainability. *Psychology & Marketing*, *31*(9), 717–735.

Antonetti, P., & Maklan, S. (2014b). Feelings that make a difference: How guilt and pride convince consumers of the effectiveness of sustainable consumption choices. *Journal of Business Ethics*, 124(1), 117-134.

Bamberg, S., Hunecke, M., & Blöbaum, A. (2007). Social context, personal norms, and the use of public transportation: Two field studies. *Journal of Environmental Psychology*, *27*(3), 190–203.

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology*, *27*(1), 14–25.

Banerjee, A. V. (1992). A simple model of herd behavior. *The Quarterly Journal of Economics*, 107(3), 797-817.

Bikhchandani, S., Hirshleifer, D., & Welch, I. (1992). A theory of fads, fashion, custom, and cultural change as informational cascades. *Journal of Political Economy*, 100(5), 992-1026.

Calder, B. J., & Burnkrant, R. E. (1977). Interpersonal influence on consumer behavior: An attribution theory approach. *Journal of Consumer Research*, 4(1), 29-38.

Carrington, M. J., Neville, B. A., & Whitwell, G. J. (2014). Lost in translation: Exploring the ethical consumer intention–behavior gap. *Journal of Business Research*, 67(1), 2759-2767.

De Groot, J. I., & Steg, L. (2009). Morality and prosocial behavior: The role of awareness, responsibility, and norms in the norm activation model. The Journal of social psychology, 149(4), 425-449.

Douglas, S. P., & Craig, C. S. (2007). Collaborative and iterative translation: An alternative approach to back translation. *Journal of International Marketing*, 15(1), 30-43.

Dunlap, R. (2008). The new environmental paradigm scale: From marginality to worldwide use. *Journal of Environmental Education*, 40(1), 3-18.

Dunlap, R., & Van Liere, K. (2008). The "new environmental paradigm." *Journal of Environmental Education*, *40*(1), 19–28.

Elmustapha, H., Hoppe, T., & Bressers, H. (2018). Consumer renewable energy technology adoption decision-making; comparing models on perceived attributes and attitudinal constructs in the case of solar water heaters in Lebanon. *Journal of Cleaner Production*, 172, 347–357.

Fichter, K., & Clausen, J. (2016). Diffusion Dynamics of Sustainable Innovation - Insights on Diffusion Patterns Based on the Analysis of 100 Sustainable Product and Service Innovations. *Journal of Innovation Management*, 4(2), 30–67.

Fitzmaurice, J. (2005). Incorporating consumers' motivations into the theory of reasoned action. *Psychology and Marketing*, 22(11), 911–929.

Gabrielli, S., Forbes, P., Jylhä, A., Wells, S., Sirén, M., Hemminki, S., ... & Jacucci, G. (2014). Design challenges in motivating change for sustainable urban mobility. *Computers in Human Behavior*, 41, 416-423.

Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels. *Journal of Consumer Research*, 35(3), 472–482.

Hair, J. F., R. E. Anderson, R. L. Tatham and W. C. Black (1998). *Multivariate Data Analysis*, Prentice Hall, New Jersey.

Han, H., Hwang, J., & Lee, S. (2017). Cognitive, affective, normative, and moral triggers of sustainable intentions among convention-goers. *Journal of Environmental Psychology*, 51, 1-13.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*, 76(4), 408-420.

Hayes, A. F. (2017). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. Guilford publications.

Hayes, A. F., Montoya, A. K., & Rockwood, N. J. (2017). The Analysis of Mechanisms and Their Contingencies: PROCESS versus Structural Equation Modeling. *Australasian Marketing Journal*, 25(1), 76–81. https://doi.org/10.1016/j.ausmj.2017.02.001

Huber, L. R., Sloof, R., & Van Praag, M. (2017). The effect of incentives on sustainable behavior: evidence from a field experiment. *Labour Economics*, 45(December 2016), 92–106.

Kilbourne, W. E., & Beckmann, S. C. (1998). Review and Critical Assessment of Research on Marketing and the Environment. *Journal of Marketing Management*, 14(6), 513–532.

Krebs, P., & Duncan, D. T. (2015). Health app use among US mobile phone owners: a national survey. JMIR mHealth and uHealth, 3(4), e101.

Liao, H. L., & Lu, H. P. (2008). The role of experience and innovation characteristics in the adoption and continued use of e-learning websites. *Computers & Education*, 51(4), 1405-1416.

Lorek, Sylvia & Spangenberg, Joachim H. (2014). Sustainable consumption within a sustainable economy - beyond green growth and green economies. *Journal of Cleaner Production,* 63, 33-44.

Madden, T. J., Ellen, P. S., & Ajzen, I. (1992). A comparison of the theory of planned behavior and the theory of reasoned action. *Personality and Social Psychology Bulletin*, 18(1), 3-9.

Malhotra, N., Nunan, D., & Birks, D. (2017). *Marketing research: an applied approach.* Pearson Education.

Matthies, E., Selge, S., & Klöckner, C. A. (2012). The role of parental behaviour for the development of behaviour specific environmental norms - The example of recycling and re-use behaviour. *Journal of Environmental Psychology*, 32(3), 277–284.

McKenzie-Mohr, Doug (2000). Promoting Sustainable Behavior: An Introduction to Community-Based Social Marketing. *Journal of Social Issues*, 56(3), 543–554.

Memon, M. A., Cheah, J. H., Ramayah, T., Ting, H., & Chuah, F. (2018). Mediation analysis issues and recommendations. *Journal of Applied Structural Equation Modeling*, 2(1), 1-9.

Motoshita, M., Sakagami, M., Kudoh, Y., Tahara, K., & Inaba, A. (2015). Potential impacts of information disclosure designed to motivate Japanese consumers to reduce carbon dioxide emissions on choice of shopping method for daily foods and drinks. *Journal of Cleaner Production*, 101, 205-214.

Nordlund, A. M., & Garvill, J. (2003). Effects of values, problem awareness, and personal norm on willingness to reduce personal car use. *Journal of Environmental Psychology*, 23(4), 339–347.

Official Statistics of Finland (OSF): Motor vehicle stock [e-publication]. 2019a. Helsinki: Statistics Finland [referred: 20.4.2020]. Access method: http://www.stat.fi/til/mkan/2019/mkan_2019_2020-02-28_tie_001_en.html

Official Statistics of Finland (OSF): Educational structure of population [e-publication]. ISSN=2242-2919. 2019b. Helsinki: Statistics Finland [referred: 21.4.2021]. Access method: http://www.stat.fi/til/vkour/2019/vkour_2019_2020-11-05_tie_001_en.html

Onwezen, M. C., Antonides, G., & Bartels, J. (2013). The Norm Activation Model: An exploration of the functions of anticipated pride and guilt in pro-environmental behaviour. *Journal of Economic Psychology*, 39, 141-153.

Onwezen, M. C., Bartels, J., & Antonides, G. (2014). Environmentally friendly consumer choices: Cultural differences in the self-regulatory function of anticipated pride and guilt. *Journal of Environmental Psychology*, *40*, 239–248.

Ostlund, L. E. (1974). Perceived Innovation Attributes as Predictors of Innovativeness. *Journal of Consumer Research*, 1(2), 23. https://doi.org/10.1086/208587

Ozaki, R. (2011). Adopting sustainable innovation: What makes consumers sign up to green electricity? *Business Strategy and the Environment*, 20(1), 1–17.

Paparoidamis, N. G., & Tran, H. T. T. (2019). Making the world a better place by making better products: Eco-friendly consumer innovativeness and the adoption of eco-innovations. *European Journal of Marketing*, *53*(8), 1546–1584.

Perugini, M., & Bagozzi, R. P. (2001). The role of desires and anticipated emotions in goal-directed behaviours: Broadening and deepening the theory of planned behaviour. *British Journal of Social Psychology*, *40*(1), 79–98.

Richins, M. L. (1997). Measuring emotions in the consumption experience. *Journal of Consumer Research*, 24(2), 127-146.

Roberts, J. A. (1996). and Implications for Advertising. *Journal of Business Research*, 36, 217-231.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Roseman, I. J. (1991). Appraisal determinants of discrete emotions. *Cognition & Emotion*, 5(3), 161-200.

Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *Turkish Online Journal of Educational Technology-TOJET*, 5(2), 14-23.

Sahlqvist, S., Goodman, A., Cooper, A. R., & Ogilvie, D. (2013). Change in active travel and changes in recreational and total physical activity in adults: longitudinal findings from the iConnect study. *International Journal of Behavioral Nutrition and Physical Activity*, 10(1), 28.

Sallis, J. F., Frank, L. D., Saelens, B. E., & Kraft, M. K. (2004). Active transportation and physical activity: opportunities for collaboration on transportation and public health research. *Transportation Research Part A: Policy and Practice*, 38(4), 249-268.

Saunders, M., Lewis, P., & Thornhill, A. (2015). *Research Methods for Business Students.* Pearson Education UK.

Schwartz, S. H. (1977). Normative influences on altruism. *Advances in Experimental Social Psychology*, 10(1), 221-279.

Sierzchula, W., Bakker, S., Maat, K., & Van Wee, B. (2014). The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy*, 68, 183–194.

Song, Y., & Han, J. (2009). Is enjoyment important? An empirical research on the impact of perceived enjoyment on adoption of new technology. 2009 International Conference on Information Management, Innovation Management and Industrial Engineering, ICIII 2009, 4, 511–514.

Soscia, I. (2007). Gratitude, delight, or guilt: The role of consumers' emotions in predicting postconsumption behaviors. *Psychology & Marketing*, 24(10), 871-894.

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, 6(2), 81–97.

Tangney, J. P., & Dearing, R. L. (2002). *Shame and guilt*. New York: Guilford Press.

Thøgersen, J. (2006). Norms for environmentally responsible behaviour: An extended taxonomy. *Journal of Environmental Psychology*, 26(4), 247-261.

Tracy, J. L., & Robins, R. W. (2007). The psychological structure of pride: A tale of two facets. *Journal of Personality and Social Psychology*, *92*(3), 506–525.

Trudel, R. (2018). Sustainable consumer behavior. *Consumer Psychology Review*, (September 2018), 85–96.

Tuffery, S. (2011). *Data mining and statistics for decision making*. Wiley.

UN Environment. (2017). Riding towards green economy: Cycling and green jobs – A joint report by UN Environment-WHO-UNECE, 46 p.

United Nations Environment Programme (UNEP). (2019). Shades of Green: An Introduction to the Green Economy for Parliamentarians - Issues Brief February 2019. Geneva, Switzerland: UNEP.

UNEP, 2011, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication - A Synthesis for Policy Makers, www.unep.org/greeneconomy

Unnikrishnan, S., Biggs, C., & Singh, N. (2020, August 11). Sustainability matters now more than ever for consumer companies. Boston Consulting Group. https://www.bcg.com/publications/2020/sustainability-matters-now-more-than-ever-for-consumer-companies

Verma, V. K., Chandra, B., & Kumar, S. (2019). Values and ascribed responsibility to predict consumers' attitude and concern towards green hotel visit intention. *Journal of Business Research*, 96, 206-216.

Waygood, E. O. D., & Avineri, E. (2016). Communicating transportation carbon dioxide emissions information: does gender impact behavioral response?. Transportation Research Part D: Transport and Environment, 48, 187-202.

Wolske, K. S., Stern, P. C., & Dietz, T. (2017). Explaining interest in adopting residential solar photovoltaic systems in the United States: Toward an integration of behavioral theories. *Energy Research and Social Science*, 25, 134–151. https://doi.org/10.1016/j.erss.2016.12.023

Appendix 1. Questionnaire in Finnish

Tutkimus ekoinnovaatioiden käyttöönotosta

Vastaa kyselyyn, ja voita leffalippuja!

Hyvä CitiCAP-applikaation käyttäjä,

Opiskelen Aalto-yliopistossa kauppatieteiden maisterin tutkintoa ja olen tekemässä tutkintooni liittyvää pro gradu-tutkielmaa ekoinnovaatioiden käyttöönottoon liittyen.

Toivoisin, että käyttäisit muutaman minuutin kysymyksiin vastaamiseen ja tukisit näin tutkimukseni toteutumista.

Osallistuminen tutkimukseen on vapaaehtoista. Jos vetäydyt tutkimuksesta, sinuun ei kohdistu mitään negatiivista seurausta. Voit keskeyttää osallistumisesi milloin tahansa tutkimuksen aikana ja voit jättää vastaamatta yksittäiseen kysymykseen niin halutessasi.

Vastaukset käsitellään luottamuksellisesti, ja tutkimusdata tullaan hävittämään 31.12.2021 mennessä. Voit lukea lisää tutkimusta koskevasta tietosuojailmoituksesta.

Vastaamalla tähän kyselyyn vahvistat, että olet lukenut tutkimuksen kuvauksen, olet yli 18-vuotias ja suostut edellä esitettyihin ehtoihin.

Kyselyyn vastanneiden kesken arvotaan leffalippuja, jota varten voit jättää yhteystietosi kyselyyn vastaamisen jälkeen. Yhteystietojasi ei voida yhdistää vastauksiisi ja niitä käytetään vain, jos voitat arvonnassa.

Kiitos vastauksistanne jo etukäteen!

Terveisin,
Katariina Sinivaara
katariina.sinivaara@aalto.fi

1. Haluan osallistua kyselytutkimukseen. Ymmärrän tutkimuksen tarkoituksen, ja osallistun siihen vapaaehtoisesti. Ymmärrän, että voin keskeyttää kyselyyn vastaamisen koska tahansa, eikä siitä kohdistu minuun mitään negatiivista seurausta.

- ◯ Kyllä
- ◯ Ei

2. Annan luvan käyttää tässä tutkimuksessa syntynyttä dataa edellä mainittuun tutkimustarkoitukseen.

- ◯ Kyllä
- ◯ Ei

3. Mikä on sukupuolesi?

- ◯ Nainen
- ◯ Mies
- ◯ Muu
- ◯ En halua kertoa

4. Mihin seuraavista ikäryhmistä kuulut?

- ◯ Alle 20-vuotiaat
- ◯ 21-30-vuotiaat
- ◯ 31-40-vuotiaat
- ◯ 41-50-vuotiaat
- ◯ 51-64-vuotiaat
- ◯ 65 vuotta täyttäneet

5. Mikä on koulutuksesi (korkein suorittamasi koulutusaste)?

- ◯ Peruskoulun ala-aste tai kansakoulu
- ◯ Peruskoulun yläaste tai keskikoulu
- ◯ Lukio, ylioppilas- tai ammatillinen tutkinto
- ◯ Ammattikorkeakoulututkinto
- ◯ Korkeakoulututkinto

6. Mitkä ovat kotitaloutesi yhteenlasketut tulot veroja vähentämättä keskimäärin kuukaudessa?

- ◯ Alle 500€

- ◯ 500-999€
- ◯ 1 000-1 499€
- ◯ 1 500-1 999€
- ◯ 2 000-2 499€
- ◯ 2 500-2 999€
- ◯ 3 000-4 999€
- ◯ 5 000-7 499€
- ◯ 7 500-10 000€
- ◯ Yli 10 000€

7. Mitä mieltä olet seuraavista väittämistä?

1 = Täysin eri mieltä, 7 = Täysin samaa mieltä

	1	2	3	4	5	6	7
Käytän CitiCAP-sovellusta aktiivisesti.	◯	◯	◯	◯	◯	◯	◯
Käytän CitiCAP-sovellusta säännöllisesti.	◯	◯	◯	◯	◯	◯	◯

8. Mitä mieltä olet seuraavista väittämistä?

(1 = Täysin eri mieltä, 7 = Täysin samaa mieltä)

	1	2	3	4	5	6	7
CitiCAP-sovelluksen käyttäminen auttaa minua saamaan käyttööni tuotteita tai palveluita ilmaiseksi.	◯	◯	◯	◯	◯	◯	◯
CitiCAP-sovelluksen käyttö auttaa minua säästämään rahaa.	◯	◯	◯	◯	◯	◯	◯
CitiCAP-sovelluksen käyttö kannustaa minua liikkumaan enemmän.	◯	◯	◯	◯	◯	◯	◯
CitiCAP-sovelluksen käyttö auttaa minua lisäämään hyötyliikuntaa päiviini.	◯	◯	◯	◯	◯	◯	◯
CitiCAP-sovelluksen käyttö auttaa minua saamaan tietoa aiheuttamistani päästöistä.	◯	◯	◯	◯	◯	◯	◯

	1	2	3	4	5	6	7
CitiCAP applikaation käyttö auttaa minua ymmärtämään omia päästöjäni.	◯	◯	◯	◯	◯	◯	◯

9. Mitä mieltä olet seuraavista väittämistä?

1 = Täysin eri mieltä, 7 = Täysin samaa mieltä

	1	2	3	4	5	6	7
CitiCAP-sovelluksen käyttäminen on hyvin helppoa.	◯	◯	◯	◯	◯	◯	◯
Halutessani voisin hyödyntää helposti ympäristöystävällisempiä matkustustapoja.	◯	◯	◯	◯	◯	◯	◯

10. Mitä mieltä olet seuraavasta väittämästä?

1 = Minulla on hyvin vähän kontrollia, 7 = Minulla on täysi kontrolli

	1	2	3	4	5	6	7
Kuinka paljon sinun on omalla kohdallasi mahdollista vaikuttaa ympäristöystävällisempien matkustustapojen valintaan?	◯	◯	◯	◯	◯	◯	◯

11. Mitä mieltä olet seuraavista väittämistä?

1 = Täysin eri mieltä, 7 = Täysin samaa mieltä

	1	2	3	4	5	6	7
Koen voivani edesauttaa ympäristöongelmien ratkaisemista omilla henkilökohtaisilla valinnoillani.	◯	◯	◯	◯	◯	◯	◯
Henkilökohtaiset valintani ovat merkityksettömiä ympäristöongelmien ratkaisussa.	◯	◯	◯	◯	◯	◯	◯
Omat henkilökohtaiset valintani vaikuttavat ympäristöön.	◯	◯	◯	◯	◯	◯	◯
Ympäristön tilan heikkeneminen on osittain omien kulutustottumuksieni seurausta.	◯	◯	◯	◯	◯	◯	◯

12. Mitä mieltä olet seuraavista väittämistä?

1 = Täysin eri mieltä, 7 = Täysin samaa mieltä

	1	2	3	4	5	6	7
Mielestäni jokainen kansalainen on osittain vastuussa oman asuinkaupunkinsa aiheuttamista ympäristöongelmista.	○	○	○	○	○	○	○
Koen yksittäisten kansalaisten olevan yhteisvastuussa heidän asuinkaupunkinsa aiheuttamista ympäristöongelmista.	○	○	○	○	○	○	○
Jokaisen kansalaisen tulee ottaa vastuuta oman asuinkaupunkinsa aiheuttamista ympäristöongelmista.	○	○	○	○	○	○	○

13. Jos mietit tuntemuksiasi CitiCAP-sovellukseen liittyen...

1 = En ollenkaan, 7= Hyvin ...., esim. ylpeäksi

	1	2	3	4	5	6	7
kuinka ylpeäksi tunnet itsesi käyttäessäsi sovellusta?	○	○	○	○	○	○	○
kuinka tyytyväiseksi tunnet itsesi käyttäessäsi sovellusta?	○	○	○	○	○	○	○
kuinka hyväksi tunnet olosi käyttäessäsi sovellusta?	○	○	○	○	○	○	○
kuinka onnelliseksi tunnet itsesi käyttäessäsi sovellusta?	○	○	○	○	○	○	○
kuinka iloiseksi tunnet itsesi käyttäessäsi sovellusta?	○	○	○	○	○	○	○

14. Jos mietit tuntemuksiasi CitiCAP-sovellukseen liittyen...

1 = En ollenkaan, 7= Hyvin paljon/huono

	1	2	3	4	5	6	7
kuinka paljon katumusta tunnet, kun ET käytä sovellusta?	○	○	○	○	○	○	○

	1	2	3	4	5	6	7
kuinka huono omatunto sinulla on, kun ET käytä sovellusta?	◯	◯	◯	◯	◯	◯	◯
kuinka paljon syyllisyyttä tunnet, kun ET käytä sovellusta?	◯	◯	◯	◯	◯	◯	◯

15. Mitä mieltä olet seuraavista väittämistä?

1 = Täysin eri mieltä, 7 = Täysin samaa mieltä

	1	2	3	4	5	6	7
Uskon, että suurin osa tuttavistani kannustaisi minua käyttämään CitiCAP-sovellusta.	◯	◯	◯	◯	◯	◯	◯
Uskon, että oman auton sijaan suurin osa tuttavistani valitsisi kulkuvälineeksi mielummin bussin tai junan kulkeakseen töihin tai mennäkseen ostoksille.	◯	◯	◯	◯	◯	◯	◯
Uskon, että suurin osa kansalaisista kannattaa ympäristöystävällisempien matkustusmuotojen käyttämistä vähentääkseen ympäristöä kuormittavia päästöjä.	◯	◯	◯	◯	◯	◯	◯

16. Mitä mieltä olet seuraavista väittämistä?

1 = Täysin eri mieltä, 7 = Täysin samaa mieltä

	1	2	3	4	5	6	7
Koen velvollisuudekseni ehkäistä ilmastonmuutosta omalla toiminnallani huolimatta siitä, mitä muut tekevät.	◯	◯	◯	◯	◯	◯	◯
Kaltaisteni kansalaisten tulisi tehdä kaikkensa pyrkiäkseen vähentämään henkilökohtaisten päästöjensä määrää, ja täten tehdä osansa ilmastomuutoksen estämisen hyväksi.	◯	◯	◯	◯	◯	◯	◯
Koen, että on tärkeää tehdä kaupungeista ympäristöystävällisempiä ja vähentää niiden aiheuttamaa haittaa elinympäristöllemme.	◯	◯	◯	◯	◯	◯	◯